# Introduction

Since I was a child this wonderful universe has fascinated me. I guess that many men and women have had the same curiosity and the same interest that I have. For 50 years I have been dedicated to its investigation: its formation, workings, structure, its beginning and its end.

Many sciences have helped me in my studies: Physics, astronomy, philosophy, theology, etc., but, above all, the cybernetics and computing.

With the help of the latter I have reached the conclusion that the universe is an immense, endless and ilimited computer. It is like our brain but without limits. The bodies, stars, planets, galaxies, etc., are similar to the neurons. The information is processed and transmitted from one star to another by means of universal gravitation and the energies emitted by the stars as it happens in the neurons.

An example that endorses this statement is in the energy of the sun (information) that arrives to the earth where it is processed by the plants through the photosynthesis and the colorific function.

I would like that after the reading of this book, you reader could add your knowledge to the subject as well and feel more free by the knowledge of new true. The error and ignorance are slaveness but the truth will set you free.

THE AUTHOR

# Presentation of the work

To the scientists:

This book has born after many years of investigation. It is difficult to understand the universal computer due to its complexity, but if we start from the computer created by man we can get to know it better.

In order to understand how the world works, that is the supreme computer, the one that has more memory, intelligence and decision, it is necessary to understand also the artificial computer, made by the man. By comparing and relating them it is possible to get to understand the universe. So I wish.

My gratitude to the people who have helped me in this mission. To all of them, kind regards.

THE AUTHOR

# Science and religion

It is legendary the popular tendency that situates Religion and Science in opposite extremes, as two things completely separated and in conflict, looking like boxers ready to beat each other to death. This image was being built in the course of the centuries. It found its climax in the Middle Age, known as "the dark times" of the Science because of the never ending religious persecutions of the scientists; and remained for many centuries.

Many important Science men finished their lives at the stake, being burned alive because of their studies of the human body or because of them contradicting the religious dogma; and many others were humiliated in public.

Well known are the cases of Miguel Servet, Galileo Galilei and Charles Darwin. This turned out to be a burden on the Science progress, and set the scientist and the religious person one against the other.

The scientist and the religious person do not differ on the aim but on the means. The scientist strives to build his knowledge way of truth with the help of his own means, relying on his senses and his reasoning. The religious person relies on his faith.

The truly scientist, as he is discovering the Universe perfection and immensity and the infallibility of its laws, he is opening his mind and finding the truth by his own means of reason and intelligence.

The truly religious person, as he is a searching for the truth, should not trust his erroneous path, since the Science progress a lot. As long as

the faith is theoretical, the doubt of his God being out or in the Universe will exist for the religious person.

A man of Science can experiment and a man of Faith can not do it, the only thing he can do is believe and be passive, while the Scientist is active and a researcher.

The religious method is obscure and mysterious, whereas the Science one is obvious and experimental because of the reason and the intelligence. Nowadays the man of Science has a structured scientific method available to him that will take him to explore the Nature and that will allow him to discover that we are part of the Universe and God and the Universe are just ONE.

At last, the man of Science and the religious person will hold each other in a strong embrace, as they have found the truth they have being searching through different methods and paths.

# History of the divinity

The evolution of the concept of the divinity. The idea of God has been evolving at the same time as the human race has evolved.

Nowadays, there are enough data to state that the religion is as old as the Human race. Since the man exists, the Religion exists. All the men search God.

Many of the most developed beliefs of the Antiquity or of our present days have their roots in the prehistoric religion. Try to penetrate in the mentality of the prehistoric man is a good help to contemplate the evolution of the religious phenomenon within the history of the Human race.

The concept of divinity has suffered several modifications through the History. The primitive man began to deify certain objects or natural phenomena that had something mysterious or terrific for him. Gradually, he turned such objects and phenomena into spiritual beings, usually intangible and invisible, that lived in a world apart, unattainable for the man. These animistic divinities, in superior stages of the civilization as those great cultures that grew on the banks of the Nile, Euphrates or Indus, were transformed in men-gods, by virtue of an anthropomorphic phenomenon.

The powers of the Nature, beneficial or harmful for the agriculture which was the main activity of these people, lost little by little their character of mysterious and terrific spiritual beings to adopt human shapes. This way divinities grew, as Demeter, the mother earth for the Greek; Hathor, god of fertility for the Egyptian; Anu, god of the sky for

the Assyrian; Tlaloc, god of the mountains, the rain and the springs for the Aztecs, etc.

Later, when the first big political organizations appeared, a kind of Courts were made up, similar to the human ones, presided over by a supreme god or a king of the divinities.

Such organization entailed a hierarchy of the world of the divine, and this way some divinities were considered superior and others inferior. The supreme gods, as Zeus and Jupiter in Greece and Rome; Apsu and Tiamat in Asia; Ahura y Mazda in Persia; Brahma, Visnu and Shiva in India; Ra in Egypt, etc., received a special worship, the main cities were dedicated to them, the best temples. While the inferior divinities were adored most of all in the agricultural communities.

The divinities, as in the preceding civilizations, continued representing the diverse powers of the Nature, but already endowed with a clearly defined personality, work of the poets imagination, as happened in Greece, or of a priestly class, that organized the worship and defined the relations between the divinity and the men or just between the divinities.

The idea of a supreme god, or superior to the others, was very close to the monotheistic conception that, adopted as a fundamental religious principle by the Hebrew people, spread later to the occidental world with the Christianity.

Taken later by the Arabs who, with their conquests, introduced it in the most part of Asia and Africa.

The concept of divinity has suffered several modifications through the history of the Human race. At the beginning, the man adored many gods. As the man evolves and acquires more information, he adopts the monotheistic conception, knowing better the Nature.

Nowadays, the progress, the technology, the Science and the Computing research the Universe and the Nature. The knowledge of the man is wider each day. He has discovered mysteries our ancestors did not know. He realizes that God and the Universe are one. That everything is God. It is visible, it is the Universe and it is the Nature, because he understands it better. And it is not invisible, as it was before. The monotheism will be replaced by the pantheism, as the polytheism was replaced by the monotheism. God is the Universe.

# Scientific pantheism

## Introduction

The universe is divine. The awe it produces in us, its force, its change, is for us worthy

of reverence as any god, and better than that: our universe is real and it is made of the same stuff as we are, matter and energy in countless forms.

This page illustrates my ideas about scientific pantheism, a world view that I have recently discovered as such, though I know I've had pantheistic thoughts all my life. This document will be largely a rant about how scientific pantheism (from now on SciPan) sees the universe, and how I and others have felt about that. Since my readers will belong to many beliefs or kinds of disbelief, I will address their main concerns in separate sections, though you can and should read all of them, only keeping in mind who I am primarily talking to.

SciPan is not a cult, a sect, a new kind of pagan religion, or an enemy of the Christian, Hindu, Muslim or Jewish faith, or anything else of the sort. It is a way to view the world, and a personal attitude that many human beings have found in themselves without help from gurus, priests, ministers or scriptures, just by looking around and acknowledging their awe. Think about this while you read on.

So, you are a believer in one of the major monotheistic religions of the world. You have a personal God you pray to, who is immensely

powerful and merciful, loving and all-seeing. What do we have to say about that? Scientific pantheism does not offer a personal God. We believe that, if there is a God, He cannot be outside the universe and

He must respect its laws. But this is not the most important part of our belief (which I call so only because of the lack of a better term) We do not really believe that God is the universe, or vice versa. Instead we revere the universe itself (with many names), which we can see and touch and experience with reason and emotion.

Nothing has to be revealed through scripture or fixed by dogma in order to appreciate the beauty of the universe. Mind you, this is "beauty" in a general sense: this word we use to convey the elegance of the natural laws, the complexity of the many shapes of matter and energy that surround us and form us, and the feeling of astonishment, of infinity, that we get from looking up to the sky, or into our very cells through a microscope, or by studying the structure of reality that Science tries to unveil for us.

You believe in God —but you can't see Him. You can only worship Him in what you believe is His creation. Your prayers are words in your mouth, and your temples and altars are made of matter: you are immersed in the creation. We do not believe there is anything else besides that, and this is because we cannot force ourselves to believe: our reason tells us we are putting our hopes in inexistent things. That is why we have taken a step forward, and accepted that we are here, in a marvelous world, and this is what deserves our attention and reverence, at least until we die. Most of us do not think there is any evidence supporting the possibility of an afterlife, so this life is all we are going to get, and we want to live it, cherish it to the fullest, and contribute what we can to the world that gave us birth. What lies beyond, if anything, will not be affected by what we do or do not do here.

Yet we do not see things of this world as idols. We watch a sunset and revere the sun, its reddening light and the majesty of its force; we marvel at the fur of a tiger or the colours of a bird; but we do not see anything past them, and do not make them into deities. The sun is a ball of hot gas, glowing and supporting itself through atomic fusion. And it is also a comforting touch to fed with our eyes shut, me light that lets us

see, the ultraviolet rays that let us get a nice tan, or serious bums if we do not take caution, and catalyzes the production of vitamin D in our bodies; it is one of the forces that ultimately made the Earth alive. It is the sun, not our god. And so on.

No one has seen a God outside the universe. No one really wants a God that is smaller than the universe, that is an idol, only one arbitrary thing in the world. We have chosen to stay in the middle, as we are in the middle of the universal scale, between atoms and galaxies. This place does not offer comfort to us, and it does not listen to prayer; it does not require rituals to be performed, or some specific morals to be followed no matter what. It is not a matter of faith, or choosing, but merely of self-acknowledgement. We have realized we are on our own, and that our own is everything.

Far from indifferent or relativist, we are not denying the Absolute, but looking at it: it is all around. Some things can be learned from it, but it is difficult unless we realize this is exactly our place. In me meantime, we enjoy being here, while we have this unique and infinite fortune.

There is no need to believe anything about God to be a pantheist. So you, either a weak atheist or a strong agnostic, should feel really at home being one. I myself do not believe in God, and do not think we will be able to find any god at all, or to prove its existence; so I am an atheist and an agnostic at the same time, and I find no conflict being also a pantheist. (If you have doubts, please see my explanation of how *atheism and pantheism can be compatible*.)

Pantheism is an attitude towards the world: seeing it as worthy of reverence, because we are in it and it is in us. Scientific pantheism further explains that the material universe is all there is, by definition, and we are only one part of it. Even though each of us has an individual consciousness, we are really not different or distinct, as conglomerates of matter and energy, from the rest of the particles that form the universe. SciPan is a monistic and materialistic worldview, but it avoids the coldness of "pure" materialism by letting room for our feelings, our emotions and instincts, and our reason.

We know that "mind" is a convenient label for a philosophical concept. We accept what physics, chemistry and biology tell us, that we are

made of matter (the same as the rest of the universe, from grains of sand to red giant stars) and we have evolved as entities capable of reasoning and feeling. We look at the chain of causes and effects that have made us into human beings, and humbly accept that we are here by chance (a chance we are thankful for) and are not special or irreplaceable; and at the same time we acknowledge a duty to make our lives purposeful and contribute to "keep things going", at least within our tiny environment.

Both the reader and I know that organized religion has caused immense harm and suffering; we know that movements based on belief only are potentially dangerous. Atheists and agnostics, even those that have come to their views by reasoning and not by sheer emotional rejection of belief, usually do not like to be labeled or associated with anything resembling religious speculation. This is natural. But I claim that scientific pantheism does not speculate. It is religious only in the sense that it attempts to rejoin or rebind (in Latin, *religare*) the human personality with the universe, by reflecting on the position of one regarding the other. Feeling, armed by the tools of reason, properly wielded, not to defend invisible and improvable deities, but to explain why it is natural for us to feel at home in the universe, and why we should feel a part of it.

While traditional dogmatic religion rejects reason, except for the making of arguments upon hidden, unsupportable premises, scientific pantheism embraces it, and uses it to gain more knowledge of the universe, so that our minds, before such overwhelming reality, accept the facts without faith having to play a part. No paths are fíxed, but we are given the tools to find them and, if we can, open new ones. From Einstein to Sagan, the last century has shown that science can explain the mysteries, and that they become no less mysterious if we see them as parts of a terrifyingly complex whole of which we are a part.

We have discovered our origins in time. Our atoms were assembled in the furnaces of exploding supernovae; our molecules, by the laws of physics and chemistry and chance, probably in the water of an old ocean. Our cells are living organisms; we are a colony of interdependent beings that have acquired the ability to reproduce, think and feel emotions. All that separates us from the rest of the matter and energy in the universe is a minute layer of continuously regenerating skin cells, and a conscious-

ness that insists on telling us that we are unique and independent. Unique we are, yes, because such chance as our occurrence will most probably not arise again in the lifetime of our world. But we are not independent: not from ourselves, our emotions and instincts; not from other human beings, or animals, or plants, or the natural laws. We are organized matter that can feel the joy of this union, and have it spread to the rest of the universe: from this premise on is pantheism built.

No matter what god or gods you have, they will not live up to your expectations if you insist on demanding from them that they be omnipotent and omniscient, and yet also good and merciful. The mysterious gods from outside the universe, if there are any, could not care less about human affairs, or well be seeing them in action every day. On the other hand, if your gods are of this world, then they are fallible and limited, and you are entitled to (and bound to) search for something else. Or are you?

You do not need to search for a god to worship. You do not have to put your trust, your faith, your state of mind, on invisible figures. And neither do you want to have your mind seduced by gods of this world, like money, power, or the visions of a greedy guru. The supematural gods are mostly likely non-existent, and in any case you cannot learn anything of them —and how will you respect or love something you know nothing about, except what folk stories tell you? The worldly gods, on the other hand, are not so powerful when it comes to important matters, and they may take away your freedom of choice and thought as much as dogmatic religion may.

We pantheists have seen this and found there is a third path. All the problems of evil, all the discussions about moral absolutes, come to an end when one looks around and says: this is my world, my universe. It would not be the same without me, and I would not exist without it, and this is a miracle in itself, the greatest miracle. This is it —and I have no right to hope for good or evil to come from the universe, which is mindless and indifferent. On one side, this is a terrible burden: all the blame, all the purpose, is to be placed on our backs; but on the other side, it is a relief humankind needs since its beginning —relief from having to watch out for spying gods, for mysterious forces that are supposed to love us but might punish and destroy us out of the blue.

Moreover, this relief and this burden are to be shared among all our backs. Harmony with the universe is not a meaningless phrase, and certainly not "tree-hugging hippy crap": it is something we owe ourselves and the world, and we will not be finding it in empty rituals, in dogmatic religions that teach us to despise the earth in favour of heaven, or in indifference. Scientific pantheism will not become the universal religion, probably, but scientific pantheists along with Christians, Muslims, Jews, Hindus, atheists, agnostics, humanists, deists, pagans and New-Agers will have to acknowledge that the universe is not separate from us. In the course of some thousand years (a blink of an eye) we have already greatly affected the only part of it where we are able to dwell so far; we cannot trust in "invisible hands" (the free market, God, Gaia?) to fix everything for us, or to comfort us in the misery we've bred, or to welcome us into glorious bliss, in heaven, at the End of Time. The science in scientific pantheism shows us the laws, the correlation of causes and effects, so that we can choose; the pantheism in SciPan tells us we cannot escape from those laws, and we can make use of them to create a better world.

And this is not all there is to scientific pantheism. We need no longer view the world as a hostile place, or something we've got to tolerate and fix from time to time in order to continue extracting resources from it. Neither do we see humankind as a kind of "Earth Cancer", for which we must despise our anti-ecological deeds and ourselves. We get ourselves into the picture, and gain a new perspective. We reduce the working hypotheses to one; we become bound by the same laws as everything else, and while we still do things for our benefit, we are ready to accept the consequences and prevent them. We become a thread in the web of things, and enjoy our belonging with the unconscious easiness of the lion in the savanna, the frog in the pond, the daisy and the sparrow.

Do you realize that scientific pantheism is about the only religion we can expect to hare with other life forms? If one day we're able to speak to dolphins or whales, or chimpanzees, or even with extraterrestrial aliens (who may or may not exist), do you think they would understand our traditional human religions, full of values that probably make sense

for human minds only? If most humans are already unable to grasp the paradoxes of religious faith, how do you think well be able to communicate our innermost feelings to fundamentally different beings? Pantheism is difficult to explain, but you can recognize it when you see it, and its basics are simple and down-to-earth ones, written in the language of science, which is based on awe and questioning.

And yet you do not need to be a scientist to be a pantheist. You could be one right now, as long as you realize the complexity of the universe and yourself within it, and dare question yourself where all that carne from, and whether you want to reach out for it. Science is only a tool, like the telescope for the astronomer, or the periodic table for the chemist and the physicist. Science is how we see things; we know that pure feeling and pure unreasoned emotion can fool us, so we like to educate them. We allow them (us) to enjoy the glorious, endless processes of the universe as purely, and more. We want to witness things as they are. We do not spoil the fun —we make it deeper, with more and more varied levels. We see the rainbow and we do not see a supenatural miracle, a myth, an epiphany of a mysterious force; we see a show of colours that we enjoy as such, and also a light spectrum, me light of the sun broken by tiny drops in suspension, the drops being held up by the air we breath and by surface tension, the light being formed of tiny particles that are also waves, the photons coming to the wonderful machinery of our eyes, exciting our retina, our colour— and bright-sensitive cells, and triggering electric messages to our brain, this mass of organized matter which is what gives us understanding of all the rest... At the same time we realize this, and the joy oft his also adds up to our sensation of wonder.

It doesn't matter where you Uve or who you are. You can feel this and your reason can see it. It's a good thing —not me best, not the universal remedy, not me ultimate solution for evil and wrong, not a promise of salvation— but it's true, as long as you do not reject it. You can be a child, a grown-up, an old man or woman, of any creed or no creed, but once you've found this and accepted it (no faith, only acknowledgement), you are, from that moment on and forever, a pantheist. (Let me know then.)

# The cosmic code

The phenomena of the Universe are verified by a rise of entropy.

The thermical end of the universe will take place, according to the second principle of Thermodynamics, when the entropy reaches its summit and obtaining an uniformity that would make impossible any kind of chemical or physical transformation. We can see that this is not contradictory with the principle of the universe's energy and that the energy, in the thermical end, will be the same as the one of nowadays; it should have arrived to an end of the available energy for the fulfilment of the phenomena that constitute the dynamics and the life of the universe; the rise of the entropy carries a degradation of the energy.

The thermical end means that the program of the cosmic code has ended, when the entropy is at its upmost/maximum. The stars are going out. The balance between the centripetal (universal gravitation) and centrifugal (stars and galaxies are off) power is unstable. When the balance breaks, all the matter, due to the universal gravitation gets concentrated again in the cosmic code. Then takes place the BIG CRUNCH.

Once all the matter is concentrated in the cosmic code, the program starts to work again, because the universe is a universal and intelligent computer. Then takes place the BIG BANG. The galaxies and the stars shine again and so on the cycle goes on forever. The BIG CRUNCH executes the Big Bang and this do the Big Crunch.

We can make a comparison between the egg and the hen. The latter can be represented by the Big Crunch and the egg by the Big Bang. The

hen (Big Crunch) gathers all the information in the egg (Big Band), the genetic code, program that will produce another hen, and so on. This follows the principle of conservation of the meter and the energy (information).

The space is needed for the stars to shine, like the house that is built to be inhabited. Everything has its finality. Everything is programmed.

Forward to the past. In the Big Crunch, the entire Universe collapses to such a small size that it can be held in the palm of the hand. But this fiery concentration of energy cannot be kept within bounds. In an instant, it bounces back —starting to expand again. It is the seed that can generate another Universe: perhaps only one in an infinite number of Big Crunches and Big Bangs. From the Big Crunch that marks the end of our Universe we can look forward to the birth of another Universe in a new Big Bang.

Other births. An oscilatting universe. A universe can rise up from the collapse of a previous universe, like the ave fenix is reborn out of its ashes. In the oscillating universe's theory, when a closed one collapses in a Big Crunch, instead of disappearing, the matter and the energy bounce and provoke a new Big Bang with completely different features as the previous one. The cycle can happen again and again. The universe collapses and ends its life in a Big Crunch. The collapse generates a new Big Bang and a completely new universe is born.

As the genetic code is the origin of the life, the fire, the plasma, it is also the origin of the inert matter. It is the cosmic code, the Big Bang. The evolution of the inorganic matter is: 1) plasma. 2) gas. 3) liquid. 4) soli. 5) condensed matter. The evolution or the organic matter is: 1) genetic code (egg). 2) growth. 3) reproduction. 4) death. The cosmic death is the plasma, the fire, the stars, the Big Bang. The life's cycle goes from origin to origin, from genetic code to genetic code, and the cycle of the inert matter goes from plasma to plasma, from fire to fire, from galaxies to galaxies, from Big Bang to Big Bang.

# The end of the Universe

Everything in the Universe —galaxies and all their contents— are passengers riding on the back of space and time. Space and time were created in the Big Bang. Since then, time has moved onwards, and space has expanded, carrying all the galaxies (or, strictly speaking, clusters of galaxies (or, strictly speaking, clusters of galaxies) apart from each other at high speed.

In the simplest view of the Universe's ultimate fate, space continues to expand for ever. The galaxies are carried further and further apart. As time goes bye, each individual galaxy fades out, as will our Milky Way. In the end, there will be nothing but enormous tracts of empty space, punctuated here and there by a dead galaxy. Most likely, in the far distant future, the dead matter of the galaxies will disintegrate into weak radiation, which will expand into the cold of infinite space.

Astronomers call this vision the open Universe. It is the natural way to extrapolate what we know about the expanding Universe into the indefinite future. But it neglects one important factor: gravity.

All the galaxies in the Universe are pulling on one another. This mutual attraction,across millions of light years of space, tends to restrain the expansión of the Universe. At first it might seem that the gravitational pull between the galaxies scattered over the Universe is too small to have any noticeable effect on the headlong expansion of the Universe. But, in recent years, astronomers have come to suspect that the Universe contains a quantity of matter in addition to the stars in the outer part of

a galaxy are found to be moving so fast that, if the only gravitational constraint carne from the stars we can see in the galaxy, they should fly off into space. Similarly, most clusters of galaxies should disintegrate because they do not have enough gravity to rein in their faster-moving members.

So we are led to conclude that galaxies contain a great deal of matter that is totally invisible, but that exerts a strong gravitational pull. Most theories of the Big Bang that include a period of rapid inflation also suggest there must be much matter that is unseen in the Universe today. These very different lines of argument all suggest there is at least ten times as much dark matter in the Universe as there is visible matter in the galaxies that we see.

This is in itself an astounding conclusion. What we actually see in the sky —all the stars, the planets, the clouds of gas and dust— make up oniy a minor part of the Universe. Most of its mass is made of something invisible, composed of some unknown substance. Beyond this, however, the dark matter has important consequences for the future of the Universe.

The dark matter in the galaxies may give them so much extra gravitational pull that they can affect the expansion of the Universe. Many scientists believe that this is a gradual effect, balanced so neatly that the expansion of the Universe will slow to a standstill only after an infinite amount of time has gone by. In practice, this is no different from the concept of the open Universe.

But it requires only a tiny proportion more dark matter for the future of the Universe to be tipped to a completely different fate —a closed Universe. If their mutual gravity is strong enough, the galaxies can slow the expanding Universe down to a standstill, in perhaps a few hundred billion years from now. Once the outward momentum has been killed, gravity takes over entirely. It starts to pull the galaxies back together again.

The expansion of space originally carried the galaxies apart from the Big Bang: now the converse happens. As the galaxies star moving together again, space begins to shrink. Faster and faster the galaxies approach, almost as if the expansion of the Universe was happening in reverse.

Time is still going forwards, however. When the Universe was at its maximum size, the galaxies were old and played out, each a necropolis of star corpses. As the Universe begins to shrinks, the elderly galaxies continue to age.

In the shrinking Universe, the stage is eventually reached where the galaxies become crowded together so closely that they begin to merge with one another. If their stars were still shining, the skies would now be bright: but in fact it is dark, unilluminated by the dismal star remnants.

When the star corpses are ten times close still, however, they begin to collide with one another. In the collision, the hot interiors of the remnants spew out into space, in a torrent of subatomic energy. The dark is lit up by intense bursts of cataclysmic fire.

Within another twinkle of an eye, on the cosmic scale, it is all over. All the billions of galaxies, with their dead stars, have fallen together. Their matter is rekindled to incandescence in the final collapse of the entire Universe. The end of the Universe has come in the sudden finality of the Big Crunch.

As the dead galaxies fall together in the last stages of a contracting Universe, the star relies begin to collide. Sparks fly as two neutron stars smash together in a prelude to the Big Crunch.

# The artificial mind

It is the operative system of the computer. It is its autonomous nervous system. Its importance can be seen by comparing its functions with those of the central nervous system of the man. The operative system coordinates the components of the hardware and the software.

Without the nervous system, the man would be condemned to a vegetative existence, without sensations, without movements and without thoughts.

The nervous cells transmit messages that move muscles, give meaning to all of them, regulate hundreds of automatic activities, such as the heart beating, which is essential for living.

The sensory nerves carry impulses to the central nervous system, the motor nervous that carry the impulses from this to the effective action. For instance, the sensory nerves detect that the fingers are touching a hot stove, then the motor nerves give the order to the muscles to retire the fingers to avoid the danger.

The nervous system is also responsible of the monitoring of its external surroundings. Each movement of the human body requires a coordinated effort between its brain and the peripherical nervous system, with many messages that are sent in both senses and that are interpreted constantly. All these interactions are automatically produced without us being conscious of them. The autonomous nervous system looks after these details and makes possible that our conscious mind carries out its dairy tasks without feeling weighed down by them.

We cannot work without our central nervous system. Like the computer it cannot work without its operative system, which also handles many boring and essential details.

On the other hand, the operative system handles the details of low level that lead the programs of processing data, the texts analysis, the analysis of electonic page and the data base help it to carry out the administration's tasks.

The operative system is the link between the man and the hardware of the computer. In order to understand this link we should first have a look to the different components of this hardware.

The mechanical and electronic part of the computer is called hardware. The main component of the computer is the system's unity.

Components of the hardware: system card. A chip. The brain of the computer is the microprocessor chip. RAM (random access memory). ROM (read-only memory). Disc unities. Different parts. The keypad. Screen. Printer. Modem. Scanner. Etc.

The computer science tries by its nature to substitute the people in their mental tasks. From the perspective of the informatics system and the artificial mind, that is the Computing and the artificial intelligence, are just one thing. The computing also tries to substitute us in sensorial activities; that is why a informatics system can have artificial vision, or artificial sense of touch.

# The artificial Universe

The Computer science can also substituted with some limitations the nature by means of simulation's techniques, as it is the case of the virtual reality and the artificial life.

The computer is the mirror of the Universe. It is constituted by the hardware and the software. The operative system of the computer is the autonomous nervous system. The importance can be illustrated by comparing its functions with those of the central nervous system. Without the nervous system we will be confined to a vegetative existence, without sensations, without movements and without thoughts.

The nervous cells transmit messages that move the muscles. The heavenly bodies are similar to the nervous cells. Through the universal gravitation and the solar radiations they transmit messages.

The entire Universe is reflected in the computer as if it were a mirror. It is similar to it and register all the information. With the help of the man it can come into contact with the reality.

The operative system is the link between the brain and the Universe. The mechanical and electronic parts of the computer are called hardware. Its main component is the system Unity.

The hardware makes it possible, but the software makes it happen. A computer can not do anything without the software.

# The Universe is a computer

It processes the information without stop.

1. All the information that it uses can be reduced to 0 and 1 (off and on). The binary information can only represent to states, information 0 and the universal Planck's constant, action's unity, whose value $h = 6{,}6 \times 10^{-27}$ erg/sec is the informatics bit 1. With this binary system the universe begins to process all the universal information.
2. The main system of coding that the Nature uses consists in the combination of the different frequencies of specific radiation to form 'letters' and 'words'. This model of frequencies, first alphabet, is the cosmic code that stores the spectral information.
3. If we compare the cosmic code of the sunlight with the codes we use in the computers but with one basic difference. In the computers we normally use data and temporal codes, because the message can only be understood after a certain time, where the data are revealed progressively. This happens usually in the speech and writing when a statement is made, as it is necessary to wait until the sentence is finished to understand the whole sense. But the Nature works differently and transmits its information simultaneously as a synchronic model of specific frequencies.
4. The receiver decoders are well known as they are simply the different sort of matter that is programmed by the radiations.

5. The periodic system of the chemical elements is the second alphabet and provides a systematic order of those in natural groups. The meaning of this classification allows us to predict the properties of the elements and their compounds. We can also understand with it the properties of the valence of the elements and the Nature of the chemical link. It is necessary to understand the skeleton of the matter as a logical set.
6. As well as our alphabet comes from the human brain, the alphabet of the chemical elements or letters comes from their universal brain. The conclusion is that the Universe is intelligent. The information is concentrated in the nucleus of the atoms that runs and controls its function.
7. With the letters of the chemical elements, the Nature form the syllables (water = $H_2O$), the words, the sentences, etc and all the minerals.
8. The hydrogen mineral, with only a binary bit, represents the natural basic memory as the most elemental letter of the alphabet. In the human alphabet the letter e is the most frequent one and the one that is repeated most. The hydrogen is the element that most abounds in the Universe. The complete table of the chemical elements is, in reality, a large alphabet and their interactions in the chemical processes are a sort of natural data processing. The Nature takes for its developments rather a short alphabet of four letters, that are the following: carbon, hydrogen, oxygen and nitrogen. With this short alphabet and using quite long words, the Nature makes up the sentences of the organic chemistry that originate the living beings. As we see, the Nature is always making up programs for the creation of the living beings.
9. The following step that the Nature takes in its evolution, and with good foundations, is the creation of the life. The origins of the universal genetic code. The Nature, once it has formed the atomic code, it has enough data to create the genetic code. The solution of the problem to form a genetic code and create the life is a evolutive consequence and it will consist in increasing the information. The origin of the life comes up with the formation

of the genetic code, that is, the dictionary that translate the language of the genes (a row of bases or letters) into the language of the proteins( a row of amino acids). A gene is a large row of bases (chemical letters). The Nature, by logic, as well as the man would do, would form the gene (letters) and the chemical elements (letters). The genes (letters) will form the chromosomes (words). The set of all the genes of a chromosome form the genome, that runs and controls the formation of the man.

# Relation between information's systems, nervous system and solar systems

We can compare the computer with the brain and both with the Universe or Cosmos.

Therefore we will make the following comparison in order to understand the brain, and, above all, the Universe. Finally, we will prove that the Universe an Universal Computer is.

1. Comparison of the computer with the brain.
2. Comparison of the computer with the Universe.
3. Comparison of the brain with the Universe.

The computer tends to copy, to imitate the brain's model in such a way that it will surpass it some day.

Since we were born our brain is obtaining more and more information about the real world that surrounds it, tends to imitate it, copy the Universe, which serves as its model. Humanity, year after year, is discovering its secrets. The knowledge about the world we are living in is increasingly wide, and at the same time it is part of the Universe. Humanity will understand it so well that it will surpass it easily. In the same way that the computer will surpass the brain, this will as well achieve more information about the world it lives in.

As the computer is a brain's product, it will always be under control of the man who has created it for his help and protection. So as the nature created the brain, this will be always submitted to it. It is similar to a child that, following a natural law, will never stir up against his father.

# Comparison between the computer and the brain

The model of a brain is similar to a computer rather than a telephone exchange. In the latter there is a commutation de messages (exchange of information), whereas the computer undergoes information's process.

The brain has programs that help it to process the information that receives through the afferent routes (entry) and displays the results of the operations in the form of responses (exit).

The brain is also able, as well as the computers, to store data and go back to them whenever it wants. However, there are also deep differences between both of them.

Among these differences we are going to point out some of the most important ones and add some mentions.

The brain operates by chemical principles, whereas computers do it by electrical principles.

In fact, this statement is so obvious that does not need any mention. If something, let's say that in the nature the chemical principles are, deep down, physical phenomena.

The brain operates in parallel and computers do it sequentially.

It must be said that computers can operate as multiprocessing, dealing with the information received from different applications simultaneously and in parallel, performing several operations simultaneously in the application. All depends on the structure or configuration of the information's system (terminology that includes computers as an constituent part of it).

The brain receives information of up to 106 sensorial receivers, whereas the computer can only deal with an entry in a specific moment.

With a powerful configuration of computers we can deal with many thousands of sensors, and with a huge one, although it would not be profitable and no one would be interested in it, it could simultaneously deal with 106 sensors. Quite a different thing is that this could provide us with such wonderful and unequaled information as it happens in the brain.

The brain is a complex formed by a great number of computers closely together so as to be able to analyze, compare, and relate its entries at the same time.

The organization of the systems of information that the computers have got is poorer as that of the brain, since the microcomputers the brain is formed with are the neurons. In this case it is impossible to imagine, even in theory, a net of 1.010 microcomputers.

An important feature of the nervous system is its hierarchical structure.

Something alike is to be found in the information's system, where we can observe:

— Central and peripheral (satellites) Units.
— Hierarchies of memories.
— Hierarchical organization of the programs' systems.
— Etc.

As a consequence of its evolutive origin, several levels of different philogenetic origins form the brain, each of them controlling the ones in lower levels and being controlled by those of higher levels.

The Information's system base also its structure and operatively in a hierarchical organization.

The brain holds a considerable redundancy.

At the present moment it is not to be compared the marvellous reliability of the brain with that of information's system, but in the future the probability will become a reality.

However, it must be pointed out the fact that thanks to the informa-

tion's systems that operate in multiprocessing and the redundancy of the printed circuits, it can be established, as theoretical hypothesis, a sort of parallelism between the brain and the computer in the matter of redundancy[1].

The basic operations of the brain are genetically programmed and supply stereotype responses to certain environmental stimuli.

The computers count as well with a micro program and programs in general that provide with expected responses to certain entries of information of the environment, where the computer works.

In all the superior animals the brain is constantly "programming" itself, in order to modify the response according to a previous apprenticeship.

Once again it must be recognized that the potential power of the brain is much bigger than the results of the apprenticeship process carried out by the artificial knowledge, and, widely speaking, by the computers or information's systems. It must be taken into account that the brain has an evolutive run bigger than the nowadays computers. Although it is acceptable to think that the distance will be reduced and that they may reach the potential of the brain.

The interest of this essay is to establish a parallelism between some functions of the brain and the computers from a systematic point of view and with the target to justify the heuristical value of the model of information's systems when we want to investigate the brain in particular and the human being in general. It is no need to say that we consider that the brain is not the same as an information's system or similar to any artificial system that can be built up.

Besides the genetic program, each brain has its individual history that it is integrated in its information's store.

That happens in any information's system because, apart from the basic programs that exist in any kind of computer, new application's programs are created and used for particular needs (these application's programs could be compared to the individual history mentioned above)

[1] In communication, certain repetition of message's information that allows, in spite of the missing of part of it, to reconstruct the content of it (editor's note).

The nervous has a basic spontaneous activity that is modify by the stimuli. In the superior organisms this activity can be a so effective internal source of stimuli as the stimuli outside.

The possible parallelism is of not interest for the reader.

The brain has not just one codification. The scheme of the code, that is, the system of signs that represent the entry of information is, digital and analogical.

The systems based in sensors (particular kind of information's systems) have the possibility of accept analogical and digital signs.

On the other side, what really understand a computer is the digital signs that arrived to its central unity, that is, precisely what sensorial receivers do. (Transform visual, acoustic,... stimuli into bioelectric boosts, digitalized and modulated in frequencies).

Computers accept obviously the digital signals without any conversion.

## INFORMATION'S PROCESS

The most part of organisms are born with their nervous system programmed in order to develop the functions that are vital for their survival. That is why the neuronal tracts are also genetically determined.

In the brain there are neuronal circuits determined genetically, that are responsible for the innate schemes of stimulus-response and some performances. The circuits originated through acquired information are where we can see the learned performance. That implies that there are innate programs and a non-stop programming.

In computer terms could be made the following association: the innate programs amount to permanent microprograms and the constant programming amounts to the creation of new programs, that set up the personal history of each person.

These microprograms and the variable programs would be the ones used by others mechanisms of the brain for the process of information at any time of the life of a person (one of the serious problems is to determine, if possible, which are these mechanisms and if all have got the

same physical explanation). Facing such problems our theory will try to justify it as far as it can, based always in information's process of chemical kind or integration in a hierarchical process.

## Complete code and shorten code

In computing terms we can assimilate complete code or high-level languages and machine codes.

The machine code is the one that understands the computer directly; the high level language can need to be translated (what the computer does through a translator's program) into a machine code.

When a program is ready for a high level language, the computer needs much more time in processing the information than if the program is ready for the machine code. The reason of making use of high-level languages is that it is easier to prepare (codify) the programs.

The language centers (located in the left hemisphere of the brain) use the shorten code (machine code), that is why the treatment of language in this hemisphere would be quicker than the right one.

The relations between computers and the brain are the most important to handle as their implications affect the person's assignment in the world. Because of it, they seem to need a thought from different points when it comes to analyze the working of the brain is no longer a black box.

## Structural aspects of the brain

In the brain there are two hemispheres that when you observe them in detail you realize that they are different (when we talk about hemispheres, it is included the subcortical zones and the cerebral trunk associated).

The left hemisphere contains less miniprocessors than the right one. The reason for it is that the left hemisphere is the one who carries out the more analytical functions, lineal, logical y in sequence, whereas the right hemisphere develops functions in parallel y not lineal, and above all, operates with wholes.

From a programmer point of view, in order to perform the functions of the right hemisphere it is necessary a bigger power of calculation and process a higher entry of miniprocessors. That is the reason why we have represented a higher number of miniprocessors for the handling of the information and for the processing of the information of the channels.

On the other side, the fact of having a higher number of microprocessors in the right hemisphere does not mean that they have the same power than those of the right one, they only have the chance to deal with more information at the same time (in parallel). It must be said that we admit some structures for the natural languages as the ones defined in the generative grammar (solved by logical arborescent), which implies a treatment in sequences of the language (in the left hemisphere but we can not be sure taking into account the current linguistic investigations). We have considered the lateral feature.

We see that both hemispheres are linked, which represents the joint through the body.

What happens if this communication disappears? Simply that each central unity of process (that is, each hemisphere) works independently from the other.

But, if there is not an suitable synchronization (due to a lack of communication) the output of the whole brain decreases. If the coherence rises within a hemisphere and so does between both hemispheres, the intelligence and creativity also increases.

On the other side, if there is communication between hemispheres and one of them is damaged, in many cases the other can assume the functions of the first one (it is as if the programs of a central unity of process could be processed by the other). This provides the brain a bigger reliability and adaptation to adverse situations.

A microprocessor should be considered as a neuronal mass where the activity is superior to the sum of the synergic effects. The miniprocessor will be represented by a neuronal mass specialized for that function.

The memory of short duration corresponds to the memory of work of the central unity of process (in this case memories of complete code of both central unities that represent both hemisphere)

The memory of long duration is the memory of the same name of the central unities of process that represent both hemispheres.

In the memory we have included three different programs:

*a*) Operating system.
*b*) Programs genetic.
*c*) Programs acquired.

The role of the operating system is the one that shows more difficulties for the man to be interpreted.

The genetic programs could be considered as innate microprograms (that is, analogue to the circuits of the information's system that represent basic programs for the information's system).

Although there are included in the memory of short duration, it must be understood that they do not disappear with the time; what happens is that similar to what happen in the information's system, we wanted to visualize the brain as it works, and for that, the operating system —in the information's system start just from it— should be already in the work's memory (that of short duration). Something alike can be said of the information that comes from the microprograms.

The genetic programs should be understood as the programs fitted from the beginning to the system that represents the brain.

The programs acquired are those that the man acquires through the apprenticeship.

From our point of view, the concept of program is the most difficult to understand, since it is difficult to think how the stimulus, meaningful o not, can modify and create those programs. If we start by saying that the genetic programs are somatic, what are then the acquired programs? How to explain that the information in the messages that we received during our apprenticeship will be transformed in some, and that it adapts perfectly to the already somatized? In my opinion, except from the genetic programs that control the development and differentiation of tissues, anything else can be said from the rest of it.

The miniprocessors have got biological clocks; it can be proved its existence because of the interactions among the neuronal mass in order to control every operation.

Besides the biological clocks of the miniprocessor, each hemisphere has got a clock that controls the lineal time in the left hemisphere and no lineal in the right one.

The concept of lineal and non-lineal time within one brain is very important because depending on which one is predominant the perception of time is different.

The short-term memory is clearly related with the sea horse whereas the long term one is distributed on the cerebral cortex.

New progresses allow knowing how the brain recalls.

The memory works as follows. The brain is an organ able to store a huge amount of information, but the process that makes it possible is an enigma for the science. However, recent investigations have located some structures cerebral that are implied in the fixing of recalls and their storage in the cerebral cortex. Due to this discovery they have found answers to many of the mechanisms of the memory.

An impulse turns on a particular pattern of nervous connections.

The impulse travels quickly to the visual cortex, a part of the cerebral cortex located in the back of the neck. The brain operates on it, sparking off several changes.

In a tenth of a second since it comes out of the retina, the message is already in the temporal cortex and stops compulsory in the sea horse.

Let's continue with the computer and the brain. I am going to analyze the similarities and differences between these two types of automaton. We should say that the similitude lead to well known themes. There are also different elements, not only the most obvious ones, as the size and speed, but also much deeper areas, which include the control's and working's principles, the global organization, etc., My first target is to develop some of these principles. However, in order to estimate them properly, is necessary to make a juxtaposition and combination with the similar points and with those of bigger superficial difference (size, speed). That is why the analysis should start with these aspects.

# Simplified description of the neuron's functions

The most immediate observation regarding the nervous system is that its working is digital. This fact, its structures and the functions, is based on the need to be analyzed thoroughly.

The basic component of this system is the nervous cell, the neuron, and the normal function of a neuron is to generate and spread a nervous impulse. This impulse is a rather complex process, with a variety of electric, chemical and mechanical aspects. It seems though that it forms a definite process, that means that it is almost the same under any conditions, and represents an unitary answer, which can essentially be reproduced, to a wide variety of stimulus.

I will analyze in detail the aspects of the nervous impulse that seem to be relevant in the current context.

## Nature of the nervous impulse

The nervous cell consists on a body where one or more branches are originated directly or indirectly. Those branches are called axoms of the cell. The nervous impulse is a continuous charge propagated, normally with a constant speed that can be the function of the nervous cell through an axon (or rather said, through any of them). This impulse can be seen under many aspects. One of the features is the one of being an electrical disruption; in fact, it is described generally as that. The disrup-

tion is an electrical potential of some 50 millivolts and with a length of around one millisecond. This electrical disruption produce also changes of chemical nature through the axon. In this way, in the part of the axon where the potential impulse gets through, the ionic constitution of the fluid intracellular changes, and so does the electrochemical properties (conductivity, permeability) of the lining of the axon or membrane. In the edges of the axon, the chemical character of this change is even more obvious. There turn up specific substances when the impulse arrives. Finally, it is probable that mechanical changes take place. Of course, it is possible that the changes of the different ionic permeability of the membrane of the cell could take place just through a reorganization of its molecules, that is, due to mechanical changes that affect the relatives positions of the components.

All these effects take place in a molecular scale; the thickness of the membrane of the cell is of an order of a few dozen of micron (10-5 cm), which is a molecular dimension that can be compared to the big organic molecules that are involved in the process. The previous differences between the electrical, chemical and mechanical effects are not so good defined as it might have seemed at the beginning.

Of course, in a molecular scale there are no marked differences between all these changes; every chemical change is induced by a modification in the intramolecular powers. That produces changes in the relative positions of the molecules, that is, are induced mechanically. What is more, each of these mechanical intramolecular changes alters the electrical properties and the levels of relative electrical power.

To sum up, in a average scale (macroscopic) the electrical, chemical and mechanical processes represent alternatives with deep differences. However, in a almost molecular level of the membrane nervous, all these aspects tend to converge. That is why it cannot be surprising that the nervous impulse turns out as a phenomenon that can be considered under the point of view of any of them.

## Stimulation process

The nervous impulses can be compared regardless how they have been induced. As their character has not been defined precisely (electrically o chemically), its induction can also be attributed to electrical or chemical reasons. However, in the inside of the nervous system is due mainly to different nervous impulses (one or many of them). Under these circumstances, the process of its induction (the stimulation of an nervous impulse) can succeed or not. If it fails, at the beginning appears one temporary disruption but after few milliseconds, this is muffled and disappears. In that case, no absorption is propagated through the axon. If it succeeds, the disruption reaches soon a typical configuration and is propagated through the axon. That means that a nervous impulse will moves through the axon and its appearance will be quite independent from the details of the process that induced it.

The stimulation of the nervous impulse usually takes place in the body of the nervous cell o nearby. Its propagation occurs through del axon.

## The stimulation mechanism of impulses by impulses: its digital character

I can now turn back to the digital character of the mechanism. The nervous impulses can be considered as an binary signal in the sense previously analyzed: the absence of an impulse represents then a value (for instance, 0) and its presence represents the other (for instance, 1). Of course, this should be interpreted as an event in a specific axon —or rather said, in every axon of a specific neuron— and, possibly, in a specific temporal relationship with others events. It must be seen as a mark (a digit binary 0 or 1) with a specific logical role.

According to this, the impulses that appear in the axons of a neuron are normally caused by other impulses that make an impact in the body of the neuron... This stimulation is usually conditioned, that means that certain combinations and synchronism of those primary impulses pro-

voke the secondary impulses whereas the remainders do not reach the category of stimulus. The neuron is a stimulus, an organ that accepts and gives out an impulse its own definite physical entities: the impulses. Under this reception of impulses in certain combinations and synchronism, the neuron will be stimulated to give out an own impulse, in other way it will not give out. The rules that describe to which impulses it will react that way are the rules that govern it as an active organ.

This is clearly the description of the working of an organ in a digital machine and the way in which the role of a digital organ has to be featured. That justifies the original statement: the nervous system has a digital character.

The previous description has some idealizations that will be analyzed below. Once these are taken into consideration, the digital character does not appear so clearly and unequivocally. However, the features described are the most evident and striking. It seems suitable to start the analysis as I have done here, pinpointing the digital character of the nervous system.

## Temporal features of the response, fatigue and recovery of the nerve

Before going into these themes I would like to set out some orientative notes of the size, need of energy and speed of the nervous cell. These will be specially important and useful when they will be compared with the main artificial counterparts. The typical active organs of the modern logics and the calculators. These are, of course, the transistors.

As I said before the stimulation of the nervous cell takes place normally in or near its nucleus. In fact, stimulation perfectly normal is also possible through an axon. That means, a suitable electrical potential or a chemical stimulant with a suitable concentration, applied to a point of the axon, will start a disruption that soon becomes an typical impulse, moving up and down the axon from the stimulated axon. Of course, the usual stimulation takes place mainly in a set of branches that are spread

near to the body de la cell, which are essentially axons, apart from their smaller dimensions. The mentioned stimulation spreads from these up to the body of the cell nervous (and from there on to the regular axons). The receivers of the stimulus are called dendrites. The normal stimulation, when it comes from other impulse (or impulses) comes out with special determination from the axon (or axons) that spreads the impulse through a synapses (the fact that the one who spreads the impulse can stimulate directly other axon close to it, is beyond our scope) The duration of the stimulation transinaptical is about $10^{-4}$ seconds, known this time as the duration between the arrival of the presinaptical impulse and the coming up of the impulse in the closest point of the axon postsinaptical. However, this is not the most significant form of defining the time of reaction of a neuron when considered as an active organ in a logical machine. The reason for it is that immediately after the impulse has been seen, the stimulated neuron has not got back to its initial condition. The neuron given is tired, that means is not able to accept immediately stimulation produced by other impulse and react in the normal way.

From an economical point of view, is much more interesting to establish as measure of speed, the time between one stimulation that induces a normal response and the following one that can be able to get the same response. This duration is of an order of $1{,}5 \times 10^{-2}$. These figures show clearly that only a 1 or 2 per cent of that time is spent for the real transinaptical stimulation, whereas the rest represents the time of recovery, when the neuron goes back to its normal condition before the stimulus, a start from of the tiredness state subsequent to the stimulation. It must be said that this recovery from the tiredness takes place gradually and soon after (of an order of about $0{,}5 \times 10^{-2}$ seconds) the neuron can response to an atypical form, sparking off a typical impulse only if the stimulus is considerably stronger than the necessary in normal conditions. This fact has a wide meaning.

The time of reaction of a neuron varies from $10^{-4}$ and $10^{-2}$ seconds, depending on how it will be defined, but the most significant definition put it closer to the second figure. Compared to this, transistors can be used in big logical machines with time of reaction between $10^{-6}$ and $10^{-7}$seconds —of course I am taking into account the complete time of

recovery; the organ remains in its initial condition, previous to the stimulus. That means that our artificial instruments, from this point of view, are ahead of their natural counterparts in a proportion of $10^{-4}$ to $10^{-5}$.

Regarding the size, that is a quite different question. There are several ways to evaluate the size and it is better to consider them one by one.

## The neuron size: comparison with the artificial components

The lineal size of a neuron varies much from one nervous cell to another, as some of these cells are in big conglomerates closely integrated, and have therefore very short axons, whereas others send impulses among different parts of the body rather far away and can have lineal extensions that can be compared to the whole of the human body. One way of obtaining a significant comparison and without ambiguities is to compare the active part of the nervous cell and that of a transistor. The neuron is a membrane cell, whose thickness varies as above mentioned between $10^{-5}$ cm. In the transistor the distance between the nohmic electrodes, the transmitter and the control electrode, triplicates approximately so as to take into account the immediate active surroundings of those subconstituents, represents little less than $10^{-2}$ cm. Saying this, depending on the lineal dimension, the natural components seem surpass the artificial counterparts in a factor of the order of $10^{-3}$.

It is also possible to establish a comparison depending on the volume. The central nervous system occupies a space of approximately of one liter (in the brain), that is $10^{-3}$ $cm^3$. The number of neurons contained in this system is of about $10^{10}$ or bigger. That represents a volume of $10^{-7}$ $cm^3$ for each neuron. The transistors can be packed with a density that cannot be estimated precisely. It seems clear that this density of packing is (in both parts of the comparison) a measure of efficiency more reliable that one referred or the real volume of an individual component. With the current techniques, the groups of few thousand of tubes will occupy certainly some dozen of cubic feet. For the transistors can contain the same quantity in volume of 1 or few cubic feet. Using these

figures as a minimum measure, we obtain figures of about $10^5$ $cm^3$. For a few thousand of active organs some 10 or $10^2$ $cm^3$ each organ. What means that the natural components take advantage to those artificial counterparts in volume, in $10^8$ or $10^9$. Comparing it with the estimates for the lineal dimension is probably better to compare the lineal dimension with the cube root of the volume. The cub root of $10^8$, $10^9$ is about $10^3$ and $0{,}5 \times 10^3$, which agree with the $10^3$ we obtain by a direct method.

# Energy's dispelling. Comparison with the artificial components

We can finally make a comparison of the energy consume. An active logical organ does not perform, by its own nature any work: the impulse that produces does not need to have more energy that the fraction of the impulses that stimulated it, and in any case, there is no intrinsic relation and necessary between these energies whatsoever.

Consequently the energy implicated disappears almost completely and is transformed in heat without any relevant mechanical work. The energy consumed is actually dissolute energy and, therefore, we can talk of dissipation of energy of those organs.

The dissipation of energy in the nervous human central system (in the brain) is of 10 watts approximately. Because in this, as it was explained before, are implicated about $10^{10}$ neurons, means a dissipation of $10^{-9}$ watts per neuron. The typical dissipation on of a vacuum tube is approximately of 5 to 10 watts.

The typical dispelling of a transistor can be so little as $10^{-1}$ watts.

The natural components take advantage to the artificial depending on dissipation, $10^8$ to $10^9$ for the natural components against the artificial. To this factor we arrive by cubing the lineal comparison, comparing volumes and the dispelling of energy. Confronting this there is a factor of about $10^4$ to $10^5$ in speed for the artificial components in relation to the natural ones.

In these quantitative assessments can be based some conclusions. We must remember that the analysis is still rather superficial, and these con-

clusions I reached till now need a complete revision on further improvements. But it is interesting to formulate the following conclusions.

Firstly, the amount of actions that can be done by active organs of the same complete dimension (defined by the volume or dispelling of energy), in the same interval, the natural components take advantage to the artificial ones of the order of $10^4$. This is the coefficient of the two factors obtained previously; this is of $10^8$ to $10^9$ and of $10^4$ and $10^5$.

Secondly, the same factors show that the natural components favor the automata with a larger number of slower organs, while the artificial ones do the opposite, a lower number of quicker organs. We can expect from this that an automaton of big dimensions and efficiently organised (like the human nervous system) tends to integrate simultaneously as many logical elements (or information elements) as it can and processing them simultaneously, whereas an artificial automaton of big dimensions and efficiently organised (like a modern computer) tends to do the things successively, each thing after the other, or at least, not so many things at the same time. That means that the big and efficient natural automaton tend to be highly parallel, while the big and efficient artificial automaton tend to be the least and work in sequence (look the observation related to dispositions in parallely mass).

Thirdly, it must be said that operations in sequence and in parallel are not able to be substituted one another without restriction, as it would be required to give effect to complete the first observation, in a simple scheme of dividing the favorable dimension for the unfavorable on speed in order to obtain the ideal measure.

In other words, not all the sequence can be immediately put in parallel, some operations can only be carry out after others, and not simultaneously (that is, they should make use of the previous one). In those cases, the transition from one sequence scheme to a parallel one can be impossible, or can be possible but only with a change of approach and logical organization of the process. So as to convert to schemes en mass a process in parallel can impose new requirements to the automaton. It will appear almost always-new needs of memory, as the results of the operations made in first place must be stored while the next ones are

made. That is why the structure and logical approach of the natural automata could widely differ from the artificial ones.

Likewise, probably the requirements in memory of the latter ones are systematically more important than the first ones.

These point of views exposed here will appear again in further discussions.

# Stimulation criteria

## THE SIMPLEST ELEMENTAL LOGICAL ORGANS

I can now go back to the analysis of the idealizations and simplifications found in the description of the nerve's action. As it was indicated previously, the normal output of a neuron is the typical nervous impulse. Different forms of stimulation, including among them, the input of one or more impulses from other neurones, can induce this. Other possible stimulants are the phenomena of the outside world, to which a particular neuron is specifically sensitive (light, sound, pressure, temperature), and physical and chemical internal changes of the body where the neuron is located.

I will start by considering the stimulation way mentioned. In first place, the one produced by other nervous impulses.

I have pointed out before that this mechanism in particular, the stimulation of nervous impulses with suitable combinations of other nervous impulses, makes possible to compare the neuron to the typical active digital organs. If a neuron is touched (through the synapses) by the axons of another two neurons, and its requirement minimum of stimulation (in order to produce an impulse-response) is that of the reception of two simultaneous impulses, then this neuron appears as an organ, in the sense that it realizes the logical operation of conjunction (verbalized by "and"), because it responses only when both stimulants are active simultaneously. But, on the other hand, the requirement minimum is simply

the input of at least one impulse, the neuron acts as if it was an organ of the kind, that is,, realizes the logical operation disjunction (verbalized by "or"), because it responses when it is active any of its stimulants. "and" and "or" are the elemental logical operations. With "no" (the logical operation of negation) they make up a complex set of logical basic operations (the rest of basic operations, no matter its complexity, can be obtained by suitable combination of these). I will analyzed here how the neurons can also simulate the operation "no", or with which tricks can be completely avoided the use of this operation. What has been indicated above should do to make clear what has already been appointed: the neurons turn up as the basic logical organs and, therefore also as the basic digital organs.

## More complex stimulations' criteria

This is, however, a simplification and idealization of the reality. The real neurons are not, generally, organised in such a simple depending on their position in the system.

Some neurons have, of course, only one or two, and in any case, a reduced number, synapses of other neurons in its body. However, the most frequent situation is that the body of the neuron has got synapses with axons of several other neurons. It happens also that, occasionally, some axons of a neuron form synapses in other one. In that way, the possible stimulants have definitions more complicated than the easy schemes and other described previously. If there are many synapses in a nervous cell, the simplest rule of behaviour for it will be response only when being received at least certain number of simultaneous impulses. However, it seems reasonable to suppose that the phenomena could really be even more complicated than that. It can happen that certain combinations of nervous impulses stimulate a certain neuron, not only in virtue of its number but also in virtue of the space relations of the synapses to which they arrive. That is, one may have to face situations in which there is, let's say, hundrends of synapses in the same nervous cell, and the combinations of stimulations that are affective (that generate an im-

pulse of response in the neuron previously mentioned) are featured, not only by its number but also by its location in certain special areas of this neuron (in its body or in its dendrites system), by the space relations among those areas, and even by the geometric and quantitative more complicated.

### THE THRESHOLD

If the criteria of effectiveness are the simplest of those mentioned, that is, the simultaneous presence of a minimum number of stimulants, at this level minimum of stimulation is known as threshold of a neuron. It is usual to talk of stimulation required by a neuron in terms of this criterion, its threshold. We should remember, however, that it is not established at all that the stimulation required should have so simple a character. It can adopt the form of relations much more complex than the simple reach of a threshold (that is, of a number minimum of simultaneous stimulations) as we analyzed previously.

### ACCUMULATION TIME

Apart from these, the properties of a neuron can show other complexities that are not described by the simple relation stimulus-response in terms of typical nervous impulses.

Every time that it has been mentioned simultaneity, that does not mean a perfect simultaneity. In each case there is a finite period of tolerance, a time of of accumulation in such a way that two impulses that arrive within that particular period of time act as if they have been simultaneous. But the reality can be even more complicated than that, the time of accumulation cannot be a well-defined concept. Even after a period of time slightly superior, the previous impulse can still join the next one partially and gradually decreasing; sequences of impulses still further (within certain limits) in time of accumulation, can, according to its length, have an wider effect than the individual; several superimposi-

tions of the phenomena of tiredness and recovery can put a neuron in abnormal situations, in such a way that the features of their responses are different of how they are in normal conditions. Regarding all these matters there are some surveys and empirical observations (more or less incomplete) and all of them indicate that the neuron, taken individually, can be, at least in certain and desirables special situations, a mechanism much more complicated than what the dogmatic description in terms of stimuli and responses can explain following the simple schemes of the elemental logical operations.

## Stimulation's criteria for receivers

In this context I consider necessary to mention a short number of concepts about stimulation of the neurons due to different factors of the output (nervous impulses) of other neurons. As it was analyzed previously, such factors are phenomena of the outside world (the surface del organism) to which the neuron is specifically sensitive (light, sound, pressure, temperature), and also physical and chemical changes in the inside of the organism where the neuron is located. The neurons whose organizational function is to response to the first class of stimulus are called commonly receivers. However, it can be more appropriated to call receivers all the neurons that have the organizational function of response to the stimuli that are not nervous stimulus, and differentiate between the first and the second category of these, being classified as external and internal receivers.

Regarding to all these, turns out again the matter of a criterion of stimulation- a criterion that defines under which circumstances will take place the stimulation of a nervous impulse.

The simplest criterion of stimulation is that can be expressed in terms of threshold, as it has happened in the previous case of the stimulation of a neuron by nervous impulses. That means that the criterion of effectiveness of the stimulation can be enunciated in terms of a minimum intensity of a stimulant agent, that is, an minimum intensity of illumination, of sonic energy contained in certain interval of frequency, of

over expression, of increase of the temperature, respectively, in the case of a outside receiver, or a minimum change in the value of remarkable physical parameter, in the case of an internal receiver.

It must be observed, however, that the criterion of stimulation of the kind threshold is not the only possible. In the optical case for instance, many of the involved neurons response to a change of illumination (in some cases the flow of light to darkness, in other cases the opposite), rather than specific levels of illumination. It can occur that these were not the reactions of a simple neuron but of the resultant of a more complex neuronal system. We do not want to analyze this matter. It serves to see that also in the case of the receivers, the evidence in hand tends to indicate that the criterion of stimulation of the threshold time is not the only one used in the nervous system.

Allow me to use again the typical example mentioned above. It is well known that the optical nerve, some fibers do not response in a certain level of illumination, but only to changes in this level, for instance, in certain fibers it is the flow from the darkness into the light, other times, the flow from the light into the darkness what provokes a response. In other words, it is the rise or fall of the level, that is the value of its derivative and not its value self what constitute the criterion of stimulation.

I consider it suitable now to set out some ideas about the role played by these complexities of the nervous system in its functional structure and its working. On one hand, it is possible to think that these complexities do not play a useful functional role at all. It is more interesting though to indicate that they do play a useful functional role and set out some elements about these possibilities.

It is licit to suppose that in the nervous system, organised essentially in a digital form, the complexities we have referred to have an analogical role or, at least, "mixed". It has been suggested that, using these mechanisms, remote and general electrical effects can have influence the working of the nervous system. It can be that by making certain general electric potentials play an important role and that the system response to solutions of theoretical problems of potential in a general manner, problems that are immediate and elemental than those described, normally,

by the digital criterion, the stimulation criterion, etc. Taking into account that the character of the nervous system is probably all digital, those effects, if exist, will probably interoperate with the digital effects, that is, leading to mixed problem rather than a genuinely analogical one. Several authors have developed speculations in these directions. I will not go deeper in the analysis in specific terms.

It must be said, however, that all the complications of this kind mean in terms of the relation of the basic active organs that we have developed so far, that a nervous cell is more than a simple basic active organ, and that any meaningful effort in order to work out its relations has to recognize it. Obviously, even the criteria of stimulation more complicated have this effect. If the nervous cell is activated by the stimulation of certain combinations of synapses in its body and by others, the relation significant of active basic organs should be presumably an enumeration of synapses rather than nervous cells. If the situation gets more complicated additionally by the appearance of the mixture phenomena we have make reference before, these relations are even more complicated. The necessity of replacing the relation of the nerve cells by a relation of synapses can increase the number of active organs to an order between 10 and 100. This circumstances and similar ones should permanently be taken into account in relation to the accounting of the basic active organs we have referred up to now.

All the complexities we have referred can be irrelevant, but can also provide the system with a partial analogical character, or mixed character. In any case, the number of basic active organs increases, if this number should be calculated with a significant system. This increment can be of an order between 10 and 100.

# The memory's problem in the nervous system

The analysis so far has not taken into account a component whose presence in the nervous system is highly acceptable, if not right —though if were not other reason other than have played a vital role in all the artificial calculators constructed to date— and its meaning is, therefore, probably a matter of principle more than accidental. I refer to the memory. That is why I am going back to the analysis of this component, or better said, subset, of the nervous system.

As I have indicated above, the presence of a memory (or probably several memories) in the nervous system is a matter of hypothesis or postulate, suggested and confirmed by our experienced with the artificial instruments of calculation. That means to admit, from the beginning, that all pronouncements about the nature, structure and localization of this subset, or subsets, are hypothetical. We do not know in which part of the nervous system, considering this as a physical entity, lies the memory. We do not know if it is a separated organ or a collection of specific parts of other organs already known, etc. It could lie in a specific nervous system, that is then related with the genetic mechanism. We are so ignorant of its nature and position as the Greek were, who suspected that the intellect lies in the diaphragm. The only thing that we know is that it should be a memory of big capacity, and would be difficult to understand as an automaton complex as the nervous system could work without it.

## Principles for the estimates of the memory's capacity in the nervous system

I would like to set out now some ideas about the probable capacity of this memory.

In the artificial automaton as the calculators exist habitual methods, widely accepted, of define the capacity of a memory. So we can extend it to the nervous system. A memory can retain a certain maximum quantity of information, and the information can always be transformed in a set of binary digits o bits. To a memory that can store a thousand of decimal numbers of 8 figures, should be assigned a capacity of $1.000 \times 8 \times 3{,}32$ bits, because one decimal digit amounts to approximately $\mathrm{Log}_2$ 10-3,32 bits —the reasons of this method of contabilization have been established in the works about the theory of the information of G. E. Shannon and AAVV. It is evident that 3 decimal digits should amount to about 10 bits, because $2^{10} = 1.024$. The same happens to $10^3$=1.000 (a decimal digit corresponds approximately to 10/3-3,33 bits). In the same way, the capacity of information of a letter of the written alphabet ($2 \times 26 \times 35$, being 2 the possibility of capital or normal letters, 26 the number of the letters of the alphabet and 35 the normal number of punctuation, numeric symbols and intervals —also important in this context—), has to be evaluated as $\mathrm{Log}_2$ 88-6,45. Because of it, for instance, a memory that can store a thousand of those letters has a capacity of $6.450 = 6{,}45 \times 10^3$ bits. In the same order of ideas, capacities of memory that correspond to forms of information more complicated, as geometrical forms (of course, taken with a determined grade of precision and resolution), colour tonalities (with the same assumptions), etc. It can also be expressed in terms of standard unities, or bits. Memories that contain combinations of all these can count with capacities resulting from the calculated in accordance with the previous principles by addition.

## Estimates for the memory's capacity with these stipulations

The capacity of the memory needed by a modern calculator is normally of an order of $10^5$ to $10^6$ bits. The capacities of the memory sup-

posedly needed for the working of the nervous system seemed to be much higher, because the nervous system is, as shown before, an automaton considerably higher than the artificial automata (for instance, the calculator we know). It is difficult to say how much surpass that figure of memory before indicated of $10^5$ to $10^6$. However, it is possible to establish by approximation certain orientative estimates.

The average receiver seems to accept about 14 different digital impressions per second, what amounts to the same number of bits. Considering $10^{10}$ nervous cells and supposing that each of them is, essentially and under normal conditions, a receiver (internal clock internal or outside) we get an input of $14 \times 10^{10}$ bits. With the additional hypothesis (from which there are some evidence) that the nervous system does not forget anything completely —that is, that impressions, once received, can be taken out of the important area of the nervous activity, of the center of attention, but not completely rubbed out— can be made an estimates for the set of an average human life. Supposing that this one will be of 60 years, approximately equal to $2 \times 10^9$ sec., the input over the duration of that life would need, with previous stipulations, a utter capacity of memory of an order of $14 \times 10^{10} \times 2 \times 10^9 = 2{,}2 \times 10^{20}$. This figure is superior to the one $10^5$ or $10^6$ that we have seen as valid for a modern calculator and is not much higher to the differences by excess that we have observed before when talking about the number of respective basic active organs.

## Possible forms of the memory's physical structure

It still exists the problem of the physical constitution of that memory. Dealing with it, different authors have suggested a variety of solutions. They have supposed that the thresholds (or more widely, the criteria of stimulation), of several nervous cells change with the time according to the previous history of the cell. The frequent use of a nervous cell can diminish its threshold; diminish the requirements of its stimulation, and vice versa. If this were right, the memory would lie in the variability of criterion of stimulation. All this is possible but I will not analised it here.

We will reach a even more drastic formulation of the same idea if we suppose that the same connections of the nervous cells, that is, the distribution of the conductive axons, vary with the time. That would mean a possibility of the following situation. It is conceivable that the failure of an axon can make it inactive for further use. On the other hand, a common use (more common that the normal one) can provide a connection that represents a lower threshold (a criterion of stimulation simplified) for this specific way. In this case, again, certain parts of the nervous system would be variable with the time and with its previous history and would represent a memory in and for their self.

Another form of memory that is obviously present, is the genetic part of the body: the chromosomes and its genes that constituted it are clearly elements of memory that due to its state affect, and to some extent determined the working of the system in its whole. There is also the possibility of a genetic system of memory.

There are still other forms of memory; some of them should be taken into consideration. Some features of the chemical composition of certain areas of the body can be self-generating and because of it they can constitute also possible elements of memory. It must be considered, then, that those kind of memory as if they were the genetic system of memory, because the properties self-generating which are in the genes can be located also outside the genes, in the rest of the portions of the cell.

I am not going to go into all these different possibilities and much more that can be considered with the same possibility (or, in many cases, bigger). I would like to confine myself here to say that also without fixing the memory in specific sets of nervous cells, it has been suggested a wide variety of physical structures with different levels of acceptance.

## Analogies with the artificial calculators

To end with, I would like to mention that there are nervous cell's systems that get stimulated among them in different ways and that also constitute memories. They will be memories constituted by active elements (nervous cells). In the technology of our calculators such memo-

ries are commonly used, and in fact, these were the first one to be introduced. With machines of vacuum tubes, this type is represented by the *flips-flops* that are checking each other. The technology of the transistors, as well as almost every other form of electronic high speed technology, allows and induce the use of subsets of the kind *flip-flop*, and these can be used as element of memory in the same way as the *flip-flop* were, in the first machines de estimate with vacuum tubes.

# The constituent elements underlying the memory do not need to be the same that those of the active organs

It must be observed though that previously it is not very probable that the nervous system should use those instruments as the principles means for its requirement of memory; such memories, more characteristically described as "memories constituted by basic organs" are, under any point of view, extremely costly. The technology of the modern calculators began with such devices (the first big calculator with vacuum tubes, the computer ENIAC, used exclusively flip-flop for its primary memory (that is, the quickest and most directly available). However, the ENIAC was of big size (22.0000 vacuum tubes) and had a primary memory really small compared to the nowadays standards (it consisted in some dozen decimal numbers of 10 figures). It is equivalent of something like a few hundred bits, of course less than $10^3$. In the nowadays computers the adequate balance between the size of the machine and its capacity of memory of $10^5$ to $10^6$ bits. This is reached by using forms of memories that are, from a technological perspective, very different to the basic active organs of the machine. A machine of vacuum tubes or transistors can have a memory that lies in a electrostatic system (a tube of catodic rays) or in big sets of nucleus ferromagnetic conveniently disposed, etc. I am not going to try to elaborate a thorough classification, because other important forms of memory, as those of the acoustic delay, the type ferroelectric, the type magnetostrictive (ready that could be increased), do not fit so easily in those classifications. I would like to pinpoint that the components used in the memory can be

completely different of those that constitute the fundament of the basic active organs.

These aspects seem to be very important to understand the structure of the nervous system, and do not seem to be enough explained yet. We know the basic active organ of the nervous system (the nervous cell). All induces to believe that a memory of great capacity is associated with this system. But we must recognise frankly that we do not know the basic components for such memory.

## ANALOGICAL AND DIGITLA PARTS IN THE NERVOUS SYSTEM

We have indicated in the previous chapter, the profound and fundamental wide problems connected with the memory of the nervous system, and we should get further to other themes. However, there is an additional, but secondary aspect of the structure of the memory in the nervous system of which some ideas should be set out, regarding the relations between its analogical and digital parts. Next I will make an additional short analyze but incomplete, and afterwards I will go into matters that are not related to the memory.

The observation that I would like to make is the following: the processes that are developed in the nervous system can, as I have indicated previously, change its character of digital to analogical going back to digital, etc. The nervous impulses, that is, the digital part of the mechanism, can control a particular phase of one of those processes, for instance, the contraction of a specific muscle o the secretion of a certain chemical product. This phenomenon is of the analogical type, but can be the origin of a train of nervous impulses that are due to the sensibility of some suitable internal receivers. When such impulses are being generated, we are again in the digital progression. As it was mentioned previously, such changes from a digital process to one analogical and again to one digital can take turns several times. The nervous impulse of the system, that is digital, coupled with the chemical changes or mechanical dislocations due to muscles contractions, that are of the analogical type, can take turns one to another, provide a mixed character to any process.

### Genetic mechanism's role in the previous context

In this context though, the genetic phenomenon plays a typical role. The genes self are clearly part of a digital system of components. Its effects, however, consist on the stimulation of the formation of specific chemical products, of certain enzymes, that are characteristic of the gene implicated and therefore it is an element of a wider branch than the one I have mentioned before in a more general way.

# The codes and their role in the working's control of a machine

Regarding other aspects different from those of the memory, we get to some principles of organization of logical orders that are of a considerable importance in the working of any complex automaton. A system of logical instructions that can be followed by an automaton and that allows it to make some tasks organised, are called codes. By saying logical orders I mean elements such as nervous impulses that appear in the axons in a logical digital system, as the nervous system, to work in a "replying and teleological" way.

## The concept of complete code

As we are talking of codes, it is especially important to make the following distinction. A code can be complete, using the terminology of the nervous impulses, can be specified the sequence of the impulses and the axons in which they appear. This will define completely a specific behaviour of the nervous system, or staying by the previous comparison, of the respective artificial automata. In the calculators, such complete codes are sets of orders given with all the necessary specifications. If the machine has to solve a specific problem by the calculation, will have to be controlled by a complete code in the exposed sense. The use of the modern machines of calc is based in the capacity of the technician to develop and draw up the complete code necessary to allow the machine to solve any problem.

## The concept of reduced code

In contrast to the complete codes there is another category of codes called shorten codes or reduced, based in the following idea:

The English teacher of logical A.M. Turing demonstrated in 1937 (and several experts in calculators have put it into practice sine then in different ways) that it is possible to develop systems of codes of instructions for calculators, able to achieve that this one will behave as if it were another specific machine. Those systems of instructions that get a machine to imitate the behaviour of another, are denominated reduced codes. Allow me to go deeper in the typical matter of use and development of such reduced codes.

A calculator is controlled, as I have indicated previously, by codes, sequencies of symbols (usually binary symbols) that is, by chains of bits. In any set of instructions that govern the use of a calculator should be make clear which chains of bits are orders and the result the machine will achieve through these.

These "significative" chains of bits do not have to be the same for two different machines, and anyway, their respective effects on the operative part of the machines can be entirely utterly different. If you provide a machine with a set of orders that are peculiar of other machine, these will probably lack in sense, at least in part, that is, chains of bits heterogeneous respect the first of the machines, will allow this to execute actions that are not part of the plan organised in order to obtain the solution of a problem: talking in general terms, they will not make a machine to behave in accordance with the consecution of a purpose in the track to a solution of a specific problem.

## The function of the reduced code

A code that, in accordance with the scheme of Turing, will be designed to make a machine work as if it were another machine (that is, imitate it), should realize the following actions: contain instructions, in intelligible terms for the machine (more detailed parts of the code) that

make this examined each of the orders that receive and determine if such order has an appropriated structure of the orders of the second one; it has to hold as well, in terms of the orders' system of the first machine, enough orders to make the machine develop the appropriated actions that the second machine would have adopted under the influenced of the order self.

The results of Turing are important because allow a machine to imitate the behaviour of any other thing. The structure of the orders can be completely different to that of the first machine, the one truly implicated. In this way, the structure of the orders we are referring to can handle orders much more complicated than those characteristic of the first one: each one of these orders of the second machine can mean the execution of several operations of the first machine. It can include complicated and interactive processes, multiple actions of any kind; in general terms, anything that the first machine can do in a period of time, under control of all possible systems of orders, can be done if only elemental actions (primitives orders, basic, simple) are implicated.

The reason for calling reduced code to such a secondary code is historical: those reduced codes were studied as a help for the development of codes and they were the result of the desire of codification for machines whose natural system self of orders was large, taking them as if were different, with a orders' system more convenient and developed, which allows an easier codification, less circumstantial and more direct.

## THE LOGICAL STRUCTURE OF THE NERVOUS SYSTEM

Reaching this point we would better reorientate the analysis to other set of matters. These are not, as I indicate, related with the problems of the memory or with the matters relative to the complete and reduced codes we have just handled. These are related with the different roles of the logical and arithmetic in the working of any complex automaton and specifically of the nervous system.

## Importance of the numerical procedure

An important matter to take into consideration here is the following: any artificial automaton that has been built in order to solve problems set out by humans and to control the complex processes, has got a purely logical part and an arithmetic part, that is, a part in which the arithmetic processes do not have any role and other in which these are specially important. This is due to our habits of thought and communication and their difficulties to express a situation taken without resort to formulas and figures.

An automaton that should control problems of similar characteristics —perseverance of a temperature, or of certain pressures, or of chemical states in the human body— will have the need of these tasks being defined in terms of equalities and numerical inequalities in hands of the human annalist that execute them.

## Interaction of the procedures numerical with the logical

Without any doubt there are parts of this task that can be formulated without reference to the numerical relations, that is, in pure logical terms. Certain qualitative principles that implied physiological or non-physiological responses can be done without resort to the figures, simply by finding out qualitatively the combinations of circumstances under which certain events will take place and the combinations where events will not be desirables.

## Reasons that induce to high precision's demands

These observations show that the nervous system, when considered as an automaton, should have both a arithmetic part and a logical part and the needs of arithmetic are as important as the logical ones. That means that we are again talking about a calculator in the strict sense and it seems appropriate an analysis in terms of the familiar concepts in the theory of the calculators.

Once we have seen this, arise a question. When can be considered the nervous system as a calculator and how much precision is expected from the arithmetic part?

This matter is crucial for the following reason: all the experience with calculators indicates that if they have to develop arithmetic tasks so complicated as those developed by the nervous system, should have enough resources in order to reach high levels of precision. The calculations will probably be complex and among them errors may appear and accumulate and the ones committed in the first stages of the calculation are amplified in the last steps of this. That is why a considerable higher precision than the physical nature of the problem might have demanded.

We can presume that the arithmetic part of the nervous system exists and when we consider it as a calculator, it must operate with a considerable precision. In the artificial calculators we are familiar with and, under the circumstances of complexity we have mentioned, it would not be an exaggeration to consider precisions of 10 to 12 decimals.

## NO DIGITAL BUT STATISTICAL'S NATURE OF THE EMPLOYED NOTES

As it was explained above, we know partially how the nervous system transmits numerical data. It does through periodical or almost periodical trains of impulses. An intense impulse on a receiver will make this to response soon after to get above the limit of absolute refrectiveness. A weaker stimulus will make the receiver response also in a periodical or almost periodical way, but with a frequency a bit lower, as now it will have to rise above not only the limit of absolute refrectiveness but also a limit of a certain relative refrectiveness, before any of the responses will be possible. Consequently, the intensities of quantitative impulses are translated in trains of periodical and almost periodical impulses being always the frequency a monotonous function of the intensity of the stimuli. That is how of a system of generating signals of modulated frequency: the intensities are translated into frequencies.

This case has been observed directly in the case of certain fibers of

the optical nerve and also in nerves that transmit the relative information to pressures.

It is important to point that the frequency is not directly the same to any intensity of stimuli, but it is rather a monotonous function of this. It allows the introducing of any kind of effects of scale y expressions of precision in terms that depend on the scales to which these stimuli occur.

It must be said that the frequencies are within usually between 50 and 200 impulses per second.

It seems clear that under these circumstances, precisions as the mentioned previously (of 10 or 12 decimals) are completely out of question. The nervous system is a calculator that realize its complicated tasks with a level of precision rather low: In accordance with the previously said, only levels of precision of an order of 2 or 3 decimals are possible. This fact should be pinpoint once and again because none of the calculator known can operate reliable and significantly with such level of precision.

It should be point another fact. The described system leads, not only to a low level of precision but also to a level of rather high reliability. Of course, it is clear that if in a scheme of the described type a simple impulse is lost, or several, or these are included in a unnecessary or wrong way, the relevant frequency, that is, the meaning of the message, do not distort in a essential way.

It comes up now a question that needs to be answered: which are the essential interferences about the arithmetic and logical structure of the calculator represented by the nervous system that can be drawn of these observations apparently without sense?

## Arithmetical deterioration: role of the logical and arithmetical depth

For anyone who has studied the deterioration of the precision in a long process of calculation, the answer is clear. The deterioration is due to the accumulation of errors on superimposition and even to the amplification of the errors done before in the calculation, this is, due to the

considerable number of arithmetic operations that have to be done in mass, in other words, to the "arithmetical depth" of the scheme.

The fact that there are many operations to be done in sequences, of course, a feature both of the logical structure and of the arithmetic structure. For that reason, it seems correct to say that all these phenomena of lost of precision are due to the big "arithmetical depth" of the scheme that is being analyzed here.

## Arithmetical precision or logical reliability as alternatives

It should also be considered that the message's system used in the nervous system is essentially "statistical". In other words, what matters is not the precise position of definite marks, o digits, but the features statistical of its taking place, that is, the frequencies of trains of periodical or almost periodical nervous impulses, etc.

The nervous system seems to use a system of notations completely different to that sounds familiar to us in the field of ordinary arithmetic and mathematics: instead of the precise system of marks where the position (and presence or absence) of each marks has an decisive influence in the determination of the meaning of the message, we have a system of notations in which the meaning is transmitted by the statistical properties of the message. We have seen how all these leads to a lower level of arithmetic precision, but to a higher level of logical reliability. An arithmetic deterioration has been compensated by an improvement in the logical.

## Other statistical features of messages' system that can be used

This frame of reference induces clearly to answer one further question. As we have seen, the frequencies of certain periodical or almost periodical trains of impulses, carried messages, that is, information. These were the statistical features of the message: Are other statistical properties that can contribute in a similar way as means of transmission of the information?

Up to now, the only feature of the message that has be used for the transmission of information is its frequency in terms of impulses per sec, in the sense of the message being a train of periodical or almost periodical impulses.

Other features of the message (statistical) could clearly been used: the frequency we have referred to is a feature of a train of simple impulses, whereas each notable nerve consists in a high number of fibers, each of them transmitting several trains of impulses. Because of it, it is perfectly reasonable assume that certain relations (of the statistical type) among those trains of impulses can also transmit information. To this matter is logical to think in different sorts of coefficients of correlation.

# The brain language and not the mathematical language

Going further with this subject leads us necessarily to language matters. As we have indicated, the nervous system is based in two types of communication: that which does not imply arithmetical formulations and that which does it, that is, communications of orders (of logical type) and communications of figures (of arithmetical type). The first one can be described properly as a language; the latter goes directly in the field of mathematics.

We must be aware that the language is, to a great extent, an historical accident. The basic human languages are transmitted traditionally in different ways, but its big variety proves that they do not have anything absolute and necessary in them. Languages such as Greek or Sanskrit are historical realities and not logical necessities. That is why it seems reasonable to assume that the logical and the mathematics are, both of them, accidental historic forms of expressions. They can have essential variability, that is, they can exist in other forms of those to which we are used. Of course, the nature of the central nervous system and the messages that transmits shows that it is positively so. We have evidence enough to realize that any message that the central nervous system uses, is featured by a logical and arithmetical depth lower than the usual. We will consider the following example. The retina of the human eye makes a considerable reorganization of the visual imagine detected. This reorganization takes place in the retina, or more precisely speaking, in the input point of the optic nervous through three consecutive synapses, that

is, three logical consecutive steps. The statistical character of the messages system used in the arithmetic of the current nervous system and its low precision indicates that the degeneration of the precision cannot go too far in the relevant system of message.

Consequently exist here logical structures different to those we use usually in the logic and the mathematics. As we have indicated before these are characterised by a lower logical and mathematical depth of that we are familiar with. The logic and the mathematics in the central nervous system, when considered as languages, should be structurally different to those languages our normal experience refers to.

It must be said that the language we are talking of can correspond to a reduced code, in strictly sense, more than a cc: when we express ourselves mathematically, we can be analyzing a secondary language made through the primary language, used by the central nervous system. The external forms of our mathematics are not relevant absolutely to evaluate which is the mathematical language or logical language used be the central nervous system. However, the previous observations about the logical and arithmetical reliability and depth, show that no matter how the system is configured it cannot differ considerably of what is consciously and explicitly consider as mathematics.

## A COMPARISON BETWEEN THE BRAIN AND DIGITAL'S COMPUTERS

Brains and computers perform tasks completely different and so they are their features. In the human brain there are more neurons than the amount of bits in a typical computer station. It could be anticipated that this situation will not last long, because while the human brain evolves very slowly, the memory of the computers raises with high speed. Anyway, the difference in the capacity of storage is lower compared to the difference in commutation's and parallelism's speed. The chips of a computer perform an order in dozen of nanoseconds, whereas the neurons need milliseconds to get activated. The brain is still superior to this, since all the neurons and the synapses are simultaneously in activity, whereas the average computers count only with one or few CPU. In a neuron's net

that works through a mass computer, hundreds of cycles are needed in order to decide if a unity similar to a neuron will get activated, while in a real brain, all the neurons do it just in one step. That is, also if the computer is a million times quicker in speed clear of commutation, the brain is dozen of thousand of million times quicker in what it does. One of the attractions of the method in the neuronal nets is the interest in created a device that can combine the parallelism of the brain with the speed of commutation of the computer. The growth of the hardware in total scale will depend on the design of the family of algorithms for the neuronal net that will serve as foundation for a long-term inversion.

The brain is able to make a complex task (for instance, to recognise a face in less than a second, hardly time enough to complete a few hundred of cycles). A computer connected in sequence needs dozen of hundred of millions of cycles in order to do the same, and not so well. It is evident that here lies an opportunity of an enormous parallelism. The neuronal' nets can serve as model for a big amount of calculation parallel, more satisfactory as the method of setting in parallel algorithms in sequences.

The brain is more tolerant with the flaws than with the computers. An error of hardware, such as that one bit alone overlooked could provoke the ruin of a whole calculation, whereas there are neurons that die at the same time without any adverse effect in the global working of the brain. Although it is true that there are certain illnesses and traumatisms that can affect the brain, in general, this can manage to work from seventy or eighty years without changing a memory card, calling the assistance service o request a restart. Besides, the brain faces constantly new entries and knows how to deal with them. The programs of computers rarely manage to work properly with a new entry, unless the programmer had been exceptionally careful. The third reason for the neuronal nets to be attractive is their gradual degradation: its tendency to a gradual decrease in its performance gets worse with the worsening of the conditions.

Lastly, the interest of the neuronal nets lies in the fact that they were designed for an inductive apprenticeship. (Contrary to the opinion created by the massive media, of course, the neuronal nets are far from being the only systems of artificial intelligence that are able of apprenticeship.) Once initiated the net, it can be modify in order to improvement its effi-

ciency in the pair entry/exit. If we can give efficiency and generality to the algorithms of apprenticeship the value of the neuronal nets as psychological models will raise and turn them into useful for the creation of a diversity of applications of high output.

Comparison between the general calculation of the computers in 1994 and those of a human brain:

| | **Computer** | **Brain** |
|---|---|---|
| Calculation unities | 1 CPU, $10^5$ gates | $10^{11}$ neurons |
| Storage unity | $10^9$ bits RAM, $10^{11}$ neurons | $10^{10}$ bits on disc $10^{14}$ sin |
| Time cycle | $10^8$ sec. | $10^3$ sec. |
| Bandwidth | $10^9$ bits/sec | $10^{14}$ bits/sec |
| Updating/sec. of neurons | $10^5$ | $10^{14}$ |

## THE WORKING OF THE BRAIN

It is still a secret for the science the exact way the brain generates thought. We know that the neuron, o nervous cell is the basic functional unity of the tissues of the nervous system, included the brain.

The body of the cell forms the neurons, or some, where the nucleus of the cell stays. From the body de la cell appears ramifications of different fibers known as dendrites and also a longer cell called axon. The dendrites ramify weaving a tupid net which surrounds the cell whereas the axon spreads a stretch. This joint is known as synapses.

The signals are spread from one neuron to another by a complicated electrochemical reaction. The synapses liberated chemical substances of transmition that go into the dendrite. This provokes a rise or fall on the electrical potential of the body of the cell. Once this electrical potential rises above certain limit, an electrical impulse or actions potential is sent

to the axon. The impulse spreads through the branches of the axon and finally arrives to the synapses and liberates transmitters in the bodies of other cells. The synapses that increase the potential are known as exciters, and those that reduce it inhibiting. Maybe the most important discovery is that the synaptic connections have plasticity: long term disruptions with the same intensity as the connections as response to the pattern of stimulation. The neurons establish also new connections with other neurons. It is consider that the previous mechanisms set up the foundation of apprenticeship in the brain.

The vast majority of this information's procedure takes place in the cerebral cortex. What is really surprising is that a set of of simple cells can produce thought, actions and conscience. In the brain is the origin of the thought. The apprenticeship in the neuronal nets is where one can see how the complex nets formed by simple elements of calculation trains, what serves to understand the way the brain works.

## THE COMPUTER

The computer is a machine that, with speed and accuracy, can perform logical operations; through these logical operations, the machine is able to take decisions, taking into account the results of calculation. An electronic brain can solve any mathematical problem. The essential feature of these machines is their high speed of calculation, that makes possible the resolution of very difficult problems taking just very little time. The time implied in any of these operations can be of a few microseconds.

There are two sorts of calculators: digital and analogical. The first one carries out arithmetic operations with numbers represented by several digits in a certain system of numeration. The commonest systems are the binary and the decimal. Each binary digit has two possible values, 0 and 1, that are represented in the interior of the machine by the absence or presence of an electronic impulse, magnetization of a sense or the opposite one, etc. The analogies to carries out the calculations, uses physical magnitudes that are generally tensions. The activity of an

electronic brain is purely automatic: does not think and cannot solve but those problems that the human being sets out. Its use is extraordinary. Thanks to it many problems could be solved, that before its construction were impossible to solve. They have application in every branch of the science, administration, bank companies, etc.

For a machine is necessary a construction of programs to solve a problem, where the necessary operations are detailed, one by one: these operations take place through instructions the machine understands, and each of them provokes an arithmetic or logical operation when it obeys. These instructions are suministrated to the machine by a unity of reading. Such instructions and the numerical data needed should be folded in the machine, in a part called memory.

In order to follow the instructions and its interpretation stored in the memory is necessary a unity of control that analyzed each instruction, doing afterwards an arithmetic unity. In this way it can carries out the indicated operations. Finally a unity of exit is in charge of taking out the obtained results.

*Periphery devices*. We can classify them in devices of input, devices of output and devices of storage de data.

*Input devices*. Among the most useful are the keyboard, the mouse, the optical scanner and the graphic splint. The keyboard is similar to that of a typewriter, with additional keys needed for the cursor of the screen to be moved, to introduce numerical data and execute special functions. The mouse is a device with a ball in its lower part, that when moved on a surface causes the movement of a pointer on the screen. The mouse allows to trace geometrical figures or to select any option the program offers.

## THE BRAIN

It is one of the nervous centers that make up the encephalon, that in the human being and in many mammals are located in front and above

the cerebellum. It is the most sizeable mass of the encephalon, with an average weight of 1200 grams in the human being. It is formed by two hemispheres separated by a deep interhemispherical fissure and joint in its base by the so-called calluses body. The surface of the hemispheres is very wrinkled and the most developed species in the animal scale, with developed cerebral functions are the ones that have the most wrinkled ones. Some of the wrinkles are permanent as the groove of Roland, of Silvio, etc., that divide the brain in lobes, that shows other folds, not always permanent, that determine the so called cerebral convolutions. It is made up by a grey substance on the periphery formed fundamentally by neurons, and a central white substance, with fibers and bundles of nervous. In its interior shows 4 cavities o ventricles that communicate with the ependimo, the central canal of the medulla. The whole brain is irrigated by two internal carotid arteries and two vertebral, that give about 750 ml of blood per minute. The respiratory activity is very intense and constant, and a defect of blood flow of about ten seconds can cause a paralysis of its functions of fatal consequences. The brain is surrounded by the meanings that separate it from the cranium. The study of the brain injuries and disorders that cause, as well as the removal of encephalic sections in simians, has allowed the location of the brain functions in the so called brain's centers or locations, engine centers, association's centers and ideation or intellectual centers, where the upper intellectual functions are carried out.

The computer or artificial brain can exist as a binary construction located in its memory and made by the man. Imitates typical behaviours of the natural brain.

The computer is made of metal and silica, of solid matter, whereas the brain is of humid matter, as it contains water. But both have in common that they work with electricity, electric current, and the software. It is the main thing and the most important to process the information.

The unity of the brain is the neuron and that of the computer is the transistor. The water is a part of the white and grey matter of the brain. But the water does is not a part of the composition of the computer. We can also name them: dry artificial brain and humid natural brain.

Features of both brains:

— The brain grows. Since its formation up to the adult age.
— The brain reproduces at the same time as man does.
— The brain is autonomous. It is selfprogrammed.
— The brain regulates and responses to the stimuli which surrounded it.
— The brain needs nutrients (blood) and a contribution of energy.
— The computer does not grow alone, but with the help of the man who has made it.
— The computer cannot reproduce itself. It has to be done by man.
— The computer is not autonomous. It has to be programmed by man.
— The computer do not regulate or response to the stimuli of its surroundings. It has to be the man the one to do it.
— The computer does neither need nutrients (nourishment) nor contribution de energy.

We have seen that the support or hardware is different; in the computer the support is made of metal and silica, it is stiff; in the brain the hardware is of white and grey matter. In the first one the matter is dry and in the second one is soft, humid. But, however, the software is the same for both of them, it is the electricity, the electrical current. Both in the integrated circuits and in the neurons flows the electricity. In the first one the unity is the transistor and in the second one is the neuron.

Now it is time to compare the computer to the Universe. The man has thought, invented and set up the computer as help in the intellectual work, so as to put order in it and control it. The Universe made the same with the brain: it created as a help to organize the world that makes part of the Universe and to put order in it. The man is the in charged of taking care of the flora and fauna and of the whole world.

The computer is a product of the man and the brain is of the Universe. The latter is more powerful, has more means and more information than the man has, therefore its product is even more perfect. But the man tries day by day to imitate, to copy the brain, he analyze it, he investigate of it, till it will be no mystery for him. He has founded the

IBRO, an International Organization for the Investigation of the Brain, in order to go deeper in the investigation of the brain. With the construction of the artificial neuronal nets the man is trying to imitate the working of the brain.

The computer progress each year, the man discovers new integrated circuits smaller every time, more reduced chips, till he will get a perfect copy of the brain. The natural language gets to perfection, the artificial vision, etc.

## Relation of the computer with the brain and the earth

*Structure of the computer*. The system that is used by the computer is the binary. It is the simplest, the best and the most economical. The rest are more complex and more complicated; the machine uses the binary code because the electricity is positive and negative. The magnetism is also positive and negative.

*Structure of the computer*. As we already know the structure of the computer can be applied to the brain. Therefore, the structure has to be the same or similar to that of the computer. Although the matter it is made different. The brain is made of neurons and the computer of integrated circuits. However, the use the same binary code, because it is the best and the quickest and also uses the electricity as the computer. The form the brain has is symmetric as that of a magnet. In each hemisphere or lobe of the brain there is a pole positive and on the other hemisphere a pole negative that are due to process all the information that is received from the senses.

*Structure of the Earth*. We can also apply the computer's structure to the earth, since all the computers are equal or similar. The earth gets the information from the sun (light and heat), this information is processed by the two focus of the ellipse: a focus do as positive pole and the other as the negative counterpart. Both focus make up the central computer, and restart from the received and processed information to the rest of the

terminals, which are plants, trees, animals, the man and the minerals, because they made up and break down with the influx of the solar rays. That can explain why where there is not much sun, there are more preservation of the matters, they received few solar information. The North and South Pole get little solar information (light and heat): there is no processing of the information, because they do not get it. Or at least it is scarce. However, in the equator the information is maximal (light and heat): there is life, vegetation. The orb has two Centers, Focus or Poles, as it has an elliptical shape. It is a huge magnet, that works as a Supreme Computer, processing the information that gets from the Sun. That information is needed to give life, movement and evolution to the earth. The planet tends to perfection, that is, to the acquisition of the maximum information.

*Structure of the brain*. If the brain is observed, we can see that has a similar shape as the magnet: the incision hemisphere is the neutral zone that serves of joint of the brain hemisphere. Each hemisphere is a pole. The right hemisphere is the positive and the left one the negative. The central computer is the one that processes the information received by the senses, sending its decisions to the terminals or periferical through the nerves that move the muscles, that hands and the feet, etc.

*Structure of our Planet*. Looking at our Planet, we realise that the shape is similar to that of the brain: the incision amounts to the imaginary axis where the neutral zone is, and the two hemispheres of earth have the same function than the two brains hemisphere. They form a central computer.

# Comparison between the computer and the Universe

The Universe is the space that contains the matter and the energy, that is, container y content. Container is the space and the content is the matter and energy. But the container is not completely empty of matter and energy, nor is it full of matter and energy. It is half empty and half full of matter and energy. It is in accordance with the binary system: 0 y 1. The 0 is the empty space and the 1 is the matter and energy. In that way, the Universe is a computer in itself, which means that it is actually the Universal Computer. Following the principle that the information is not created and is not destroyed, is just preserved.

The information gets conserved thanks to the code where is stored. Therefore, the Big Bang was the universal code that is still developing itself. When its process and evolution will finish again se set up the universal code, that is the Big Bang, that is the beginning, the birth of the galaxies and the evolution of the Universe. When the program will end, when the stored information in this universal code will end, when the evolution of the Universe will end, then this will contract and the information will be concentrated. Once all the universal information will be concentrated, the Big Bang will come again, and so on forever, because it did not have a beginning and it will not have an end, because it is a cyclic, it does not have a beginning and an end, with the information going through different steps and followed the phenomena, chaining indefinitely. In the Universe everything works in cycles. So does the mineral reign as well as the vegetal and the animal. In the mineral reign, for

instance, the cycle of water changes in shape and goes through different steps: plasma, gaseous, liquid and solid, but the information it is preserved, it is always water. In the vegetal and animal reign through the seed and ovule it is done.

## The Universe

It is the set of bodies and other body that are in the space. Or better said, a set of all the things, facts, relations and energies susceptible of being observed and described objectively. The cosmology deals with its origin and its formation, that for centuries, has been exclusively theological and only recently it has been considered as a science. The idea about the dimension of the universe has changed lately. For hundred of years it has been thought that the solar system occupied the best part of the Universe and that the stars were only little lights located in a vault not too far away. After the work of Galileo, Newton and Kepler it was known that the Universe was much bigger and that the sun was only a star similar to the rest of the ones in the Milky Way. The modern telescopes and radiotelescopes have allowed to discover that neither the milky way covers all the Universe but it is only a galaxy of a group of 14, which is called local galactic system and at the same time, this group of galaxies, joint by the mutual gravitatory attraction, within a radio of five millions of light years, it is not more than one of the among several hundreds of similar systems. In modern times, all the known galaxies have been catalogued and numbered, in order to avoid confusions. It is supposed that the galaxies evolve from a very concentrated state of globular masses, of stars, up to spiral shapes every time more open and the galaxies are getting apart one from another at higher speed the more far away they are. This suggested that the Universe is is in expansion to unknown limits. The constant separation of the galaxies means a delay of some 150 km/sec in the arrival of the light that emit every 5 million of light years that get away. That is why the galaxies that may be at 10.000 millions of light years are getting away from us at a light speed and we will never received them.

The comparison of the computer and the universe is similar to the one of the computer with the brain. This latter is a model of the universe, that is, it works equally, it is its representation.

If we see the brain like a universe in miniature, then we will find it easier to establish such comparison.

The brain gets information through the senses, process it and keeps it in its memory. The universe and for example planet earth, gets information from the sun (light and heat) to its surface, it processes it (the photosynthesis) and this information is kept in the earth for its development and evolution (the earth is its memory).

The universe is the computer par excellence. It is processing without stop but for the night that has a rest in one half of the surface and works in the other half, and so on alternatively.

The universe is infinite, has no limits. It has no a central point because any galaxy can be considered as the center.

The thought of the universe as a computer was introduced between 1930 and beginning of the 1970, when a branch of the science, the biochemistry, proved that the matter of the organic matter is a matter that is in process.

The biochemists started to deal with the organic matter as if it were codified information; they needed more and more techniques of the theory of the information to decipher the genetic codes. It was an attractive idea to think that the universe could be as simple as a system of data processing. If this was right, we should stop talking about matter and energy as the physical fundaments of the universe and start to consider them as data and data processing.

## PHYSICS

The physicists had something missing although they had something called the Planck constant, an action unity that they were not able to explain. This was the main pillar in the construction of the universe. It is universal constant whose value is $h = 6{,}6 \times 10^{-27}$ erg/sec = $6{,}6 \times 10^{-34}$ jul/sec.

It was in 1965 when it was mathematically demonstrated that the constant of Planck was the "unity of definitive information" of the cosmic binary numbers. That was the last discovery that was missing. The universe is information's construction.

The whole Universe, even all the shapes of matter and thought, form a whole virtually undistinguishable to a computer, and all its actions are as an intelligent process of data. That is the reason why we describe it as an intelligent Universe.

The main idea is that the Universe in its whole is simply a grand brain. It seems obvious to say that the natural radiations of the light through the atmosphere are very similar to those created by the man in the media, radio or television, as both belong to the same electromagnetic spectrum, and the only real difference is that the light vibrates quicker than the waves of the radio. If we start from the idea that the Universe's energy is formed in a 99% by cosmic radiations among others, and that man has used the radiations to transmit data, it would be probable that the cosmic radiations were some sort of data transmission. The solid matter is intrinsically a datum.

### CHEMISTRY

If we have a look to the inorganic chemistry we will find a parallel situation, as each of the more than hundred chemical elements has assigned an amount of electrons in its orbit, and an amount of protons and neutrons in its nucleus, and this information is nothing but a simple number of a code. I can describe an element as nitrogen but I can also call it 14, its atomic weight.

But the interesting thing is that these specific numbers are the result of some patterns of electric waves (quantum theory) and each molecule has a different but singular pattern of waves, a specific code, and specific data.

### BIOCHEMISTRY

The biochemist has no choice but to deal with his particular chemistry as an encrypted code and become a decipherer of codes. The ad-

vance of the biochemistry in the last years has let behind the old ideas of thinking that in the genes of the chromosomes reigned the creation of the creatures' structure. The new discoveries in the chemical analysis proved that the small gee was not of importance but the compound chemical it was made of, and particularly, some molecules known as the nucleic acid (DNA). These chemical compounds are not different from others that are dead but for the nature of its atom's model. This is virtually the life's program and contains all the information for the growing of life, the maintenance of the health and the differentiation of every species, from the grass till the man. But this is only possible if the dead molecules of the DNA are truly data and nothing but data. We know now that in the biochemical field the data of the dead matter can be the difference between an elephant and a giraffe.

For a biochemical the result of this should be to deal with the nucleic acids as complex data and use the information's theory to decipher the code.

## COMPUTING

The computer produces new data by an interaction between the electronic language (the program) and others such as the memory.

This is exactly what happens in chemistry, an acid is the program for the salt. This is also what happens in the nature where an acorn is the program for an oak.

It is evident that the DNA should be used as well as programmer system for the orderly reply of every cell. It must be specified not only which molecules of proteins se synthesis, but also how many and in which sequence. The DNA should also determine the three-dimensional configuration of each protein, as well as its specific biological activity. The DNA should also program the ensemble of the specific proteins' molecules in organised associations or supramoleculars complexes, such as multienzimatic, membranes and ribosomes. Last but not least the DNA should lead the formation of the organs, cells and guide its ensemble in order to form the complete cell. Going even further, the DNA should decide if a cell has to be nervous one or a renal cell.

We still do not know the details of all these events directed by the DNA in each sort of cell. However, two basic principles underlying the development of the cell structure have come up.

All these information should suggest that the natural process of the Universe is almost the data process that takes place within a computer, and the following table shows their correspondence.

| Electronic computers | The Universe |
|---|---|
| 1. *Data*. The structure of the knowledge in a computer "data" are always in the electronic form, that is the code and is built with identical and definite numbers (simple and definitive features). | The structure of the physical matter is specified in the elemental particles such as electrons, neutrons, etc, and the most trifling features of the different types of matter correspond to different electric models. |
| 2. *Data processing*. The conversion of the data through the processing of data takes place by the imposition of a sort of electronic language (the program) in the storage of computer data (memory of data) that are electronic as well, and the result of this process is a new electric pattern. This leads us to say that the data process in a computer is nothing more than a mass of transformations of electronic patterns. | The transformations of the physical matter are called "chemistry" and this takes place through the transformations of the electronic models related with the orbits of the electrons which surround the nucleus of the atom. In this way the chemistry in the nature can be considered as a natural data process. |
| 3. *Data program*. The data in a computer exist at two levels, as data programs and as memory of data. The programs of data are in a higher level of power and effectiveness than the memory of data because the programs can charge memory but the memory can not charge programs. This difference will be called "intelligence" later on, as potential and will when is effective in the process of data. | In the physical Universe there are evidences that show that in the chemical processes there are substances that are at a higher level (of programming). An acorn is a program of an oak and can be considered more intelligent than the datum of the tree is made of water and carbon dioxide. In a lower level we can say that the DNA can be considered the program for the acorn self and therefore the DNA stays in a higher level of intelligence. |

| Electronic computers | The Universe |
|---|---|
| 4. *Letters and words*. In a computer we establish a pattern of electric charges (binary numbers) that can have a deciphered meaning. This will be easier for the letter C than for the word house. In its own way, a language with its grammar is created with these electronic patterns. | Dealing with a physical world, the language of the letters and words established by the different chemical elements, where the elements are the letters and the compounds are the words. The nature seems to have two alphabets: one of more than a hundred letters which correspond to the more than hundred chemical elements for the construction of the words of the inorganic chemistry, and a small alphabet which uses the letters: "hydrogen", "carbon", "nitrogen" and "oxygen" for the words of the organic chemistry where we can differentiate an elephant from a giraffe. |
| 5. *Transmission of data*. The transmission of data takes place through the movement of electric waves, which allows us to move data from one place to another. | The transmission of data in the nature takes place through the electromagnetic equivalent of the waves that we know, such as the light, X rays, cosmic rays and other varieties of radiation. |

Considering all together, we see that there is a close correspondence between the computer working and that of the universe. This will serve us later on to describe it as the Universe of data or, due to the existence of different levels of programming of data in the Universe that we will see further on, the intelligent Universe.

# Replacement of energy's data as the original matter of the Universe

The physicists consider generally the energy as a basic product of the Universe, that is ordered in different mathematical formula that we call Nature Laws.

The hypothesis of the Intelligent Universe shows this fact of the organization of the matter by the description of data. What is more, these data could be considered objectively current and not a mere abstraction of ideas built up by a human observer. Therefore, in the origin of the objective reality are the objective data. This statement can be compared to the religious expression: "at the beginning was the Verb". Taken this into consideration, it can be said that the Universe is a construction of cosmic letters, cosmic words and cosmic thought. That is the reason why Professor Eddington was right by saying in 1927: We have started to think that all the matter in the world is thinking matter. There is nothing else."

The idea of the Universe as "thoughtful matter" was proposed for the first time by sir Arthur Eddington in his book "The Nature of the Physical World", after the Second World War.

But two important discoveries in the field of biochemistry have led to consider the nucleic acids as a complex information where appropriated techniques can be used. There is also a parallelism between the working of the chemistry and that of a computer. If the man uses radiations as the radio and television, which serve only for the transmission of data, the astonishing idea that the Universe is basically a phenomenon

of cosmic radiations is possible, because the cosmic radiations can be essentially some sort of data transmission.

## A FEEBLE LIGHT IN THE OBSCURE WORLD: MOLECULAR BIOLOGY AND CYBERNETICS

But there is still one ray of light alone in the darkness of the modern science and arise by the new coming of the molecular biology and cybernetics.

### Definitions

*Molecular biology*. It is the study of the disposition of the molecules in the genes, what indicates that the organic matter is biological information.

*Computer*. It is the science that handles the information with computers. The science of control.

I will not get much deeper into details of the extraordinary possibility of the two subjects mentioned above. I would like to say though that there has been so much progress so as to take into account that soon we will be able to transform elephants in giraffes.

The appropriate religion of a scientist has gone through the following steps:

1. God as engineer (up to 1900).
2. God as mathematic (1900 to 1930).
3. God as a magician (1930 to 1965).

Now it seems as if we had to change our stance and say:

4. God as a merchant of software that programs the hardware of the Universe.

No matter how strange it might sound, this corresponds to some extent to the information above, as: Engineering + Mathematics = the magic of computers.

Does it mean that maybe we are reaching a time where a philosophy has been discovered that can be stable for some time?

## THE SOLUTION MUST BE FANTASTIC!

I have always been interested in finding a philosophy based in the science, and for more or less thirty years I have observed several scientific mysteries discovered before and I have made use of them as a part of a puzzle, with the hope of being able to get by arranging them, to a new philosophical solution.

But every time I analyze a concrete part of that scientific puzzle, the sole aspect in common that I could find to lead me to the solution in order to finish the puzzle was that *every single piece disappeared among mystery and magic*.

Little by little I got convinced that that mystery and magic were due to the fact that the physicist has used an incorrect alphabet and an incorrect language in order to explain that phenomena. It was using the language of "the matter and the energy", and somehow that language was inappropriate for the explanation of a solid object in terms of areas. It was missing at least a dimension. Although the physics were trying to explain the design of an auto without paying attention to the concept of time or movement, when these were the basic essence of the car's function.

Eddington clarified an aspect of this by saying that each physical phenomena is altered by the action of the scientific and Einstein raise this enigma to higher levels making necessary an "observer" to validate the nature laws.

Finally, Eddington appointed directly to the thing when he said: "we have started to suspect that the matter of the world is mental-matter".

# The data in the nature: matter and chemistry

When approaching the theory of the Intelligent Universe we can see an interrelation between the data, the intelligence and the cybernetic process. Of these categories, the data is the most fundamental, and we have seen that in the computers' field the central aspect of the data is the electric model. In the latest chapter we saw as well that the human data belong to 6 levels, the highest dominating the lowest one. We will examine now the most general case of the existence of data in the nature.

## THE ATOM OF HYDROGEN AS FIRST ELEMENTAL MEMORY

In the computers, the capacity of the memory is established in binary bits making the electrons turn clockwise to establish the binary bit 1 and the opposite to establish the binary bit 0. This turn of the electrons is called magnetism. If the electrons turn in one sense they create the North Pole and if the do the other way they create the South Pole. This Poles establish the difference in the data between the binary bit 1 and the binary bit 0.

Going to the nature world one makes himself this question: "How can I make a natural computer?" One should find out a system in which an electron turning would be captive in a memory, and this is the hydrogen atom. This establishes a exact correspondence with the most elemental part of a computer, where is to find an electron turning to esta-

blish the code of the binary bit 1 and still remain captive in its orbit surrounding the proton nucleus. This is the first elemental memory.

### The alphabet of the chemical elements

The hydrogen atom, considered as the first code or sign, can only establish the equivalent of the binary bit 1, though its absence can be interpreted as the binary bit 0. But this will be an artificial concept as the nature has established an alphabet of approximately hundred chemical elements of the scale of Mendeleiev. That is why the nature has something in common with the vision of Bernard Shaw, who suggested an alphabet of 46 letters. I think Shaw and the nature exaggerated a bit. But this theory accepted, the nature has certainly established an alphabet of memory of data of around 100 characters, each of them being unique and specific. With it a more sophisticated and complicated language could be established. This sort of alphabet gives more possibilities of combinations and permutations than the 1 and 0 of the computers, and seems that the nature is ready for any eventuality though remote, as to be represented in complexity. Fortunately, the nature has not done such thing, as we will see, and the vast majority of these letters of the natural alphabet are simple curiosities and scarcely used.

### The experience of the Universe: the relativity of Einstein

The theory of the Intelligent Universe is much more than a vision of the Universe, seen from the distance with its defined atoms and radiation codes, as a sort of painting where we can only deduce that there should be some sort of internal meaning for all. However, the deduction must be more accurate, as by analogy, if one has a look to a computer, seems very possible that inside there is some sort of process of data that have meaning.

Fortunately, we are now in the position of observing the Universe from a point of view from the inside.

The relativity's theory of Einstein was based in a unique physical experiment whose meaning is astonishing. The conclusion changes completely our point of view about the nature of the Universe and it might be worth to handle this subject right from the beginning.

In the last century Michelson and Morley demonstrated that the light speed of 300.000 km per second was independent of the speed of the observers and this will contradict it.

# Computers and the Universe

It is not difficult to establish analogies between the two apparently systems so unequal as computers and the earth are, though it might seem that such relation does not exist at all. Several studies carried out from different points of view could lead to the identification of some similar lines.

Some are immediate and trivial. For instance, for a geologist interested in the mere physical-chemical composition of the systems, will appear similarities in the fact that the earth and computers are formed with the same basic chemical element, silica, and will find starting from of that interesting common features. A sociologist, whose interest lies in knowing the behaviour of the human masses, will arrive for sure to establish parallelism between the human beings, as members of a society and the different individual components that form every chip of the computer. Such immediate relations are not, however, of much interest for our purpose, that is why we are going to identify other of more meaning and more evident.

## Orderly systems

The first point we are going to consider in our study is that of the Earth (as synonymous of the Universe or the creation) and the world of computers as similar because they constitute two orderly systems. Say-

ing that the Universe is an orderly system, a pleonasm (every imaginary system is, to some extent), is to verify one of its main features. The notion of order that lies behind the universe is what makes of it in potentially comprehensible and, therefore, habitable for intelligent beings as we are. The last aim of the science is nothing but an intention to understand and enclosed the structure of the universe in few laws easily understandable.

Well known is the famous sentence of a physicist of the last century, Laplace, who was convinced of having found such relations except from two "unimportant" problems, and the fact that those unimportant problems caused tremendous problems to the physicists of our century and are still to be solved. Such an eminent character as Albert Einstein spent the last years of his life handling this problem, finding a unified theory in order to express the physical structure of the universe.

From this example among others one can deduced that it is common to all the international scientific community the idea, almost the hope, that those simple laws turn up, and with them also the understanding of the intimate and deep structure of the Universe.

In a different scale, but similar to the previous one, the computer may be an orderly system. Because it is formed by the juxtaposition of many elements that belong to a few different categories, the order of these is of vital importance in order to identify them correctly; besides that, the different categories should contribute to the operation in the computer following the idea of order. However, and different from the Universe, this order, that is the laws that govern the internal working of the computer, are perfectly understood by the man, its creator. It can be said that in the design and fabrication of the computers the man sublimates his ambition of becoming a creator being.

### Specialized analysis

When the man of science gets close to the understanding of the universe should divide the problem in specialties. There come up the different branches of the science: physics, chemistry, astronomy, philoso-

phy, and theology, depending on the particular aspect of reality that wants to be investigated thoroughly. Times of wise encyclopedic man has gone long time ago, that were so popular in the flowering of the Greek civilization o in the Renaissance, able to project their shadow in several branches of the knowledge at the same time. There are not many universal wise men nowadays, but experts in one or another branch.

It happens the same when a technician tries to know the internal structure and the way a computer works. He should divide the object of his study in segments o parcels related to each other only collaterally. From this come up different specializations and the chance to classify those who work in the field of computers. This is a fundamental change that turns an art or craftwork into a science or into a technic ready to become an industrial activity.

## Analysis levels

In the systematic study of each system we have mentioned (Universe, Earth, computer), it is possible to make a separation in several levels of abstractions. These phenomena is independent but parallel to some extent, to the specialization we have referred to: it deals with now either a global vision of the object we are studying or a detailed knowledge, as being observed through a microscopy, the different aspects of such object. The higher the abstraction is the lower level of detail and a higher level of generality. Here there will be shown, as an example, up to four levels of analysis.

## Four levels in the analysis of the Universe

In their effort of knowing the structure of the nature, the physicists establish several grades of detail, that can be designated as levels of analysis. Of all we have chosen four of them, as a way of example.

To start with, one can specialized in the study of the intimate knowledge of the matter, identifying the atoms and particles that form it. This

is the origin of the specialists in nuclear physic, elemental particles, etc. These disciplines were born by the second half of last century and have led to several industrial and military applications, from the X rays to the hydrogen bomb.

Another possibility is to study the behaviour of the visible matter and its interactions, so as to explain the phenomena directly observed by the man: the movement, heat, the matters' resistance or the electromagnetism. This is the oldest discipline, and from its activity resulted in the most part of the techniques that are used today by the humans, from the architecture to the telephony.

A third option is to analyze the facts that take place in a high speed, when what seems illogical turns to real. This is the field of the specialists in high energies and that of relativists. Even if its practical need is still unproved, some ideas will result of interest in the coming future.

Last but not least, the astronomer, astrophysicists or cosmologues try to know the big structure of the universe, the stars and galaxies, and through their study determined the evolution of the universe, from its origin till its predictable end. The application of their studies is not evident and, in fact, they are contemplated by the rest of the scientific community as a mixture of physicists and philosophers: they mark the ends of the physical science.

Any of these specialties is marginal to the others, that is, there are contemplated as limit cases, sometimes as degenerated cases. As a consequence, any of them takes advantage, to some extent, of the knowledge achieved by their 'neighbours'.

## Four levels in the analysis of the earth

The earth can also be studied by applying some levels of abstraction. Following our criterion, we will find four of them, though this subdivision could be infinite.

In a first step, there is the astronomer or astrophysicist, as I described them before. These will study the relations on the Earth, considered as a planet, with the surrounding bodies and the rest of the universe. They

will identify the composition of the earth, the quantity of heat that gets or its mass, and they will inform the heavenly bodynautic engineers of the orbits the artificial satellites describe around the earth and to the geologists the composition of it.

Next there are the scientists that know the characteristics of a segment of the earth. The same as geologists that study the composition of the continents, there are the meteorologists, who divide the atmospheric heaven in order to predict the weather forecast, or the volcanologists, experts on earthquakes and volcanoes.

Thirdly, there are the studies of the aspect of the visible measure, of human scale, of the earth. A good example would be the zoologist, expert in the morphology of animals, or archaeologist, who study the rest of human beings as a way of knowing the man at he present moment.

Lastly, there is also the study of the microscopical facts that take place on the earth: the biologists that study the behaviour of the bacteria and virus, or the chemist that get specialised in the behaviour of the atoms of the matter.

## Four levels in the analysis of the computer

There are also some points of view when one wants to know and make use of the computers. At the present moment, it can be excluded for complexity reasons, the fact that a person can belong to more than one category. The computer process, which has to give services to its users, needs of all of them. Computers need a work made by a group of specialists. We have firstly, technicians for its central processor (CPU), who design and develop such units. Their products are of none usefulness if isolated, the same way a brain without body is not of use: it cannot communicate with the outside world. There are also experts in the whole physical structure of the system, that deal with the joint of computers starting from their fundamental units. These people will manage to join all the components, making use of the CPU and the devices that will work as the eyes and ears. From their work will come up a sort of human being, though without intelligence, some sort of Frankenstein.

Thirdly, we have the people who deal with the logical organization (software) of low level (being this not pejorative whatsoever), who will work in order to generate such logical organization and give it to the users. We get from them computers potentially capable of carrying out many tasks, but still not prepared for any of them, such a little kid with capacity to learn but without any knowledge or experience yet. Lastly, others will handle the applications that makes the computer perform the functions the users need, and develop and modify them. These would be, following our metaphor, the teachers who teach the kid the knowledge that he needs in order to develop rightly the tasks. We can see that the role of each of these people has in the creation of the computer system and the way this is the result of a gradual work and in team.

### Causality principle

One of the basic ideas where our real experience is based is the causality principle. It means that the causes precede and originate the facts that cause. This statement seems rather inane. The truth and importance of something so evident and useful at first sight will be understood soon if we imagine a world without this fact. We would find that the light would be on before someone turned it on, that the elevator gets to our floor without telling it to do it, or that it would be night and day without seeing the sun go up and down. So, the causality principle establish, so to say, an arrow in the time, a natural sense where all the events take place and that we all accept as normal: no one expects the time to go back. The life on earth and the existence of the universe are based in this principle. Without any cause that produces the Universe it would not be any evolution in it. Without the principle of causality, it would be no entity at all. The earth self is an example of this principle. We can see every day how the light comes and goes, and this happens at the same time as the sun appears y disappears. We can notice our weight, how the planet attract us and we know that because of it we can stand to the surface and fall if we stumble. At the end of the month we get paid because we have been working all that time in order to get it.

The causality's principle does work also in the scientific disciplines such as humanities and social sciences, though it is not so evident as how it works with the positive sciences. Neither the economist is able to identify the only reason for unemployment, nor can the linguist know the reasons why the evolution of the consonants from Latin to Spanish. That does not restrain those things to exist, of course, but they would not have a only reason but some circumstances, each of them adjusted in a specific way and with an unrepeatable character in the laboratory. In my opinion, one of the factors that makes the knowledge of the computer more bearable is that you can appreciate perfectly and in an immediate way the relation cause-effect that are coupled with the actions of the operator with the results that one gets. For instance, it is rather simple to determine the change that should be introduce in the program that is being generated in order to solve a problem which has arisen. Also simple is the process to see if the change solves those problems and to demonstrate with other simple similar evidence that there have been no further effects undesired (errors in other parts of the program, caused by the previous modification). It is easy to design a new team and even easier the development of a new program. It is easy to introduce a modification and see immediately its effect without further effects that hide it. In the same way, it is easy to prove the causality parallel, that is, undesired effects introduced by a cause. The computer or the simple user of a computer can see everyday the causality's principle, which becomes the most characteristical factor of the science of computers.

## THE COMPUTER AND THE WORLD

Wiener defined the cybernetics as "science of control and communication in the animal and the machine". A dozen years after we can add a third feature to this science, the relation between human beings and the machines. Apart from this appreciation and clarifications that can be done, the basic idea of the studies of this science is to show the similarities between the organs of the machines and those of the human beings. That is, the principles in which the functions of the mechanical organs

are based are the same to those that guide those of the natural organs. In order to prove this theory we are going to study the relation between a representative of the machine and one of human being: the computer, symbol of our days, and the earth as the unknown animal-machine. Before we start we should say that we have considered the computer and the earth as two different machines. Even if both have similarities, they also have significant differences, as we will see.

The first difference is to be seen in the terminology. The computer has an English terminology, not only in the physical support but also in the programming languages, whereas the earth has a terminology that comes from the Greek and Latin. This fact takes us to the origin of both of them. The classical terms show us the age of the planet, while the English language shows us a modernity of the computer. The latter arise in the second half of our century, as a logical evolution of the first machines. We look for improvements that benefit the human being. The earth set us a problem, right from its origin, as there are several options about the beginning of our world (Humboldt, Big Band, divinity...). There is therefore a clear opposition between the concrete of the machine, with the name of its creator and date of its creation, and the abstract and unknown of the Earth. However, both of them are machines of unlimited and unknown possibilities. These depend on the imagination, the intelligence and above all, the necessities of the man. Even if the benefits that one gets will be positive for the humanity, one runs the risk of falling in a complete dependence in the machine, that is already to be seen nowadays.

In the maintenance and working of the machine there is always a base where to start from so as to get further and improve. There are basic sources of energy in the earth that are still being used. There is a basic language to start from so as to begin with new programming language, which means that the new programming systems are applications of an original one.

The Earth is a huge machine with a hardware of amazing possibilities. The programming of the Earth depends on the man. The systems and languages to get the programming depend on the evolution, imagination and needs of the man.

The work is constant. The Earth is never disconnected and is at any

time working. Even if the man considers the night as a stop of activities, this is not true. Something similar happens with the computers and machines. The activity does not stop at night and it is possible that it can be even higher than during the day, as it has not so many interruptions.

Let's think in a computer of any bank. During the day it has to serve several hundreds of clients, which difficulties a continual activity. With an suitable program, the same computer during the night can bring up to date the clients account.

But the computer can be disconnected because it is a device of two states, similar to a light switch. However, the earth is always working, as its operative system is constant.

If we compare physically the computer and the earth we would get the following identities.

The physical support of the computer is known as hardware. In the machine these would be the components we can see and touch when contemplating the installation of the computer. Talking about the planet this would be the planet itself: the ground, the mountains, rivers, seas, etc. The big difference would be that the forms, size and colours of the computer depend on the imagination of the builder. In the case of the Earth, this idea is much more complicated.

The software would be the set of programs that lead the computer. They are known as operative systems. This operative system is the key that opens the working of the computer. In the Earth, the operative system would be more diversified than in the computer, though, similar to this, it is not necessary for this operative system to be in the computer. In the earth, the key system would be the sun, air, water, internal heat, deposits... As we can see, not all of them lie in the hardware, but not all of them allow the working of the planet.

A third element is that in computers the application's programs are those that allow the machine to carry out useful functions. Going back to the previous example of the bank, we can see that the programs would be those that allow to bring up to date the account of the clients. The machines interpret what man has designed and work following the interest of him. In the case of the Earth, the man programs solar, hydraulic power station.

## CHEMISTRY AND COMPUTERS

In every system of the Universe there are some laws that help to determine their order and structure. This can be also applied to the fields of chemistry and computer.

As we know, the base of the computer is form by a series of basic elements, bits, that have a binary code: 1 (flow current) and 0 (does not flow current). Depending on the relative order of each basic element, this group of signals can be codify so as to become a legible message for man.

In the chemistry field we have to take into account basically two aspects in a system: the matter and the energy associated to this matter. In order to describe the level of order of the group of elements in that system we have a term called entropy. This is a variable that indicates the disorder of our system. This variable shows how our system can or cannot evolve in order to obtain other products.

By saying this we mean that depending on the structure of the system, this can evolve in one way or another till a final result that in computer can be a datum and in chemistry a product.

We could make a comparative analysis between both systems: the chemical and the computer.

With an analytic process of the simplest components and the most complex we can see that in chemistry the elements of the periodical system are the base of the system. Such elements can be combined with each other to provide us with molecules and even these can get combined to get further molecules more complex of a different nature. Depending on this nature we can be able to synthesize molecules of superior structure.

If we apply this to computer we get the software of the system. Firstly, the basic elements are the orders, variables, data... on their own. When we put such elements together we obtain a program with a more complex structure.

As we can see, these orders follow some laws (IF followed by THEN, FOR followed by NEXT...), as the atoms.

Depending on the elements we can get different sorts of programs: Basic, Cobol, Pascal, Fortran... What means that when we want to solve

a problem we can deal with it from different perspectives depending on the language of programming we use.

The software is compound with the application programs, the languages and the different operative systems. The importance of this machine is bigger everyday, not only because of its costs but also because of its use and its loaning.

As the chemical elements, depending on their nature, we can have different types of reactions that are studied in the different branches of the chemistry: organic, inorganic, metallurgy, biochemical...Therefore one single problem can be solved in different ways.

Another point of view in the computer system is the hardware. This is the matter component of the computer formed by the physical elements of the system: circuits, communication, peripheric channels, memory device... This support makes possible the application of the software.

As in the computer, there is a correlation with the chemical system, being the support the group of physical conditions where the reaction can take place. Different factors are to be taken into account such as: pressures, temperatures, volume of flow... Such conditions are possible using the matter of the laboratory or the machinery in an industry. Without them the chemical process would not have any effect. Therefore, so as the hardware and software are complementary, we can consider that the chemical reactivity and the conditions to make this reaction possible are complementary as well. They have real sense only when we take them together.

In conclusion, between both systems we can establish correlation starting from an elemental base, because they have undergone an evolutive process due to the faculties of man to create, manipulate and modify his surroundings.

## COMPARISON OF BIOLOGY AND COMPUTING

It may seem that the sciences have not relation between them, as the biology deal with living beings and the computer with the computers, dead ones.

However, there are relations as we will see soon: the living being thanks to a genetic code that is a program and the computer also needs a program that is the software.

The biology makes use of a binary system, so does the computer. We can see in the following example how the biology uses the binary system: each man has been created by one father and one mother. He has 2 grandparents and 2 on mother's side, 4 great-grandfathers on father's side y 4 on the mother's side and so on.

| | | |
|---|---|---|
| 01 —— Luis = | $2^0 = 1$ | |
| 10 —————— | $2^1 = 2$ | (the son) |
| 100 —————— | $2^2 = 4$ | (2 grandfathers and 2 grandmothers) |
| 1000 —————— | $2^3 = 8$ | (4 great-grandfathers and 4 great-grandmothers) |
| 10000 ———— | $2^4 = 16$ | (fourth generation) |
| 100000 ———— | $2^5 = 32$ | (fifth generation) |
| 1000000 ——— | $2^6 = 64$ | (sixth generation) |
| | ⋮ | |
| | $2^n =$ | (*n* generation) |

## CONSEQUENCES

1. We can see that the generations of every man go on into the infinite. The eternity. The generations are eternal. They have no beginning and they will have no end. Due to the preservation of the matter and the energy: nothing is created and nothing is destroyed. Everything changes.

Principle of the information's preservation. The information is not created and is not destroyed. It only changes. The information of the genetic code preserves from one generation to another, but this information changes as well from one generation to another. Each generation gets good and bad genes.

2. With each generation duplicated the ancestors.

3. Every living being has had a unlimited number of ancestors, as the binary code proves.

4. Every living being has inherited good genes and bad ones but the wise nature tends to get rid of the bad genes by the natural selection and tends to improve.

5. When the human genome map will be completed, the defective genes will be eliminated.

6. The generations graphic of the living beings is a pyramid whose base has no limit and the top is formed by the sons and daughters, but with the time they will create another pyramid whose base will not have end. There are two symmetrical pyramids, and their vertex are the current children that form the symmetric axis.

7. The information of the genetic code goes from parents to children without stop, without beginning without end.

8. The nature is wise. The Universe is intelligent. The superior being that we call god is the nature.

9. The insects help the plants to be fertile. Therefore the vegetative life has not existed before the animal life, but at the same time, forming a whole in order to keep a balance in the nature.

10. The egg is not before or after the hen. All depends on the point of view you choose. The egg and the hen form a closed circuit of information that goes from one generation to another. Such information turns up sometimes in form of an egg and sometimes in form of hen, but the information is always there, it only changes in egg, hen. It is a cycle.

The same can be said of the inorganic beings that have existed as base and foundation of the vegetal and animal life.

# The computer, the brain and the Universe

We should review briefly the reasons why time can not be a primary category in the description of the nature, but only secondary, approximate and derived, and therefore the physic laws could not be eternal, fixed, but only reached by a mechanism which worked without an order. It is difficult to defend the thought of the existence made of particles, power or space and time fields. The creation of the physics starting from the edifying elements can be compared with the problem of creating a computer starting from binary mechanism of 'yes and no'.

## From the elements to the structure and from the structure to the elements

We see an atypical computer in the middle of the room. Some people wonder of its unimaginable power; other get together in groups and try in vain to understand its philosophy, its logical and its architecture. They cannot get the main idea of the new device. They cannot get the main idea of the universe.

Any computer comes out completely molded by the brain of Minerva. We start from its elements and analyze how can get together. In the case of the universe we start from its structure and try to decompound in its elements. The computing and the physics mark two frontiers in the civilisation of this area. The first one tries to obtain complexity from the

simplicity. The latter tries to solve the complexity to reach the simplicity. No one can better than the person who creates the puzzle when trying to decompound it and no one can better make it than the one who decompounds it. Could not be then something in the physics of use for the computers? Can we learn something useful in order to understand the universe with the philosophy of the computer design?

There is an immediate similarity between both fields. It would be difficult to find someone completely submerged in a discipline and that does not experience the hope and despair everyday, and without getting grasped with the words of Einstein: "In my opinion there is a right way and it is in our hands to find it" (Einstein, 1934)

It would be of help compare and contrast the two both enterprises under 4 points of view. First, the modern computer and the quantum universe are similar when operating with the principle of 'yes and no' rather than the 'how much-how many'. Second, the computer and the universe are different completely in their needs for the construction.. The computer is made of matters and power and laws of the physics. The Universe has to build particles without particles, fields without fields, space-time without space-time, and laws without laws. Third, there is something similar: the calculations have to have a compromise between the fitting and the cost, and so do the measures in the world of physics. Four, the main point in both cases is the need for the user to differentiate the right result from the wrong one. Finally there is another contrast. The result of a computer is fixed only by what it makes it work, whereas in the world of 'how much-how many' there is an unpredictable element.

## BOTH DEAL WITH "YES AND NO" RATHER THAN "HOW MUCH-HOW MANY"

The first similarity between the computer and the brain is their "yes and no" character. Who would not have attached both in a character of "how much-how many"? The mechanical clock of the Greek (Price, 1974), in order to preserve its register of solar and lunar movement, that belong to both worlds, computer and physics, and was a device of "how

much-how many", if any. An ancestor of the analogical computer and the differential analyzer of Vannevar Bush. It was also a symbol of the kinetics of the "how much-how many" of Potolomies, Copernicus and Kepler, of the dynamic of the "how much-how many" of Galileo, Newton and Euler, and also of the theory about the "how much-how many" of Faraday, Maxwell, Herzt and Einstein.

The great Leibniz had a deeper vision of the computers and the physics. He established the aim for the different enterprises of Godel and Neumann and created a device that would past the era of the "yes and no" of a logical prove and that would bring the power of the logical in order to help with the everyday problems of many kinds. The "yes and no" of Leibniz inspired Kant in physics, Mach and Einstein. Kant considered the space and time as two essential conditions for the sense perception. These are not data given by the things but an absolute need of the brain when wanting to do anything with the data of the experience. How interesting would be to go back to the critic of Kant (1781) with the modern brain. Would one find out that the real conditions to obtain sensory data make the space-time and not the space and time separated that Kant thought to have derived?

Mach (1886) was of the opinion that the sensations are the fundament of all concepts of the physic world, that one "law" of the physics only puts the sensations in a appropriate order, like a perch of jackets puts the jackets reachable.

If the opinion of Mach, later rejected by Einstein, was at the beginning inspirited in Eisntein and its development of the general relativity (Herneck, 1979), it would not be a surprise that the words of Einstein "time and space are ways we count on when we think and not conditions we live with" (Forsee, 1963) catch on to the words of Leibniz: "… space and time are orders of thinks and not thinks" (Leibniz, 1908).

The sensations, however, those sensations where our physical imagine lies, are not of a "how much-how many" character. The quantum theory tells us that there are sensations of "yes and no".

Our eye watching a simple tiny spot in an impressionist painting just for a second receives 50.000 photons. Each photon is accidental in its direction and in its moment of arrival. The "how much-how many" of the

information are so many that give the impression of a perfect uniformity of light. Who of us have time to count them all? We base on, however, in a measure and more manageable of intensity, which the eye sends to the brain. There is no place in this message for qualifying words, "with an average quadratic fluctuation of 224, for an average number of 50.000". Who needs to know about the "how much-how many" to know that the point of colour is there? The measure of the amount even the most intense and continuous in character, as the position of an electron, was taught by Newmann (1955) with his "projection's operators" to classify in matter "yes and no". For the world of physics and the alfanumerical impression of the computer, the character "yes and no" of what is happening can be not apparent, but it is behind the scene.

## Construction of the machinery in contrast to the construction of the Universe

Similar in their character "yes and no", the computer and the universe differ in a main feature, their *substance*. The computer is made of machinery, whatever its kind. It depends on the laws of the physic world for its working. How is the universe made of and which its principles of construction?

The particles, the power fields and the space-time are all surely intermediate parts in the building of the universe. But above these there is the "how much-how many", the main principle of the physics in the XX century. In its heart lays the phenomenon of the elemental "how much-how many". The word "phenomenon" self is a term which came up from the collaboration of 28 years between Bohr and Einstein (Bohr, 1949) about the logical consistence of the quantum theory and its implications "in reality". In nowadays words, "any elemental phenomena is not a phenomenon until it is a registered phenomenon" (Wheeler, 1980).

When someone of previous eras, used to see the universe as a machine made of "atoms", gets disappointed and get puzzled when reading Leibniz and his conception of the ultimate constituent unity, the monad (Leibniz, 1962).

1. The monad is nothing but a simple substance that will form compounds; by saying "simple" we mean "without parts".
2. There should be simple substances because there are compounds; because a compound is nothing but a group of simple substances.
3. When and where there are no constituent parts there is no possible an extension, form or divisibility. These monads are true atoms of the nature; and the elements of things.
4. There is not also any way to explain how a monad can be altered or changed in its inside by other created thing, because there is no possibility of transposition... the monads have not got windows to let anything can go in or out.

…

9. Each monad… "should be different from the others".

These words of Leibniz about the "monad" are even more relevant for the "quantum phenomenon" than for the term "atom". There is no simpler illustration for quantum phenomena than the divisor of light in figure 1. With the mirror in its place, the photodetector down right makes click-click when the consecutive photons arrive, but the adjacent meter does not register anything. This evidences the interference between the rays 2a and 2b; in language of photons, evidence that every "how much-how many" photic that arrives has done it from different ways, A and B. In such experiments, Einstein originally pointed that it is unreasonable for a simple photon to cover simultaneously two ways. If you take out the mirror down left and you will find that either the first meter or the other one turns off. So, the photon has done only one way. It covers only one way but run over both ways, but runs only one. What nonsense! How obvious is that the quantum theory is unconscious!

Bohr pointed the fact that there is no inconsistency. We are dealing with two different experiments. The first one, with the mirror out of its place, tells us which is the way. The second one, with the mirror semi-silvered in its place, shows that the photon has run both ways. But it is impossible to make both experiments at the same time. One can see a feature of the nature, or the complementary feature of the nature, but not

both at the same time. Our choice to measure has a consequence in what we will find.

We learnt to fix the fact even more accurate with the so-called "postponed election experiment" (Wheeler, 1978). Then we make the decision whether to put the mirror in its place or leave it in the last real second, after that the photon has done its track. In this sense, we have a strange inversion of the normal order of time. Now, either having the mirror in or out, we have an inevitable effect on what we have to say about the past history of the photon.

Einstein was not satisfied with the dependence of what has been observed on the election of the experimental structure. It made conflict with the vision of the universe as being "out there", with independence of our observation. On the contrary, Bohr was of the opinion that there is another unavoidable new feature in the nature that is incomprehensible. It is wrong to talk of a route of the photon in the experiment of the divisor of light. It is wrong to attribute tangibility to the photon in all its track from the arrival point to the last instant. A phenomenon is not yet a phenomenon till it has been taken to an amplification, as the blackening of the silver bromide emulsion or the activation of a photodetector (Bohr, 1958). In wider terms, we see that in the nature the quantum level is not a machine that follows its inexorable track. But the answer we will get depend on the question we make, the experiment we establish, the register device we choose. We are implied in taking what seems to be happening.

The election of the question made has a decisive consequence for the phenomenon of the elemental "how much-how many". Going back to the figure 1 on the photon track, or the track of an electron through the light divisor, or the movement of an electron in a atom. In the examples at least one of the possible choices for the question made (which track for the photon or electron; which position or moment has the electron in the atom) has an answer completely unpredictable. We can send a million photons through the light divisor when operating in the structure "which route" down left in figure 1. Then we can assure that a million photons more or less (the variability of statistics have a order of a magnitude of 1500 photons) would be recorded by each meter. However,

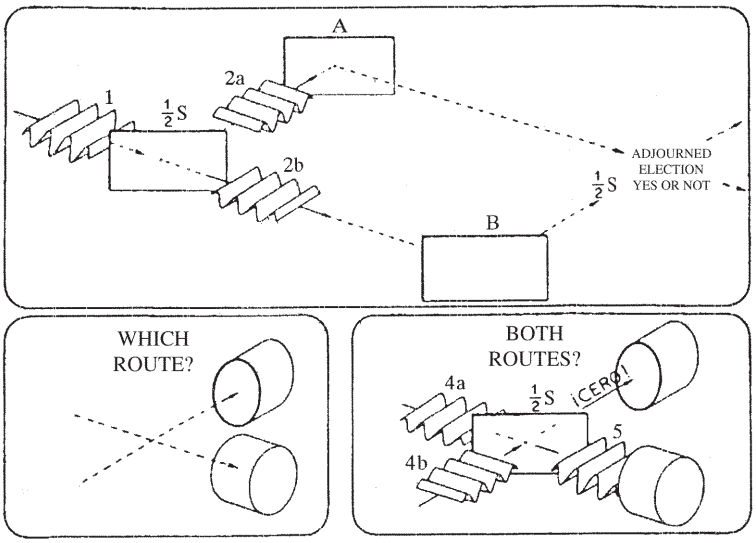



**Figure 1.**—Light divider (above) and its use in an experiment of adjourned election (below). An electromagnetic wave arises and finds the semisilvered mirror marked as 1/2S that divides in two rays, 2a and 2b, of an equal intensity, and that are reflected by the mirrors A and B to a cross point to the right. The meters (down, on the left hand side) located after the cross signals which route has been taken by a proton given. In the alternative structure on the right hand side a semisilvered mirror is placed in the cross. The rays 4a and 4b rays are placed on one side in destructive interference, so that the meter located on that side can never register anything. The rays on the other side are placed in constructive interference so as to reconstruct a ray, 5, of the original power, 1. Each photon that enters 1 is registered by that second meter in an ideal case of perfect mirrors and of an 100% efficiency of the photodetector. In the first structure (on the left hand side, down) we can see the route that was taken by the photon. In the other structure (on the right side, down) we can see that the photon arrived and took both routes. In the latest version of "adjourned election" of the experiment, we can decide whether to put or to take out the mirror at the very last moment. By doing this, we can decide if the photon "will have arrived taking one route or taking both after it has covered all its stroke".

when with the same structure we handle just one photon, we do not have the least possibility of predict which meter will hit.

Is there not any mechanism in the underground, in the working of the world, that we can discover in order to assure an indication, previous to the result? Is there any determining secret, any hidden variable? Each theoretical or observational effort to defend such hypothesis has been taken apart (Pipkin, 1978). There is no firm evidence to question the direct prediction

of the quantum mechanics: the prediction is not possible. Probability? Yes. A definite forecast? No. Einstein could be unsatisfied with the sentence: God plays dice with the universe"; but Bohr could tell him sarcastically: Einstein, stop telling God what he has to do" (Bronowski, 1973).

If there is no mechanism to indicate to the photon which way to go, why do not tell simply that ALA wants that track?

It is beyond the power of logic to pull down a proposition of this kind. Instead of that, we simply say that the fatalism is not an approximation useful when choosing between the ways of danger or opportunity. If in the individual "how much-how many" the prediction gets to the end of the track, we will be wrong to ask the science a cause for the result of the individual "how much-how many".

How came the universe to existence? Is far from the possibility of analysis? Or is the mechanism that started something that shows itself always? Does Leibniz anticipate with the monad the quantum phenomenon? It does not matter.

Of all the features of the "creation act" that is the quantum elemental phenomenon, the most disturbing is the one we have seen in the experiment of the postponed election. It looks at the past, in apparent opposition to the normal order of time. The distance in an experiment on the division of light can be of 30 metres and the time a tenth of microsecond, but the distance could have been also of thousand of million of years. So the observational device here and now, depending on its last minute adjustment, has a irreversible consequence and therefore we can say that a photon that was produced long time before there was any existence in the universe.

In other words, we are dealing with an elemental act of creation. It comes to the present after thousand of millions of years. It is wrong to consider this past as "already current". The past is theory. The past has no existence except if it is recorded in the present. Our team of quantum register decides which questions will be put in the present and therefore we have an undeniable election on what we can say about the past.

What we call reality consists on several iron post and among them we put an elaborated imaginative and theoretical work of papier-mâché (Gombrich, 1961).

Although it is useful in normal conditions to see the world as "out there" independent of us, this vision can not stands. There is a strange feeling to think that this is a parcipative universe. Is it the foundation of all for the observer the thousand of millions over thousand of millions of facts of participation? We are so far away from knowing the mechanism of the universe, so as to answer this question. To widen our knowledge in detail has brought a increasing ignorance on the plan. The fact self of set out a strange question shows how insecure we are about the deepest foundations of the "how much-how many" and its implications.

To find the "how much-how many" is feeling like an explorer of a far country that has just found for the first time a car. It is obviously thought for one use, but which is its use? One opens the door, opens and closes the window, turns up and down the lights, and also maybe turns in the engine, without knowing its use. The "how much/how many" is the car. We use the "how much/how many" in an transistor in order to control the machinery, in a molecule to design an anaesthetic, in a conductor to create an magnet. Could be that we have miss the main point, the use of the quantum phenomenon in the building of the universe? We have turned in the starter, but we are not driving yet. Three features of the nature provide more than other the need of analysing this matter.

Firstly, as we learn more and more about the laws of physics, we learn more about how tiny is our knowledge. The electromagnetism, the gravitation and the theory Yang-Mills about the power field of the quark (Yang and Mills, 1954), the output of dozen of years of investigation, hundreds of investigators, and thousands of experiments, are in the end derivative in principles of simplicity almost trivial. One is the principle that the limit of the limit is 0 (Misner and others, 1973). The other is the principle of inlaid of Hojman and others (1973), the fields and its moments in a temporal surface in the future should be calculated with the same value no matter their operations order. The simplicity of such considerations puts the mechanism behind the physic laws.

Secondly, the universe started with a big explosion, and before that, as Einstein said in his theory, was nothing. Coupled with the beginning of the particles and fields of power was the laws of physic, and this due

to the genetic mutation or the second law of the thermodynamic. There was not a granite table with the laws engraved in it beforehand.

Thirdly, there is one reason why the elemental quantum phenomenon, or monad, or however you call it has to have a intangible and ultraterrenal character. This constituent unity and the process have to transcend the time category. In 1915, in the era of Einstein, the standard space-time, the general relativity is the spatial geometry in its dynamic evolution in time. The quantum gravity (Misner and others, 1973, chapters 43 and 44), the geometry-3 and its time of change are, however, quantities dynamically conjugated. The principle of uncertainty revert us to give exact values to both quantities in the same spatial surface. The space-time is the classical theory of the space in development in the time. The space-time in geometry can be compared with the limit of the world as a history of a particle. Both are classical idealisation. Both, as the quantum theory says, are erroneous and do not have any value but for small distances and for small duration. The length of Planck, $L = (hg/c) = 1{,}6 \times 10$ centimetres, the quantum theory says that the same ideas before and after lose all its significance and application. The time is not a primary category in the description of the nature. It is secondary, approximate and derived.

As far as we can see nowadays, no one report about the time that presupposes the concept of time can inform about the time or the existence. Of all reasons to presume that the how much-how many elemental is really the constituent unity itself, one of the most stunning is the circumstance of leaving apart the time, as we saw in the experiment of the postponed election. There the contrast takes place really between the constituent materials and the constituent plans of the computer and the Universe.

## Distinction as central operative principle of the computer and the Universe

A computer would be out of an office if it was not precise enough to differentiate a profit from a lost. The concept of Universe would be im-

possible if there were not physical concepts clearly distinguishable. The distinguishable feature is the principle needed for an informatic design. Can the distinction be also the main requirement for a comprehensive universe and maybe in some strange way the quantum beginning? This matter is not the main thing of the fascinating thesis of Wootters (1980) but it is a motivation for his work and it is mentioned in it.

In the figure 2 (used with Wootters permission), the laser on the left is the tool used to send signals to the quarters, with two meters located miles away on he right (one mile is 1609 metres), the direction of arrival of the enemy. In the laser there are one thousand of photons of identical lineal polarisation. The guard sends a laser to the right orientation and pushes as soon as he sees the direction of the enemy. As the photons arrive to the prism of Nichol go to the meter of "yes" and the meter of "no" in the proportion of 6.000:400 if in that moment there is an expectation. Usually there is not. There is is a way out of root from the ideally —a huge amount of repetitions in an exercise of $(600 \times 400/1.000)^{1/2} = 15{,}49$. This figure tells us how different should be the value of expectation of the meter of "yes" in order to differentiate the two directions.

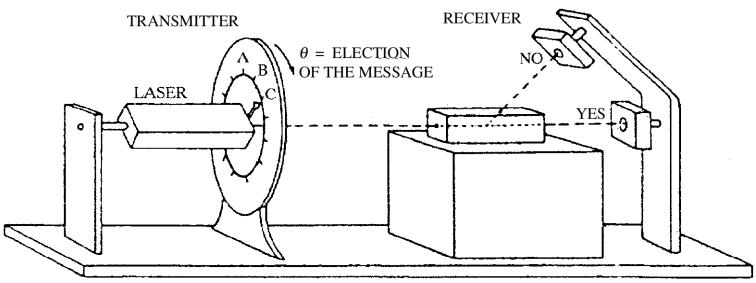



**Figure 2.**—Decision of the polarisation's direction measuring the relative number of the steps to "yes" or "no".

Wootters asks: How should depend the probability for a "yes" from the angle of polarisation, *e*, if the system of defense should take benefit from the highest number of directions? He solves these problems with the variation calculation. The answer is simple. In a world with the highest number of possibilities, the recount rate can vary 2 *ne*. Surprisingly,

the nature is made just in this way, with $n = \sim$ for electrons and neutrons, with $n = 1$ for photons, and $n = 2$ for gravitons. It is not clear why the nature would like to give the highest number of possibilities. It is clear though that this simple "distinction's postulate" gives a standard result of the quantum theory without mention it one single time.

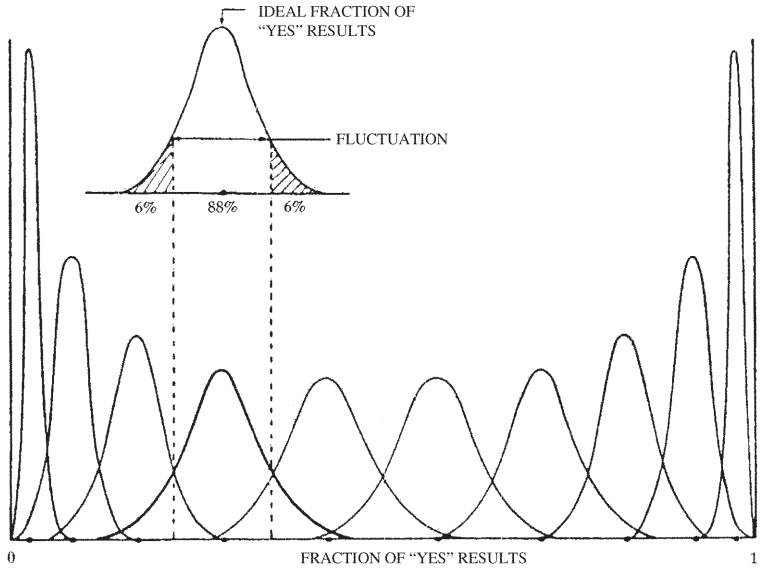



**Figure 3.**—Probability of the three steps to "yes" for the selected adjustments of photon's polarisation from a laser.

Another distinction can be use in the defensive context. My general tells me that it is very important to know if the enemies are the tores (allies of the big enemy) or the eddas (who we may persuade to be our allies). None of us knows their languages. In order to differentiate them we only know their different colours of eyes: blue and grey (figure 4). The general orders me to bring prisoners enough in order to tell him which tribe we are fighting with a probability 12 to 1. If a make a mistake, the general will kill me, so I must take prisoners enough. But if I take many prisoners would mean that I would have also many loses. A simple statistical analysis, in accordance with Wootters, shows me that I should take 16 prisoners.

The problem to differentiate the aelus from the boreals (figure 4), also enemies tribes, seems at first sight much more difficult as between them the difference is less clear as in the previous tribes (eddas and tores). In the diagram the axis are the probabilities P1, grey eyes, P2, blue eyes P3, brown eyes. However the same number of prisoners will do for the mission.

When one puts the same information in axis of P1 1/2, P2 1/2, P3 1/2, the triangle becomes in a quarter of a sphere and the distance are almost equal. In other words: the same tool for the analysis in this new context is the probability width, and not the probability self. Again a feature of the quantum theory without it.

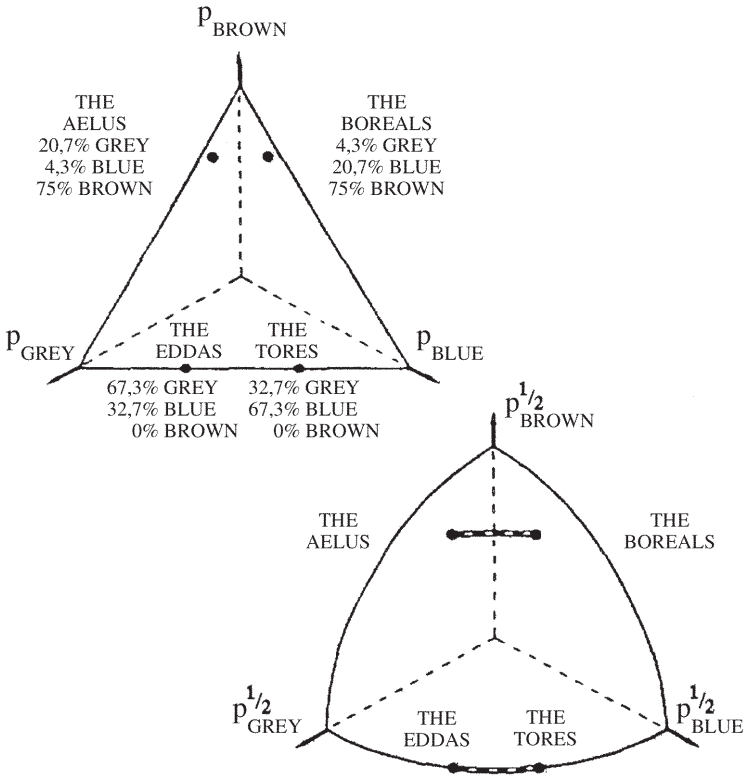



**Figure 4.**—Superior triangle: probabilities of blue, grey and brown eyes for the tribes drawn in a three-dimensional space of probability. Quarter of an sphere below: the same information with the axis that mean "probability width" (W. K. Wootters).

More than half a century ago, Fisher (1922) analyzed the genetics of the population and discover that it was much easier to describe the genetic formation of a population where the axis are square root of the probabilities more than the probabilities self. Wootters recognised the analogy with the space of Hilbert of the quantum mechanical. He even got a new result of the quantum theory: the distance in the space of Hilbert shows the distinction (Wootters, 1981).

No one sees as possible to go further and to derive the quantum theory from considerations of distinction. No one even knows how to use the probabilities with a complex value, rather than real probabilities. However, the work of Wootters that was not published shows a tantalum difference between the spaces of Hilbert based in numerical systems of the three types. We consider a high number of quantum states, pointed in the spatial sphere of Hilbert with uniform density. To each quantum state corresponds a point in the triangle of space of probability P1, P2, P3 of figure 4, or appropriated simpler if the space of Hilbert has a higher dimension. The distribution of the point on this simpler diagram is uniform if the numerical system is complex. Wootters shows this result for a discovery of Sykora (1974), but for a real numerical system are located on the edge of the simpler. In other words: the numeric system of the quantum mechanical is such that the complete random on the sphere of Hilbert gives a complete random in the simple of probability.

The distinction has another feature: it implies measure. The measure for a elemental quantum process has only been made when, in words of Bohr (Bohr, 1958), the phenomenon has come to an end by an act of "irreversible amplification". Only then is possible to communicate the discovery to other "plain language" (Bohr, 1963). The communication at the same time is a previous condition to establish meanings (see, for instance, Follesdal, 1975).

It is impossible to give a meaning to the term track of the photon in the experiment of light division of the figure 1 just because of the register in one or another of the meters. Besides, The end of the phenomenon can be postponed by moving to the right the meters and installing more mirrors in the route. Such movement is possible in the experiments of

Stern Gerlach of atomic radiation, but there is necessary an end in order to get a result. In this respect the quantum world is greatly similar to the computer. As Bennet pointed out (1973, and also the conclusion of Keyes and Landauer in 1970), also the computer can be designed to be as close to reversion as one likes. Again, the information has no meaning until the end comes with an irreversible process.

It is evident though that we should have an irreversible world if we are going to have a world of distinction and meaning.

## More is different

The growth of the capacity of a numeric process, from the abacus till the computer, has provided an evolution of the informatic architecture. It has also provoke a functional specialization in the computer made by von Neumann (1958) that reminds the extremities, the sensors and the organs of the animals, or the particles, the fields and the space-time of the Universe. "More is different" has been for long time a lead theme in the multicorporal physics. It is appropriated for every kind of complex life and complex computer. Is it also the knew of the universe structure? Thousand of millions over thousands of millions of elemental quantum phenomena" or elemental acts of observing participation take part. Leads this great number of phenomena to a specialization of physics?

One thing is to make these questions and another completely different s to find a way to get them analyzed. In any matter of high numbers we count with entities we can touch and rules to use and a pre-existent surrounding where to make the movement. Here, on the contrary, we start without time, without space and without laws. The formative element is the phenomenon of the elemental "yes and no". It is an abstract entity. It is not to be located in space and time. Its interior is untouchable and inscrutable. The combination of such entities is a new and interesting problem. There is a tendency to describe one by one the knowledge fields where other entities can work in big numbers: but among them is difficult to find one better than the computer's theory and the information in general. Do not we agree with the tradition of Leibniz,

Kant, Mach, Godel and von Neumann if we suppose that one day we will understand "the physics as information"?[1]

The discovery of the "how much/how many" by Planck in 1900 was a goal in the deep secret principle of the existence. We are at the beginning and not the end of this goal.

[1] This sentence was used by E. Fredkin in a conference.

# Analogy of the Coulomb law and the Newton law

There is a clear analogy between both laws as we can see by comparing its respective mathematical expressions.

$$F = k\,\frac{M \times n}{E \times r^2}$$

$$F = k\,\frac{Q \times Q'}{E \times r^2}$$

Both laws are very similar, are equal: they give us the value, where materials mass $M$ or an electrical $Q$ work at a distance from another mass of their same nature. The differences between both laws do not exist: the actions between material masses are of attraction and repulsion, as well as those between electrical masses. We are in the gravitational field of the north hemisphere and therefore we cannot embrace the south hemisphere. In order to make the experiment a cable should go from the north pole to the south pole in order to prove the attraction and repulsion.

We can make use of the magnets, putting together the positive and negative poles to achieve the attraction. we can also put together the positives with the positives and then we will obtain the repulsion. But we can not use the magnetic fields of the earth. If that was possible we could prove the attraction and repulsion, with the help of other bodies, as we do with the magnets.

Each body attracted by the Earth is of the contrary sign.

The actions between the material masses are of attraction and repulsion as the actions between electrical masses, but only if the masses are of a similar volume. If we put a big magnet with a small one, the big one will always attract the latter. The same happens to any body attracted by the Earth.

However, if we put together the similar magnets on the same pole they repel.

The actions among material masses also depend on the interposed middle. With materials as big as the bodies we cannot appreciate the interposed middle. Besides, the middle between bodies is the absolute emptiness.

The relation between the computer, brain and world are intimate. There are relations of origin, of generation. The Earth makes the brain in its own image and the man does the same with the computer. Maybe in the future the computers will imitate the man. There are relations of paternity.

# The software and hardware

We cannot set apart the set of software-hardware, in computing as well as in the man and the universe. In the computer the software is the information, the program that needs to work, the information needs the hardware to be processed. It is impossible to think of one without the other. The hardware also needs the software to be of use, to work.

In the case of the man happens the same. The information that goes to the senses is conducted to the brain by the nerve system to be processed.

The information cannot be processed without the brain and this cannot work without information. There are complementary, they need each other. They form a bosom unity.

It happens the same with the Universe. The information is the light and heat that comes from the sun. The earth receives and processes the information, keeps it in its memory and uses it in the growth of the plants, animals and human beings. Therefore the universe works like a computer. The sun sends the information that the earth receives and processes and uses it for the growth and evolution of itself. The sun and the earth form therefore a bosom whole.

### THE ARTIFICIAL MEMORY

The memory of the computer is artificial, made by the man. The memory is information stored, reserved for a later occasion to make use of it.

The computer has just one mission although it can be enlarged. The ROM memory is the one that the computer has already when taken from the factory. Part of it is filled with the language, whether Basic or any other language, and the other part stays virgin, like a child waiting to be filled with the information that comes from the outside. What a child first learns is the language to get into communication with the outside world and to get the necessary information. The machine also learns a language in order to get the information and to be understandable and to communicate with the outside. This is another similarity and relation between the computer and the brain. If we compare them we can see their relations and similarities.

The RAM memory is the one you can add to the ROM memory. It can be enlarged to carry out a bigger program. However, the memory of the brain cannot be enlarged as the computer. It could be by means of a surgery, joining the memory of the brain with other brains with optic fibers or appropriated matters to transmit information one another. But this is not possible yet, maybe in the future.

Another disparity between the computer and the brain in regard to the memory is that the man has a constructive memory that is its seed, capable of building another brain. However, the computer has not got this seed or capacity. Its builder is the one who can build another computer equal or similar.

### THE HUMAN MEMORY

The human memory is natural; the man is acquiring it as he grows up, from his birth. He stores the most relevant information in his brain. It is like a treasure that he keeps safe. The human memory is information of the most relevant facts of his life. At any time he can make use of it for his benefit. It is like a film of his life. As he is not interested in all the details, he chooses the most interesting parts. It is a reproduction of his life. It is a copy of his life.

The human memory can be enlarged by means of a surgery, joining it with other brains and also with the artificial memory. Soon it will be possible to do this. There are techniques of improving the memory.

There is also a lack of memory called partial or total amnesia. The memory is the most important mental faculty, of the human brain. The man has got two memories: the natural one that is the genetic code that produces the human computer, and the acquired one.

Has the world also two memories? It seems very much so. One is the superficial memory that is a copy of the central memory and is the seeds of vegetables and animals that live in the surface of the planet. This is temporary, as long as the sun is up. The other memory is the central one, located in the centre of the earth. It is the centre of data, the original. It is last long, it is eternal. It is the control of the memory.

### THE INTELLIGENCE

The computer has not got intelligence, but helps the man's intelligence. It is his assistant, because of its speed and quantity. The man is slower. The level of intelligence in the computer is similar to that of the animals. The tendency is to surpass the intelligence of the man, but at the present moment is still a "baby", in its $5^{th}$ generation of computers. There are several levels of intelligence depending on the age of a man, and also there are several levels in Humanity.

Also the humanity progresses in intelligence as the child. It also has its cycle. The intelligence is a matter of the memory and depends on itself. As much memory it has got, more information it will get. If the intelligence lacks any data it would not work properly. That is why when getting old one loses memory; it is like the child who has not got much memory. The old man that does not remember things and the child that has not got a proper memory yet are similar and stay at the same level. The child has not got a good memory, because it is still virgin and without potential of memory. The old man has got a aged memory, saturated and with little capacity to learn. The encephalic mass is full of data and information obtained during his life and has completed his cycle. It is the opposite to what happens to the child. The intelligence is the capacity to put order, to co-ordinate the data of the memory. It is to put each piece in its proper place.

As the human brain (the memory) is a photocopy of the world, the human intelligence is also an imitation of the intelligence of the world. The memory and the intelligence of the man are quicker than that of the world, so are those of the machines with regard to the man. Maybe because they are smaller. They have to cover smaller circuits and connect quicker. The memory and intelligence of the world are bigger and take longer. Therefore the memory and intelligence of the man are copies of the world. The intelligence is the second faculty or capacity of the mind. The first one is the memory that is the base.

### THE ORGANIC MATTER

The organic matter begins the cycle from the seed that is the memory. The intelligence is energy. The seed is the code, the program, the memory, the base. The seed needs energy to develop; this energy is like the intelligence that the program needs for its development, and the decision, the end of the development comes from the seed. A seed produces another seed to continue the eternal cycle.

### THE CYCLE OF THE INORGANIC MATTER

We have the idea about the physical states of the matter and we know that these are four: plasma, gaseous, liquid and solid. We also know that those states depend on the temperature of the body, or degree de heat the bodies are submitted. When the temperature varies, the body adopts a different state, that is, undergoes a change of state. There are multiple applications with the changes of states. We are going to see in detail all these phenomena following the physic laws that govern them.

### PHYSICAL STATES OF THE MATTER

The first state is the state of plasma, that takes place with really high temperatures, when the thermic agitation ionize the atoms completely, or

all the electrons are taken away. The man tries to reproduce in the laboratory such physical state, although run into great difficulties, because is trying to build an artificial sun. It tends to expand without stop. It has a minimum cohesion.

The second state of the matter is the gaseous state. Its shape and its volume vary, adopting the shape and volume of the jar there are in. There are very elastic and tend to expands with a more and more separation of its molecules. In the gases, the cohesion is very little, however its kinetic energy of agitation of its molecules is very big, with the result of a constant crashes among them and also against the walls of the recipient.

Liquids and gases have several common properties, as the fluidity, property of the molecules to slip. That is why both are known as fluid.

The third state of the matter is the liquid state. Its shape varies, adopting that of the recipient it is in, but its volume stays constant. Its molecules have great mobility and are very difficult to condense. The free surface of the liquids, in small masses, is always straight and horizontal. The liquid have power of cohesion, but its value is much smaller than that of the solids. That makes the molecules not to be joint intimately and slip.

**The solid state**

It does not change shape and the volume is always the same. The solids have a constant shape and volume.

The solid bodies have their molecules very closed to each other by the cohesion power, of electric nature and se become apparent within a certain radio of action surrounding the molecule, decreasing very quickly as it get further.

In the majority of the solids the molecules or other particles that are in a perfect order in a crystalline structure. Many times this intimate structure has an external manifestation, with a shape of polyhedron, that is called crystal. A lot of natural solids, such as common salt and sugar, have this structure and before being pulverized are true crystals.

Other solids have their molecules without any order, they are called amorphous bodies. That is the case of the wax and clay among many more.

## Changes of state

These changes are due to the heat absorbed that provokes a raise in the kinetic energy of the particles (molecules, atoms) that form the body.

### *Vaporization*

That is the name for the change of one body from a liquid state to a gaseous state. The vaporization has two forms: if the change takes place only in the surface of the liquid, and ebullition, if it takes place in all the mass.

In the vaporization, as the temperature raises the so-called tension of steam, coming out molecules from the surface and changing to the gaseous state. This produces a fall of temperature and in order to go on with the process is necessary to apply more heat to the liquid.

A vaporization can take place in the vacuum setting the liquid in suitable conditions, also within other gas as happens with the air. What serves us most is the vaporization within a gas, which happens on and on in seas, lakes, rivers, etc.

Three facts favour the vaporization. Secondly, the increase of a surface favours the vaporization, because it raises the possibilities of a contact between more molecules with the outside. The raise of temperature increases also the tension of the vapour. Thirdly, the wind takes away the molecules of vapor, giving space to be occupied by new molecules.

### *Fusion*

It is the flow of a solid state to a liquid one produced by the absorbed heat. There are two types of fusion. The fusion produces a

brusque change from solid to liquid when the necessary temperature is reached. This form of fusion is to be seen in most of the bodies, as tin, lead, sync, ice, etc.

In some bodies, as the glass, iron, fats, as the heat raises, they soften and adopt some intermediate states between the true solid and the true liquid, and called doughy states. It is said that these bodies have doughy fusion. We will see mainly the fusion.

*Heat of fusion*

This is the quantity of heat in heats necessary to melt a gram of a substance given when the fusion temperature is reached.

*Fusion laws*

The fusion follows certain laws:

1. For the same pressure, each body melt at a certain temperature, that is called the fusion point.
2. While the fusion is taking place, the temperature remains constant.

The second law does not serve for the doughy fusion, as the temperature in those cases raises as the fusion is taking place. There are variations in the volume during the fusion. Most of them increase their volume but some, such as iron, decrease their volume. Usually when a substance melts, the still solid part remains at the bottom and the rest above. But in the case of iron and ice, as when melting there is a decrease of volume there is an increase of density and the already liquid part will go down and the still solid part floats above it.

*Influence of the pressure in the point of fusion*

There is a relation between the point of fusion and the necessary temperature for the body to melt, and the pressure on the body. When the pressure increases the point of fusion falls.

We can see it perfectly in the case of the ice and prove that with an increase of the pressure (hitting it) the ice melts at the same temperature of the previous solid state. That explains the funny phenomenon called reiced that takes place when the ice melts by means of pressure and then again solidifies when the pressure decreases.

If we compare and relate the organic and inorganic matter we can observe the following equalities and similarities:

1. The cycle of the organic matter starts from the seed, that is the program, the origin, the minimum expression where the necessary information is contained in order to form either a tree or an animal.

The cycle of the inorganic matter should start also from the minimum expression, the smallest quantity of matter necessary to originate the rest of the matter. This minimum quantity of matter is the hydrogen, that contains a electron and a proton. A negative charge and other positive to keep the balance. The same happens to the masculine and feminine chromosomes to form the first living cell. The electron and the proton form the first atom of matter that is the hydrogen. The electrons and protons amount to the chromosomes, that are particles as the genes. It is clear by now that the warmer the matter is the less cohesion it has.

If we compare the Morse alphabet with the alphabet of the matter, with the elements that form the matter, we will see the following similarities:

1. Point (.) and dash (-) is similar to the structure of hydrogen: positive (+) and negative (–). For the formation of the following element would be (..) and (– –). For the formation of the helium (++) and (– –) and so on until the last letter of the alphabet and the last element of the periodic table is formed.
2. It happens the same with the cells, because they reproduce, until they form organs and the whole body.

*Point of ebullition of some elements*

| | |
|---|---|
| Water | 100 °C |
| Iodine | 180 °C |
| Sulphur | 450 °C |
| Lead | 1.750 °C |
| Silver | 2.200 °C |
| Aluminium | 2.320 °C |
| Gold | 2.660 °C |
| Platinum | 4.010 °C |
| Wolfram | 5.900 °C |

NOTE: The osmium should have the highest point de ebullition (more than 6.000 °C, as it is the heaviest one.

## WATER CYCLE

The effects that the heat produce on the water lead to some natural phenomena, as the rise and concentration of steam in the atmosphere; the formation of clouds; production of rain, snow and hail; fall of water and creation of rivers and other formation of underground and surfaces waters and subsequent vaporization. This effect is called cycle or repetition of the same phenomenon with a fixed sense without end.

The water cycle starts with the vaporization, due to the solar heat, coupled with the steam sent by plants in their transpiration and by the animals in their expiration. In places where there are masses of snow or ice, takes place also a sublimation, where the ice flows directly to steam. The steam of water flows to the atmosphere and as it is not too dense, rises.

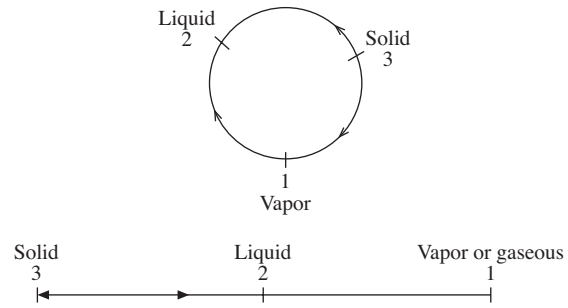
As it raises goes to areas where the temperature are lower and lower until it changes to liquid, the process of liquefaction. This process forms tiny drops of water.

As the drops of water are denser, fall slowly due to the friction with the air. As they are falling, go through areas where the temperature is higher until they evaporate again and then starts the process again.

The clouds are formed by masses of steam of water concentrated and tiny drops of liquid water, located between vaults of the atmosphere: a higher, whose low temperature liquefies the steam and a lower one with a temperature high enough so as to evaporate the water drops.

When there is a decrease on the temperature in the lower cloud, the drops keep on falling and as they do it their size increases when the get together with others and in the end they are so heavy that fall to the earth as rain.

Sometimes the decrease of the temperatures is very high and the drops freeze and form crystals of ice that with the effect of strong wind becomes snow. If the decrease of the temperature is brusque, due to the cold wind, takes place a quick frostbite in form of dense drops of ice, the hail.




The motor: depending on the heat of the sun, the water flows from one state to another.

## OUR OMNIPOTENT COMPUTER

We have been created with a brain that is a biological supercomputer where circuits of thousand cities shine. There are more than 10000 millions of neurones in the human brain, with a certain order, and in our brain take place between 100.000 and 1.000.000 chemical reactions.

There have been made comparisons between the human brain and one of the biggest computers in the world, the Cray. For instance, this computer even if it worked in 400 millions of calculations for 100 years, only would do what our brain does in one minute. It is inconceivable

that such an incredible net, of an extraordinary complexity, is within us just for physical functions. This is the nucleus that has given us the technology of the spatial era, the computers, the discoveries, the sciences, the arts and the outstanding works of literature. It is a transmitter and receiver centre that has incubated everything we have known, everything we use now and everything we will use in the future. Do you have any doubt about the capacity of that grey matter of 1 kilo and 3 quarters of weight we have on? You should start thinking about your power as an individual, that anything your brain is on will become reality and anything your brain is out will not become reality. It is just a matter of election.

Our brain that is composed by 10 billions of active pieces has a capacity of storage enough to get 10 new data per second. It has been estimated that the human brain can storege a amount of information equivalent to 100 billions words and that each of us use only a tiny part of this capacity of storage. It is a hard tool and you can use it for incredible applications you have never thought of before. Please keep this in mind when reading this book and try to adopt new ways of thinking.

## COSMOLOGY

### Heliometry

It stands from two Greek words: *helio*, which means sun, and *metry*, measure. It is the part of the mathematics that deals with the properties and measure of the extension of the sun. It is divided into heliometry of the surface of the sun and heliometry of the inside of the sun.

In the sun the powers are centrifugal so as to arrive until the earth. They go from the centre of the sun to the south face in all directions in a controlled way to last as much as possible to complete the cycle of the earth and the rest of the planets.

The radiation of the sun are centrifugal, contrary to the gravity. The elements that form the sun are plutonium, radius and other radioactive elements. The sun is like a nuclear central. The sun has an ellipse shape

with two focus: one positive and other negative, as the batteries. The elements are centripetal, constituents. These elements form mostly the earth, as they are part of it, from the silver, number 47 in the periodic table till the element that occupies the number 103. It can be elements in the sun not to be found in the earth but that can be artificially made, and conform the interior of the sun. These are disintegrated that give light and heat to the earth and the other planets: there are the engine. The heliometry deals with the powers, the energy.

## GEOMETRY

The word geometry comes from the Greek, *geo*, earth and *metry*, measure. It is the part of the mathematics that deals with the properties and measure of the extension of the earth, the measures and relations between points, lines, angles, surfaces and bodies of the earth. It is divided in geometry of plane and geometry of space.

### History

The geometry was born in Egypt in the 1700 before Christ and its development was due to the problems they had when measuring the surfaces. At about the 600 before Christ Tales of Millet introduced it in Greece.

In the Earth the powers are centripetal, from the surface to the gravity centre. The Earth is like an magnet that loses its power of attraction as the bodies get far away of the centre, following the formula $f = m \times m/d \times d$. As the earth is an magnet should have the shape of an ellipsis with two focus, one positive and other negative. The gravity has the finality to establish the stable balance in the earth so as to be inhabited. It is like building well built. The earth is the best construction ever done and the most permanent. The origin of the earth is in the sun and the sun comes from the milky way. It has its beginning and its end as the other things. It has its cycle as everything. The earth follows the rules of

the geometry, that is constructive, and goes from the body to the point that corresponds to the electron and proton. The powers of the earth are centripetal, constructive and preservative. They go to the centre of the earth, the sum of all the powers of the earth. The most powerful point, our god, that controls everything.

The elements that form the centre of the earth will be those of most density as the osmium and other dense and hard elements, like an architect would have done with a building. The earth is like an magnet should be have the shape of an ellipsis with two focus, positive and negative for the electrons and protons. The elements, from the hydrogen to the silver (number 47 in the periodic table) are constituent of the earth and they are disintegrated and are radioactive in a lower proportion. That is how the wise nature builds a huge house that is planet earth and the others to be inhabited.

### THE PRODUCT

We can say that factor one is the sun and factor two is the earth. The result of the factors is the product. The sun as motor, with its energy will produce with the help of the earth the minerals that are combinations of the elements. These would not have been formed if it had not been for the solar energy. The minerals will serve as nourishment for the vegetables that also need the solar energy as we can see in the chlorophyll's function. The vegetables will serve as nourishment for the animals and together with the vegetables and minerals will serve as nourishment for the man, but always with the help of the solar energy. There are some long stages in the formation of the minerals, vegetables and animals. We can deduce though that there has also been a long stage in the formation of the elements in the sun and the earth. There are like different plants or levels where the first one serves as base for the second one and so on to complete the cycle. It seems a program of the universal computer, that is the wise nature. It is a sequence of the universal program. Everything is related and chained.

Everything is programmed. Everything is determined; everything

works as a machine of the world. Among the animals the man stands out, that is a rational animal and he is here in this world to protect and look after the other species as director and responsible.

But the creation of the sun, the earth and all the planets must have follow a program, a code. They should have been programmed in order to get as much sun as planets in order not to see the end of the universe, as it happens with the number of boys and girls to prevent the human species from dying out. Everything has got its finality. We have to resort to the genetic code of suns and earths to explain their formation. We have to resort to the intelligent universe to explain the beginning and the end of suns and planets. The man has got 23 chromosomes and the woman another 23, comparing this with the sun we can deduce that the half of the elements of the periodic table are contained in the sun, prevailing the radioactive ones, and the other half in the earth, where prevails the elements that are part of it. If we put together the two halves they will form a whole, the product, when the man and the woman create the child.

# The cycle

Everything has its cycle. Appear and disappear. The same will happen to the sun and the earth. They also have got their cycle. By the principle of preservation of the mass and the energy, nothing is created and nothing is destroyed, everything is converted. So the sun and other planets will be recycled, they will start another cycle and so on, without end and without beginning, through the fusion they will get back to the galaxy they came from.

You will understand better the recycling with an example. A bottle of glass is broken, old, ready for recycling. It must be smelt, from the solid state to the liquid state by with the help of fire. In order to get the shape of a bottle we need a cast or mold, that represents the code and the program. That cast is taken from the old bottle. Once it is cool down we will have again the bottle, now new and recycled. We can see that the cycle goes through the four states of the matter, that will happen to the suns and planets that will go back to the galaxy to form the elements.

The cycle spans from the state of plasma or fire till the solid one. From this state it not possible to go to the first one directly, but through liquid, gaseous and plasma... we can see it with the ice, if we warm it up, first goes to liquid, then gas and if we burn it up, for instance the hydrogen, it disintegrates and goes to fire. The fire dominates everything, controls everything. We can see all the stars that dominate the universe. The fire is the software, the heliometry, the intelligence, the stars, the

energy, the information... But it needs the hardware to walk; is like the water the channel needs. In order to work they both have to be together, separated they will not work. We can deduce from this that the universe there is a software as well as a hardware, suns and earths, that means that each star is a solar system. When the cycle of the earth will be over, the energy that the sun has given it will have to go back to the same place it came from. The earth needs a recycling. When will arrive the end of the earth? Simply when all the elements of the periodic table will have finished their combinations. With these combinations, minerals, vegetables and animals have been created and among them stay the man that it is trying to do the same but in an artificial way. He has substituted the animals de charge with the motor vehicles. He has imitated the birds and builds plains, he even has built robots imitating themselves. I believe that when he finishes to imitate the nature the world will end up, there will not be any imitation left.

We can know also when the solar energy will be finished, when the sun will not warm anymore. When the rays will shine little as it happens in Mars. But there is still to come the life in Venus. And when this will end up the solar system will recycled in the galaxy, because Mercury is small as the Moon. In other planets such as Mars, Jupiter, Saturn and Pluto there have been already life, their cycle is over. The solar rays arrive there slightly, with little energy. The light they have got is as the light we get from the stars. As we see, all depends on the sun that provides the information. It is the software that controls everything, like our mind, our brain does.

* * *

A cycle is a succession of phenomena repeated in an immutable order. This succession ends where it has started. It is a succession of facts that form a whole and that are related with a central element. Cycles: carbon, economical, hydrogen, hydrological, historical, solar, alternating current, frequency, geological, nitrogen, waves, period, reproduction, periodical system of the elements. The cycle is a group of phenomena that go one after the other with an order and that repeats in-

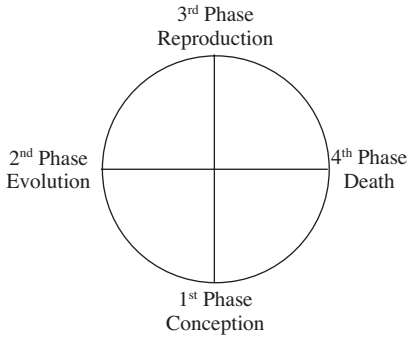
definitely. The hydrological cycle: travel of a particle of water from its vaporization from the ocean until it goes back to it.

Everything has its cycle. It consists in four main parts called stages. The time that takes to cover its cycle is called period. Imagine a moving object that has to cover a circle of 10 km.

$$E = V \times T$$

The cycle depends on the speed and its time. The higher the speed the shorter is the time it implies in covering it up, and the longer the time, the lower the speed it would need to covering it up. In our cycle of life if we do things quickly, instead of living 100 years we will live less, depending on the speed we use for our acts.

During the cycle of life, we go through 4 stages: the conception (the ovule with the spermatozoon) is the first one. The second one is the evolution or growth. The third one is the reproduction. The fourth one is the death or destruction.




As the cycle is a circumference and the length is $L = 2\pi r$, the circle always depends on the radio of the circumference. Some living being do not live long because their cycle is also small, the radium is very short. Others live longer because their cycle is bigger. The radium is bigger. The inorganic living beings have a very long cycle, as their speed is low. The rocks, the mountains, the inorganic beings have a shorter cycle as their speed is faster.

## THE CYCLES

Every being has a cycle. In the universe everything is cyclical, turn around its axis, or the centre. They cannot go on in straight line indefinite, because it do not have any sense, is indefinite, has not reality. In order to be defined has to be concrete, cyclical.

### Minimum cycle

The minimum cycle is to be seen in the hydrogen, that is the first element of the periodical system. The electron turning around of its proton, constituted the minimum cycle. It is an elemental particle turning around of the proton that is another particle and both form the first element of the system, the first and smallest atomic clock:

$$10^{-24} = \frac{1}{10} \times 24 \text{ seconds}$$

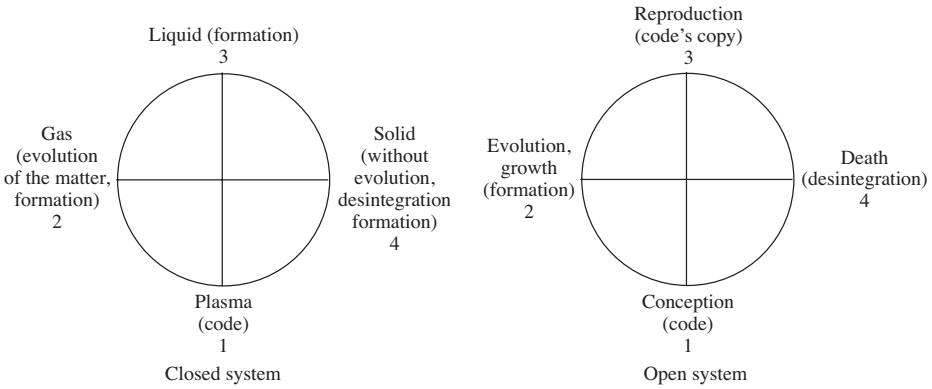
It is the maser of hydrogen, the minimum elemental time.

### Maximum cycle

The maximum time or maximum cycle is the cycle that carries out the matter from the beginning till the end of the cycle. The first state of the matter is the state of plasma, of fire, where the matter has been disintegrated in its constitutive particles, it is the chaos, there is no order, it is the entropy, it is the universal code. The information is concentrated in its elemental particles, as the information is concentrated in the genes of the chromosomes. The genes are particles of the chromosomes and the elemental particles are particles of the atom. The information is preserved, it does not get destroyed. The second state of the matter is the gaseous state, where the particles are more concentrated and the order begins: Hydrogen, oxygen, etc.

The third state is the liquid one, it is the second order. The elements start to form compounds as the water, formed by hydrogen and oxygen.

The fourth state of the matter is the solid state, where all the element of the system are together. Here ends the evolution of the matter. Its cycle ends, and se recycles, goes back to the first state of the matter, to the plasma. and so on for ever. It is the maximum cycle of the matter. It is difficult to calculate the duration of the cycle. It depends on the duration of the solar energy, the sun starts to shine until the energy runs out that makes the elements of the system to get combined. It can be calculated but it is hard work. There is a hierarchy of cycles.




NOTE: Code in order to continue, to outlive the specie.

# Comparison of the brain and the Universe

The brain works with the help of the neurones. Its structure is formed by the nets of neurones. Through the neurones flows the electric current, the information. The universe also works with the help of bodies' nets. That is its structure as well. Through the bodies flows also the electric current, in form of radiation, universal gravitation. That is the information. The brain is similar to the universe in the aspect of nets of distribution of information. The nets are the optimal systems to process the information.

The neurone is the unity of the brain and the heavenly body that of the universe.

The neurones are joined by the synapses, dendrites and the axons.

The bodies are all together by the universal gravitation. They are like magnets that are attracted to each other, but the distance and the rotation keep them apart from each other.

The neurones work with the binary code: flows the current, the electrical current, or it does not. The bodies also work with the electric current (radiation, heat). Some bodies are active (the stars), that is, give information as the sun does, and other are passive (planets) as the earth. The day and night are as good as the binary system, because during the day, the information goes from the sun to the earth, and during the night it does not. The brain is limited, whereas the universe is illimitable, but the brain works as the universe. They are similar to a big computer and a small one. The memory is different: one has a big memory and the other a small one. It is like a child and an adult.

The brain, in order to communicate with other brains needs another system called alphabet, with is vowels and consonants. The latter is as if the electric current was not flowing, since they cannot be pronounced without the help of the vowels. It is the binary system applied to the alphabet.

The universe can have its own alphabet, for instance the genetic code. This alphabet is the periodical system of the elements. With the first letters (elements) it creates the vegetative and animal life, and the beings necessary for the life, as the water and oxygen.

We can compare the vowels with the first elements of the periodic table. The vowels are weaker than the consonants and help them to form syllables. They should be placed in the first place of the alphabet, which is badly ordered since the Greeks and is still now. The alphabet needs an order, as does the heavenly bodies, that should be studied as a computer, because it is computing.

The first elements, oxygen, carbon, hydrogen, nitrogen (vowels) have more links than the rest (consonants) that are heavier (iron, gold). Because they have more links and combinations, as the carbon, they serve to create the life. The other heavier elements will serve to form the fundaments of the planet. The genes contain the information and the same happens to the elemental particles, where the information is to form all the beings.

# Universe brain

Firstly we have compared the computer with the brain, after the computer with the universe and, finally, we are going to compare the brain with the universe. We will make all the possible combinations in order to understand better the universe, that is really complex.

The brain is a product of the universe, that tried to do it perfectly. Its intention was that the brain could take care of the earth and all the creatures that inhabitate it. We can deduce from that that the producer (the universe, the nature) has more intelligence, more memory than the product (the man and its brain). The same happens in the relation between the man and his computer, the product.

The shape of the universe is round, spherical, illimitable, because the sphere is the most complete form. The brain is also round, spherical. The universe has programmed everything, even the man.

The brain could never surpass the universe, as well as the computer could not surpass the brain. It could get close, imitate it but never surpass it. If we observe the universe, we can see that also makes errors as the man does. It seems as if the error is inherent. The more number of cars driving, the more accidents will be. The error is directly proportional to the quantity.

The universe, the nature makes many errors with the human species, as the brain paralysis in a new-born baby, in the formation, in the chromosomes, etc.

The atom is a tiny computer, as the cell. Atoms, molecules and cells have got codify memories similar to that of the computer.

The atomic computer of the universe has its base in the intelligence. The kneecap articulation of a fly is exactly the same as the one of a human being, because has been built by the nature with intelligence.

The instinct is the information and instructions in the genes that have gone through from generation to generation. The instinct is innate intelligence. The acquired intelligence is the information given to the cells by the experience.

The life is a natural process of the evolution of the matter, whose information is in the atom waiting for the right environment. The macroscopic evolution can only be the result of the microscopic evolution. The evolution takes place not only in the earth but also in the universe.

The modern biology has discovered a semblance of intelligence in a cell level. The DNA spirals can be compared to the memory of an electronic computer with vast system of storage of information. The matrix molecule DNA is in charge to transmit this information from one generation to another and also regulates the proteins, the base of the organic life. The code counts with four letters. In order to form a genetic word it uses three of them, and this code is valid for all the living beings. The word contains the necessary instructions to produce the proteins whenever the body has need of them. These words of code can demand any of the amino acids, whereas others work just as signal of the end of the message (the length of the filaments and of our organism is really enormous: 160.000 km) Even at this microscopic level there are complicated mechanisms of reproduction that indicate when the program should start and end.

The RNA is the messenger of the DNA. After leaving its nucleus is recollected by a ribosome (where the proteins are synthesized) that reads its clue of three letters. A transfer RNA received then the appropriated amino acid from the fluid of the cell and sends it. The processes of the molecular biology are more complicated than the function of a modern computer and show the existence of rational and intelligent patterns in the cellular and molecular levels. If somehow these programs were annulled, the life would become chaotic, reaching its end in few hours. The discovery of intelligence and logic in the infinitely small is an exciting discovery.

The theory of the matter previously programmed does not mean that all particles of organic matter follow their plan previously established. Each unity has its own program, which should be followed. A virus does not grow or reproduces by its division but has power to perpetuate it by introducing in the interior of a cell and cancel the codified instructions of the chromosomes, forcing therefore the cells to work against the invader.

The intelligence is not only confined to the brain, because also the plants have got an analogue net to the nervous system of the animals. There are many plants that open or close depending on the increase or decrease of the light. Always has last a factor: the reason, the intelligence.

If we consider, for instance, the basic component of the nervous system, the neurone, whose relation to the brain is similar to that of the transistor to the computer. The relation of the first one towards the second one is of 100 to 1000 millions. If we take the crouton instead of the transistor this proportion would be of 100000 to 1 million. This is the reason why the artificial limitations of the brain tend to be more prodigal with the space although the compensate this waste with a higher speed. But the speed recquires more power and more energy to activate it, whereas the expense of energy of a neurone is of about a billionth of a watt. The brain consumes en total near 10 watts.

It would be thoughtful for all investigators of the brain to get together with those of the computer and those of the universe in order to investigate its secrets and progress after their discoveries.

The some of a neurone can have one or many ramifications, but only one of them constituted the axon: the others are called dendrites or terminals. What differentiate the axon from the others is that when the neurone shoots, is this the one in charge of carry the nerve impulses from the some out. The others take the impulses coming from other neurones to the some. The connection is called synapses. There are sensorial and receiver neurones, afferent or efferent neurones (that activate the muscles). The brain has got about 10 billion neurones in biological circuits; the binary system is identical for the computer, for the brain and for the universe. All three work and process with the electricity that is also bi-

nary: positive and negative. Therefore there is no soul in the brain and no god in the universe. What we call the energy, the power and the particles soul and god. In the universe all is matter and energy, that is the same to the hardware and the software. Time ago people did not know about electricity, the powers of the man and the universe were a mystery, that is why they called it soul and god, when in reality it is the software, programs. It is like children that believe in the Holy Kings because it has no information in its brain. The truth is that the Holy Kings are their parents. The humanity had not information about the soul and god. But the humanity is growing thanks to the computers. As the child that has already discovered the secret of the Holy Kings, the humanity has started not to believe in the soul and god. It is all history now.

The computer processes in mass and the brain in parallel. The neurone is slower than the transistor because it needs to recover itself. That is why the computer processes quicker than the brain. The brain can undergo some errors and few defects in its working, solved by making use of many resources, using parallel neuronal nets, but the computer can not stand errors because it processes in mass. The brain overcome its problems using its superior logic. The brain has been able to compensate a defective arithmetic with a superior logic. It is still unknown the language the brain uses, that has the shape of an magnet. It surely works as an magnet: the two hemispheres of the brain are the two poles of the magnet. It is still to be discovered the complete topology of the neuronal nets of the brain so as to see how it works as a whole, with all its neurons. It can be compared to the project Human Brain where all the countries have taken part to draw its map, its topology.

In the computer the storage of the information lies in the memory, the calculations in the arithmetic unit, and so on. The neuronal circuit of the brain is still unknown. The brain has got an amount of information of some $10^{15}$ bits. The schemes of the afferent and efferent neurones are known, but not the working of the brain: the deep interaction within the brain. It has not been discovered yet a deeper logical than the one the computer has got. We should also go deeper into the study of the artificial and natural neuronal nets. The brain has got approximately 10 billions neurones and 1000 billions sinaptical connections.

There is not any mathematical theory of nets that would justify the cortical activity of the brain. All the different models of engineering, electricity and heuristics created to imitate the processes of the thought have hardly touch the mystery of the brain. It must be discovered first the primary language of the mathematical logical that the brain uses.

## Neuronal nets

Electrical circuits of switches can represent the abstract logical operations. But also the neurones' nets can represent the circuits.

The investigation of the mechanisms of the human and animal brain is still one of the main and most difficult problems for the biology. Among the numerous mysteries of the nature, the brain is the most magnificent. We ignore the base of the thought. The application of the mathematical biology, the theory of the probabilities, theory of plays, etc., to the study of the brain will allow to establish new principles that are the foundation of the working of the brain as complex system. The method of the black box is also of importance for its investigation.

The brain mechanisms of the memory are related with the RNA. They have their origin in the mutual action of the electric processes with the structure of RNA. We should pinpoint the form of the two mechanisms of the memory: operative and long life. The operative memory can reach up to 80 bits. It is rather reduced. The calculations of the memory remains in the brain and its volume lies between $10^{10}$ and $10^{15}$ bits.

The modern machines surpass the human brain in speed of calculation, in speed of searching information and in volume of the operative memory. The volume of the permanent memory of the computer ($10^{-5}$) shows a tendency to get close to the volume of memory of the brain. Computers solve many problems that have been always thought to correspond to man: plays chess, composes music, etc. But the computer can not think as the man. We do not know how the brain works and physiological, psychological and cybernetic investigations are needed. The im-

provement of computers is possible thanks to the comparison between the natural brain and the artificial one and with the help of the neurocybernetics, the neuroscience, the computation and the bionics.

## Investigation of the nervous system

The nervous system of the man and superior animals eases sometimes in front of the computers. The slow speed of its action (the time of the brain processes are within the limits of 0,1 second), the impossibility of perceiving simultaneously pieces of information of different origins, the tiredness and emotional instability. Apart from these deficiencies, the nervous system has qualities that give the man a superiority in respect to the computer. The qualities are the following:

1. Ductile and improved receiver of outside information. The computer can not receive information in form of a printed text, or drawings, words, images moving, etc.
2. A high reliability that exceed the technical systems. It is well known that just a tiny detail can bring a technical system out of order. The higher the number of a technical system is the lower is its liability. The nervous system contains thousand of millions of nervous cells and even if a traumatic agent affects it, the capacity of work is still active.
3. The elements of the nervous system are miniatures. The volume of the brain respect to the man is of hardly 1,5 $dm^3$ and houses an amount of element of the order of $10^{10}$ A computer that would have such amount of elements would need a volume of $10 \times 10 \times 10$m (the dimension of a skyscraper).
4. The economy of the operation of the nervous system. The total consume of energy of the brain does not exceed a tenths of watt, and the nourishment is of $10^{10}$ triggers a start from the triad: the semiconductive (supposing that each triggers imitate a neurone) needs energy with a power similar to a electrical central.
5. The high degree of organization of the nervous system, the quick

adaptation to new situation, the possibility to modify the programs of its activity. The vast majority of the computer systems works with strict programs and previously defined...

The simplest organization systems have functions strictly determined and a defined purpose.

If we take the thought, memory, conscience process the list of advantages of the brain would coupled. It must bear in mind though that the technics is what is still in the nature. It is natural that the first efforts to model the nervous system has begun with the building of analogous of the neurones and neuronal nets.

In accordance with the modern concepts, the neurone is the structural basic element of the nervous system. When creating models of neurones some simplifications were adopted. The neurones created have the following features:

1. The scheme of the neurone has some entries and just one exit. Entries and exits can only chose between to states: off or on.
2. The signals of entries act on the neurone through contacts that have a delay in the signal of access.
3. The excitation of the neurone arises as a result of the access of excitation or inhibition; the model of neurone shoots up only in case of a excess of signals of access.

There are other conditions that determined the work of the artificial neurones but we are not going to them at the moment.

Several types of artificial neurones have been created: neuronimes, arthrons, neuristrons and others.

*Neuronimes*. The fundamental type of neuronimes is a translator of binary exit and two types of exciters e inhibiting entries. The builders have achieved neurones analogous that has some features of the natural neurones: in the entries not only appear exciters e inhibiting impulses, but also can the neurone can shoot up when a certain magnitude of en-

ergy, accumulated for some time, appears. This time, refractory time count with a time of absolute and relative refractive, a capacity of temporal and space sum, an impulse of exit of constant duration and magnitude. The model of neuronime has the property of adaptation and has got 10 exciters entries and 10 inhibiting. The circuit of each exciter entry is provided with a multiplying and a memory cell.

*Arthron*. It is the basic element of a cognoscitive machine that is selforganised and recognised. The arthron has two entries: one stimulant and another punitive. Its logical functions actin one direction that correspond to the dendrites, the exit that imitates the axon. The arthron cannot have 16 possible states. A machine of knowledge is constructed with the help of many arthrons directly connected or by feedback. In the initial state all the arthrons, as well as the machine in its whole are not specialised. The machine is taught its tasks. The feedback takes charge of the errors during the teachings.

*Neuristrons*. Another kind of bionic elements is the neuristor. With them has been built a computer that reproduces the memory, knowledge and apprenticeship processes. The artificial neuronal nets allow to investigate several aspects of the brain work, such as the memory, logical operations...

## THE COMPUTER AND THE HUMAN BRAIN

The relation between the computer and the brain is maybe the most important, since they show implications that affect the concept of the assignment of the man in this world. That is why a thought from different fields is needed, and especially as the brain is no longer the black box.

At the present moment it is already possible to see brains in action. We have started to see the interconnection of neurones nets when a subject is solving a problem. Using the chess as the problem, and with the tomography as emission of positrons (TEP) has been determined that neurones nets are activated to develop certain processes. The movements of a given piece seem to be responsible for the activation of the sea horse and the temporal lobe, while two prefrontal areas, one on the right,

one on the left, seem to provide the knowledge needed for the planning and execution of the strategies.

The cartography of the brain can help the neurosurgery to clear up the neuronal differences that present some mental patients.

A new technology of the computer that helps the neuroscience is the virtual reality, that allows to visualise objects in three dimensions and is giving place to the so called computational neuroscience, imitating microscopic fragments of the brain.

For the studies of the virtual reality has been used thicker section to recreate the neurones. Such cuts have been done by means of a computerized axial tomography, with a mobile camera to generate several angles and create with the computer its three-dimensional structure. It is estimated that the power of calculation of the brain is of 4.106 bits/sec, and it is believed that such power will be reach by the computer within the first decade of the 2000.

## THE QUANTUM REVOLUTION OF THE COMPUTERS

The technology used to build the current chips will reach its limit by the year 2010. The future of the computers lies in a drop of chloroform. The investigators of IBM, the Institute of Technology of Massachusetts (MIT), the University of California in Berkeley and the University of Oxford in the United Kingdom have announced recently that they have created the first computer based in the principles of the quantum mechanics, a branch of the physics that describes the world of the subatomic particles, where the yes and no can be true at the same time.

The scientists achieved what it had been investigating for long time. They were able to create an original computer where the processor consists in the atom of hydrogen and the chlorine of the chloroform and they used it to organise a disorganised list of articles.

The discovery has triggered such enthusiasm among the physics and computers that it has led to a dozen of investigation's centres of all the world to perform similar experiments. This predicts the advent of an era

of quantum computers, specialised machines that one day will be millions of time quicker that the most potent computers of our days.

"It is a main step", said Richard J. Hughes, physicist that led the quantum computer team in the National Laboratory of Los Alamos. "The fascinating thing is that now has been demonstrated the simplest algorithm in a quantum computer. There are still important obstacles to surpass before the quantum computers can be used for general problems", explains Hughes. But we have get further enough to predict important applications.

Computer enterprises such as IBM and Hewlett Packard have already form a team of investigators to work with a generation of quantum computer systems that could be working by the second decade of the XXI century. Many experts think that by that time the conventional technologies will reach their physic limits.

The transistors have been decreasing on size and the processors have gained speed and power. But the designers of semiconductors think that the transistors will begin to fail when they will reach the size of some molecules, possibly after the 2010.

The new progress in the quantum computer are specially impressive because just a couple of years the vast majority of the investigators of this field was of the opinion that quantum computer was just a theoretical possibility, but not to be use in the practice.

The difference between the conventional computers, constituted by millions of digital switches that can be connected and disconnected quickly, the quantum computers are compounds by unites called qu-bits where the 1 and 0 can represent many other states simultaneously.

### *Qu-bit* in Benasque

The fourth session of the Physics Centre of Benasque took place from the 15 to the 25 of july and it was dedicated to the theoretical as well as the experimental aspects in the field of Information and Quantum Computation. Some 60 scientists coming from 16 countries got together for three weeks in a school in Benasque (Huesca). The school was fitted

out, its dining hall transformed in an aula for seminar and its gym housed ten stations connected with the Center of Supercomputation of Cataluña (CESCA).

The present edition handled specifically the "Progress in Quantum Computing", "Chryptogralphy and Communication" and "Progress in Quantum Optics and Atomic Physics". The scientific co-ordination was directed byA. Ekert (Oxford Unversity) and I. Cirac (Innsbruck University). Among the participants are the leader of the main groups of investigation of the whole world. A. Zoller (Innsbruck University) and C. Bennet of IBM, creator of ideas of quantum teleportation. Also N. Gershenfeld (Media Lab. MIT), R. J. Hughes and W. Zurek (Los Alamos National Laboratory), P. Knight (Imperial College) and G. Milburn (Queensland University).

The vitality of the quantum computation was evident in the talks and discussions. Themes such as the limitations of the techniques of the magnetic nuclear resonance (NMR), the problems with the trap of ions or the new ideas about the optic nets have been discussed. The theoretical progress is also evident, going deep into the comprehension of the use of qu-bits (quantum bits), creating new quantum algorithms and making up protocols of efficient and safe communication.

The results of the three-week work came to light in form of new scientific collaborations that are reflected in investigations articles.

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# The earth

## What is the earth?

Many possible definitions can be right. An astronomer would say that it is the third planet of the solar system; an astrologer would think that it is an opaque heavenly body that revolves around the sun. A biologist would say that it is the environment where the human being lives. A religious person would consider it as the scenery god created for its best creation to live in. But in this essay we are trying to examine the earth as a whole compound by many parts related. The point of view developed here is that of an computer.

So as the parts of a computer are designed and fixed in order to work together, we have many examples in the earth that interact proprerly to reach an aim. We can see how the seas, the clouds, the rain, the rivers interact properly to participate in a process called (by us) the water cycle, and among its aims is that of keeping the processes irrigated, and contribute to the existence of the living beings. So as the programs have certain features of accuracy, in these processes the quantity of water remains (temporary) in the clouds and then fall in form of rain.

The computer systems are centralized, that is, there is a part (CPU) that decides what should do each component of the computer and in which situations. Here comes up a difference because the parts of the earth, the air, the seas, the living beings, the ozone layer, etc behave in

an suitable way, without any brain that controls it (as far as we know). That is why as long as we do not have knowledge of the existence of a superior entity, we should think that the earth is a decentralized system.

We know that an computer system in a computer has a hardware, the electronic system, and the software, represented by some instructions that should be followed by the computer and that indicates what should be done in any situations. We also can identify the hardware of the earth, which is all we can perceive through our senses, the tangible part. The problem comes up when we want to identify the analogue part to the software of a computer system.

It is still undiscovered the programation of the earth, the criteria it uses for its actions. But we can take some of the different natural phenomena and deduce that there is a defined order and organised in the different events that we see in the nature. A clear example is the cycle of water mentioned above, where it seems that the water has a way to go, we can also observe the cycle of the life of animals and plants (birth, growth, reproduction and death). The air protects us from the external radiations, there is a perfect ecological balance, where some animals feed others and by this they keep reasonable levels of population.

Of course, all the natural phenomena obey some steps perfectly defined. Here we see the similarity we were looking for and see that this software is perfectly built and structured, so that it exists macroprocesses, such as the volcanic eruptions that result from the overheating of the inside of the planet; not so big processes, such as the flowing of the water in the seas, the rivers and the air, and also microprocesses, that are even more interesting, among them it is to find the photosynthesis process, the process of reproduction in mammal, oviparous animals, reptiles, plants, etc.

It seems as everything matches, hardware and software are together to preserve the seas, the surface, the life, to maintain the balance. and this macrocomputer goes even further, because its components not only are renewed constantly but also exists an element impossible to find in an electronic machine: the intelligence of the man, that has the power to help to preserve the system or collaborate with its destruction.

## The clock of the solar system

In the computer system take place some processes or programs that generate some kind of result. But these programs have a given order, each process has its moment to begin and to end, generating data that afterwards will be used by other processes, or send to the user through the printed-paper, the screen or other device of exit. The appropriate moment for the beginning and the end of each process is signaled by an internal clock that the computer has got in its inside. So when the clock marks 24:00 the programs of the banks start to work.

In the earth system, the natural phenomena do not occur randomly either. The earth executes some processes in a repetitive and sequential way, that serve (among other purposes) to define the instant of time where other processes (waiting for the signal) will start to work. The two main processes that work as a clock in the earth are the rotation on its axis and the translation around the sun.

The movement of rotation is a process that takes 24 hours. Clear examples of this are "the day" and "the night". We say that it is day when the sun sends us light enough to perceive clearly our surroundings through our sight, and on the contrary, we say it is night when there is no light. The daytime is when the earth has rotated on its axis enough to be in an appropriate position to get the rays of sun. This situation will happen again exactly the same after 24 hours. When it is daytime in one place, it is nighttime in another. The process of rotation obviously marked the guidelines to define when the night should start and when the day should start, like the clock on the computer of a bank.

Another phenomena that happen in some stages of the rotation of the earth is the tides. The seas will be in one position or another, with one temperature or another, depending on the position of the "hand" of the earth. Other phenomena of no less importance start and end when it is ordered by the earth system. Among them: the presence of the moon, of the stars; the heat or cold in certain moment, etc. It must be said that the human being (like the rest of the animals) makes use of the natural clock to define our way of living (when to sleep, when to work, when to eat, etc.).

It shows us the guideline for the beginning of another event.

It must be taken into account that the rotation marks a short period of time so that we can measure and signal the beginning and the end of many phenomena. We can consider then as the minute hand of the clock of the earth. It has though other natural hand that signals longer periods of time, which are the translation around the sun. This hand of the clock indicates the start of very important processes for the earth and for the people who live in it.

Among the different states generated by the position of the sun regarding to the earth we can quote the excessive heat in the north and south of the earth in certain period of year. This period of time is called summer. As we know there are also other three stages that we can clearly differentiate one form the other depending on the climate and other atmospheric changes. As the rotation marks guidelines for the changes that influence our current customs (the 24 hours' periods), so the translation entails a kind of life that changes with the cycle. In winter we use warm clothes, we eat certain food, etc. The days are shorter and the nights longer. The other seasons have also their peculiarities. But it is not only something exclusive for the humans, we can observe how animals, such as the polar bear, the insects, the birds, etc., change their rhythm depending on the position of the second hand of the clock.

It does not mean that long processes take 360 days; we just want to say that such period of time is a natural measure. We should take into account that there are processes that last thousand of years (formation of glaciers, movement of continents, appearance of new species...) and it might exists a third hand that takes thousand of years to finish its cycle, but our short longevity does not allow us to study such long periods.

The earth is part of a solar system that at the same time is included in a galaxy, that is part of a constellation. We know really few about constellation, the galaxies, planets, even the earth self, and therefore we do not intend to say that there are only two hands of such a complex clock, that belong to such a perfect system.

## USES THE EARTH THE SAME PATTERN OF WORKING AS THE HUMAN BODY?

It is interesting to discover how the nature seems to have used the same pattern of working in different sorts of processes. We can see the same pattern in the processes of the entire mammal. We can see also how the processes of reception of stimuli (visual, tactile, auditory) are very similar in animals of different species.

It is interesting to study the working of the brain, how the external stimuli (light, noises) stimulate our receiver organs (sight, ear, etc.) that at the same time send impulses through the nervous system that stimulate the dendrites of the neurons originating some mysterious reactions in neurons until impulses are sent again through the nervous system and originate engine movement.

If we see the earth as a complex unity (similar to any living organism), its working is nothing more than a series of responses to stimuli that come from the outside (solar rays, electromagnetic waves...). An example can be the effects produced by the solar rays on the different subsystems of the earth. The rays are like stimuli that affect some receivers located in the plants, triggering some processes that we know with the name of photosynthesis; they also stimulate our retinas (and those of other animals), starting the phenomenon of the vision; another effect is the warming of the water, starting the well-known cycle of the water.

Once the solar rays have originated the beginning of the different natural processes, these generate at the same time other effects that serve as the start or continuation for other natural phenomena, for instance, the cycle of water has the secondary effect of the liquid falling to the earth, what contributes to the birth and growth of the plants, apart from satisfying the thirst of the non aquatic animals. We must bear in mind that this helps in the growth and reproduction of the plants, is nothing but the beginning of many and complicated subprocesses, and the same happens with the second example of satisfying the thirst of the animals.

Starting from the extraterrestrial stimuli, some internal processes are

generated with a harmony and a marvelous complexity. We still should study the effect that these internal phenomena have in the outside part of the earth. This pattern of working is very similar to the one our brain uses, taking outside stimuli and triggering many processes that lead to the thought and locomotion.

# Physiological models

## Approach

The physiology, included the neurophysiology, deals with the internal clock internal organization of the human being. It builds models with elements that can represent simple cells of the body. The cells of the nervous system are called neurons and have had an important role in the methods of construction of these models.

The principle of *homeostasis* is the adjustment to the outside conditions to keep a balance within an organism. It is a link between cybernetics and physiology in general and neurophysiology in particular.

The field of the physiological autoadapted models is sometimes called biocybernetics. The neuronal nets establish a natural bond between the theory of automata and neurophysiology. As well as the cybernetics and the psychology have points in common, also the psychology, physiology and the cybernetics.

## Biocybernetics and neurocybernetics

The physiology and anatomy deal with the function and structure of the organisms of the body. The neurophysiology and the neuroanatomy deal with the function and structure of the nervous system, and this has a special interest for the cybernetics. We will focus on the human ner-

vous system, since up to the present time is the field where most problems of behaviour and the cybernetics have been handled.

Many psychological processes are clearly susceptible of a description in neuralgic terms. That is, we can observe and describe a simple response like the patella reflex (reflex of the kneecap) by analyzing the nerves that arrive and go out of the knee. We should go further and say that it would be necessary to formulate, as fast as we can, in a biological language, the observed behaviour. The theories of the behaviour that try to explain the behaviour in psychological terms, should also be translated into a language that refers to the internal working of the organism. At least in context that requires a more detailed level of prediction.

It is not possible, up to now, to put into practice this program, but there are signs that soon we will think in neurological terms when we will discuss about the behaviour. It is not necessary to do that, but it is desirable from the point of view of the integration of our scientific knowledge and also because we do not seem to be able to reach the necessary grade of prediction with the psychology without the help of biological data.

The problems of the behaviour can be described firstly in neurological terms, and afterwards, much later, can be possible to go back to describe them in biochemical terms. Anyway, this entire program should depend on the development of the rest of the biological sciences. The current knowledge of the biochemical aspects of the nervous system does not allow any immediate hope of a quick development. At least it is so for the second period of the plan. This program is sometimes called "reductionism".

The problem of describing the behaviour in neuronal terms is very important. The difficulties to verify these hypotheses can even become worse. But at the present moment this investigation has already started and before we go to some suggestions is useful to think about our knowledge of neurology and neurophysiology.

Sometimes the central nervous system has been compared to a complex telephonic system, where the entire superior centers and the synapses (the connection points of the neurons) are considered as similar to the telephonic centers. This analogy is useful to some extent, but only to

some extent. There are certain adaptable features of the nervous tissue that suggest differences as well as similarities. Every nervous tissue is an enlargement of the nervous cells that ramifies throughout the body. The cells located in the gray substance of the tracts spinals, and the brain self, have a common origin with the rest of the cells that integrate the organism. But during the evolution they have specialized in its communication activity. Naturally this does not mean that the properties of transmission are completely excluded from the other types of cellular tissue, but it is true that they are less marked, due to the presence of special tissue, that mitigate them from their function.

The nervous cells constitute the body of the cell, many short ramifications called dendrites, and a long ramification called axon. They can be classified depending on the amount of ramification.

The brain self (figure 1) is integrated by bundles, layer of connection of cells of the grey substance. The brain is the most specialized part of the spinal cord, located in the head. The configuration that has adopted the specialization can be better analyzed in comparative terms. If we make an exam of the nervous system of a worm, frog, rat, etc, in scales

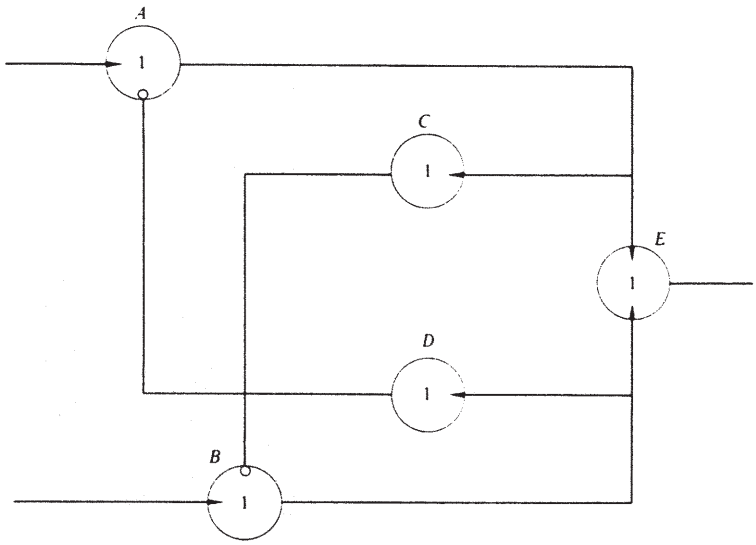


**Figure 1.**—If a message $X = 1010$ arrives to $A$ while $Y = 0101$ arrives to $B$, the exit for $E$ is 1111.

of complexity we can observe the configuration that has developed the evolution for much time. The simplest invertebrates have not got specialized nervous cells, but we can see perfectly in the worm that the two main nervous fibers cover its length, with two nervous knots more or less specialized, or ganglion in the edge of the head, the main part and necessarily the most sensitive part.

The nervous system is integrated by $10^{10}$ neurons. The implicated complexities in the possible combinations of this number challenge the imagination. However, the human brain is divided in a convenient way, though rather arbitrary, in regions due to the embryological evolution. From the superior part of the spinal cord (rising) we have, firstly, the ovoid medulla, the *mesencephalic* and the *pons varolii*. The *medulla* is probably a mediator center of reflex.

It contains certain nucleus, or a series of neurons and we can say the same to the mesencephal and the pons; although the details are of great difficulty. The cerebellum, a organ motor located behind the main mass of brain, is related with the balance and position. El thalamus and the hypothalamus are probably related with the mediation of the "emotional" responses. They could have been at some time the control area of the brain; now they have become a terminal station of the sensorial system. It is true that the thalamus and the hypothalamus, as well as the *blood ganglion*, that are the last cape before the brain cortex, are under cortical control. It is evident though that they work in close harmony with the control areas of the brain cortex, in the integrated behaviour of the organism. But the discussion about these different control centers and their relation with the control of the internal states of the body (temperature, blood pressure, etc.) would required many volumes and even so it would be incomplete. It is true that the nervous system works to some extent as a whole in the organism and therefore we should consider the divisions shown above as totally arbitrary.

It is believe that the *brain cortex* represents the control center of all the activities of the behaviour in the man and this complex layer of neuronal cells has been object of study for recent psychological and physiological investigation. The blood ganglion is other important organ also related to the cortex. They used to work with a capacity of control and

still do control the laugh and the yawn and many other involuntary activities.

Initially we have seen that the behaviour's problem could be solved if we eliminate the difference between stimulus and response. No matter the relation they both have, it is true that the brain cortex plays an crucial role in the "intelligent" human cortex. Let's look at some evidence of it. The cortex is divided in four areas: the frontal areas that constitute the most part of the frontal half of the superior part of the brain; the temporal areas are slightly above the ear; the parietal areas occupy the superior part of the head and the laterals, approximately the zone covered with a hand in the posterior part of the head (figure 1).

The brain self has a similar shape to a nut and the two hemispheres are symmetric joined by connection fibers. Each area of the brain is duplicated: one on each side, and in the same areas is isolated one from another through fissures, or incisions, that are clearly visible in the surface of the brain. It is interesting to examine what happens when some of these areas is damaged or electronically stimulated.

The occipital areas are in the posterior part of the head and are specifically related with the vision. The stimulation and destruction of these areas produce an effect in the visual function. The destruction of the cortex in the occipital part originates partial blindness. The occipital area is related with the primary and secondary visual areas. The areas of *risual elaboration* or secondary areas are in front of the primary areas. The eyes are the main source of sensor entry; through the eyes the human being gets a large amount of information. Of course some of this information could be received through the ears, or other senses, but these are not usually used at their most if the vision works properly, although the entry of any piece of information implies all the senses.

The optical nerves that start in the retina (a thin layer of nerves, formed mainly by cones and bastones in the posterior part of the eye) go back to the optical quiasm, where part of the bundles of fibers intersect and after certain connections with the thalamus, go back to the occipital areas. The crossing of the nervous fibers is typical of the most part of the nervous system. The right leg is controlled by the left hemisphere of the brain cortex and the left leg by the right hemisphere. In fact, the right

side of the body is controlled by the left hemisphere and vice versa. The occipital lobe is probably more specific in the function of all the cortical areas, except for the language areas of the brain.

We are going to handle briefly the language areas. There are some different forms of language's deficiencies, known as *aphasia*, which take place when the language areas are damaged. Penfield and Rasmussen (1950) in their study located the primary areas of the language in the superior area, or superior frontal, and in the temporal areas or parietal. They have a rather clear demarcation and therefore damage near these areas would not affect the language. The damage of the language areas can lead to different types of disorders: loss of language, loss of the use of some words, loss of the association word-object, etc.

The temporal areas are closely related with the "memory" and contain areas that serve for the audition and balance. Penfield discovered that the direct electric stimulation of the temporal areas in a patient locally anesthetized, provoke visions that are part of the schemes of the memory of the individual. It would be interesting to try to find out as much as possible about the memory, since its extension and accessibility to the memory determined greatly a large part of the organism capacities, as it happens to the computer.

The illusions and hallucinations are closely related with this area. The electric stimulation of this area can disconnect completely the patient from his reality. This sort of evidence makes us doubt about the "introspection" and the psychological methods less adequate. The most stable neuronal configurations are located in this part of the cortex. The synaptic connections, the fundament of the "apprenticeship", are probably located in this area in a permanent way. The parietal lobe is not too revealing, it does not response clearly to the electrical stimulation. However, Penfield and Rasmussen took off the best part of the parietal cortex in the non-dominant hemisphere and the arm in the opposite side was affected when the patient was getting dressed and acted as if he was not aware of its presence. Therefore the parietal areas are connected probably with the mental projection of the opposite member.

It is probable that the whole brain cortex implies a projection of every system of the organism and facilitates the best part of the orga-

nism's functions. However, the relations are complex: the areas are superimposed and the values in the threshold interconnected are modified in a different way with changes of movements in the individual. The notion of threshold needs to be explained. If a nervous fiber is stimulated, then it will response, only if the stimulation is strong enough. It is possible to stimulate a fiber without getting any "response". The threshold is the point where fiber responses to a minimum stimulation: it is a measure of the sensibility of any neuron o a series of neurons.

In the cortex, where there is a superimposition of these, th stimulation of just a point will provoke one or another functions, depending on the relative thresholds of the functions. The frontal lobe that is related almost sure to the consciousness and imagination, has been of much interest, since here it can take place an important damage without clearly affecting the behaviour of the individual.

The changes are really changes in the so-called "personality". The most recent evolutive development implies the social activities of the man and these seem represented by the development of the frontal areas. An example will show the normal response when the best part of the frontal lobes is taken off. One shy and closed man, with an important "block" or with a series of "frustrations states" was operated and his frontal areas partially destroyed. At the beginning his recovery did not show any change regarding the originary *self*. But soon his friends noticed changes in his habits; he was not shy any longer and he showed a indifference towards the conventionality and the money. His "frustration" has disappeared and with it all sense of responsibility and social organization. Let's have another example of damage, this time on the areas of visual elaboration that will damage the visual function and visual reception. We can say the brain gets all the images but cannot interpret them. Many neurological experiments and the fundament of the theory have started from the theory of the *arc reflex*.

The experiments that have provided so much information have been made by electrical stimulation of nerve-muscles: a muscle from frogs' flippers, coupled with the nervous fibers. Charles Sherrington (1908) is the name always related with the experiments of the arc-reflex type. He develops a rather complex theory of the neuronal working, using some

theorical terms as “central exciters state”, “central inhibiting state” and demonstrated processes of inhibition and excitation of a nervous impulse. In fact, he presented us a scheme of impulses that cover the nerves like the trains in their different tracks. When two trains drive in parallel tracts and these get together, one of them should stop to let the other go first. When the impulses are not antagonistic and meet, the train attaches to the second one and become a bigger one. The figure 11.2 will show us this.

Sometimes there are situations where any train can go past, only if the come together; in terms of our analogy, the trains with only five wagons should use the tracks till the junction, whereas those after the junction should have at least 10 wagons. The central exciters or inhibiting states make reference to the commutation box that let (or does not let) the trains go past.

In fact the chart is more complicated than this but we can use this basic knowledge on the behaviour of the nervous fibers when we build our neuronal nets. The figure 2 shows this point.

The EEG (electroencephalograph) is an instrument to measure the electric activity of the brain between two points where the electrodes are located. The best-known electric feature is the state when a person at rest closes his eyes. It shows a special interest because this alpha rhythm is believed to be associated with the permanent exploration rhythm of the visual mechanism. This is used in television and the similarity between television and human vision has the same development in cybernetics.

Recent studies on EEG are so large that it would take us long to explain them. The main points are the electric registers that indicate the high relation between the electric state of the organism, the chemical state and other states. At the same time, the main hypothesis that comes from the studies on the EEG is that there is some sort of homeostatic process that controls the electric activity and the best part of the behaviour. The perception is considered as the process of exploring the visual field and search sensorial stimuli and the analogy with the television must modify somehow our nervous system. It is a complex system of the kind of a computer that implies a codification and a decoding of the messages that receives. This is not contradictory though with the idea of

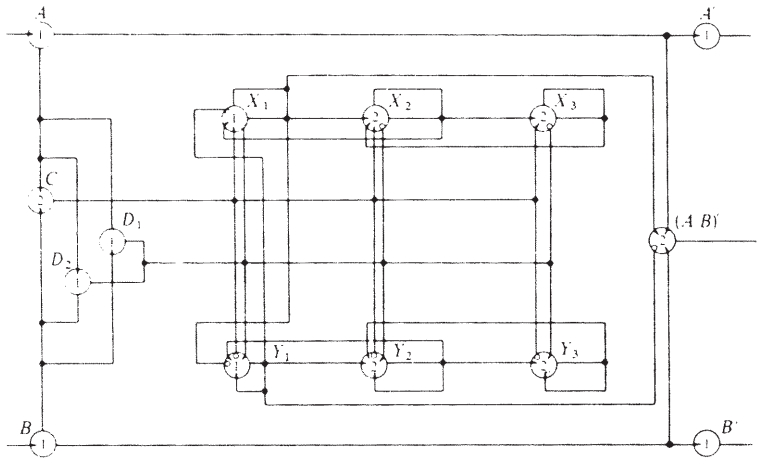


**Figure 2.**—With only two entries a and b, the net stores, on one hand, the reasons of the events $C = (a \times b)$ and on the other, $B = D_1 \times D_2 = (\sim a \times b \text{ o } a \times \sim b)$. The element $(a \times b)'$ shoots up if there has been more $C$ than $B$ between the recent registered events.

a teleronic system, but is a bit more complex than the sort of telephonic system.

## CORTICAL LOCATION

The cortical damage, no matter where it takes place, seems to have at least with the rats an identical effect in the apprenticeship. Hebb (1949) discovered that we can avoid difficulties if we can prove that the partial damage of the neuronal net does not lead necessarily to the loss of the associated (respective) function, but it is only a short-circuit that allows to withhold the associated function.

Hebb's theory on the cell's association is closely related to the classical point of view that the nervous system should establish new connections in the synapses during the apprenticeship. Hebb has developed his theory in his experimental work on visual perception. He believes that there is a definite sequences of nervous stimulation, "phase sequences" he called it, when the person is watching a simple geometrical shape. This orderly sequences allow, with suitable repetition, the establishment of new

nets, probably due to a sort of little neuronal growth, already suggested in a bigger scale by Arien Kappers (1936) and Lorent de Nó (1938a, 1938b, 1947). These introduced the idea of "reverberating circuits" and the existence of auto stimulants close to neuronal circuits. Hebb (1949) makes use of this to give time to the necessary neuronal growth, which leads to the composition of the new net.

The notion of reverberating circuit was used by Hebb (1949) and made with it the basic idea for the neuropsychological theory of the apprenticeship. Milner (1957, 1969) has proposed a modification that provides the initial work of Hebb with a new neurophysiological validity. However, the facts are to be seen by Hebbs. He describes a cells' net that grows and develops through specialized means such as fractionation and recruitment. Regarding a theory of cells' grouping we should include at least concepts such as the amount of fibers that shoots up at any moment, sensibility of the cell and neuronal fatigue (George, 1961). The most important point that we should count on is that we can easily represent all the cells' grouping through the neuronal nets. The efforts made in this direction point that the initial association needs at least a reconsideration (Rochester, Holland, Haikt and Duda, 1956).

It is difficult to illustrate in so little space the depth and complexity of the matter, but it is important the global meaning of the new theory. It means that there is a possibility to describe the behaviour in neuronal terms.

We should avoid possible misunderstandings: what have been said is that it is necessary a more detailed analysis of the human organism, if we want to obtain a predictive psychology. However, we should not think that the psychology in its whole has to be integrated by proposition of mathematical and neurological nature. These propositions are necessary for the psychology, but should be described from a psychological point of view. The global problem is that a descriptive psychology is not suitable without a detailed underlying model in order to be used to examine every detail in a predictive way.

We are going to examine the nature of this progress. Between the stimulus and the response occur many things. Life can be considered as ruled by complex guidelines and outside stimuli to which the organism can react. We can develop theoretical terms as "mind", "ego", etc., that

take part between the stimulus and the response, or have a look to our theoretical terms of neurology and biology.

Both approaches are possible and we believe that the first one on its own is not suitable for some subjects of the psychology. But the trouble has actually been the link between behaviour and biological substratum. It is now a possibility that should lead to the development of a rigorous science of the behaviour but also the development of a descriptive theory, with a firm and stable base.

The importance of the physiology for the cybernetics, and vice versa, is almost the same as for the psychology. We see that the physiology and the psychology are dealing with the same theme or at least two aspects are superimposed.

The importance of the physiology lies in its description of systems of control and communication. This allows us to understand the human behaviour and therefore, the human operator. We can use this information in different ways but the most evident is that of simulating the human behaviour. But it should be taken into account the possible physiological changes.

We go back to our "black box". We know what it does and we can predict its behaviour with some accuracy by an outside observation. But for a detailed description, as the psychologists wish, it is necessary the internal physiological details.

The same happens when we look at a car. To some extent we can predict and understand without looking its engine, but it comes the time when we can only understand it opening the bonnet, for instance when the engine breaks down.

The cybernetics can provide us with models of physiological level as well as psychological levels. By doing this has changed, above all the nervous system, in a discipline that at the present moment does not exist yet, known as neurocybernetics.

## Recent progresses

Conditional reflexes have been the bases for the best part of the neurological investigation until very recently. For instance, Doty (1965)

demonstrated that the electric stimulation of the brain in macaques produces significant systematic results. He used 0,2-1,0 mseg impulses as conditional stimuli and these produced conditional responses of pressure on the lever. He discovered that if we put stimuli in one concrete point of the cortex, the pressure on the lever would start. He also discovered that this conditional response could be provoked by stimulation of other points of the cortex, even when it was stimulated from the contra lateral area.

We should say that Spinnelli and Pribram (1970) have demonstrated that there is probably a functional connection between the visual and the motor cortex. They studied two types of waves with implanted electrodes in the visual and motor cortex and demonstrated that after the removal the functional connections signals have diminished. Buchwald and Hull (1967) have demonstrated that an electric stimulation of low frequency on the trail nucleus, ventral o anteroventral of the thalamus inhibits the results of the learned behaviour. A new stimulus afferent can provoke the inhibition of this effect: this stimulus can provoke an inhibition and a lack of inhibition probably as a internal function on one of the nervous system.

Sharlock and others (1965) have done another experiment and demonstrated that the cats could be trained to distinguish differences between sequences of tons. The they realized a bilateral removal of the audition cortex and applied a evidence of withholding. They elaborated a table showing that certain areas of the cortex, when destroyed, not only was destroyed the withholding but also interrupted the apprenticeship. Semmes and Mishkin (1965) studied the effect of the removal in the sense-motor in monkeys. The monkeys were submitted a one evidence of tactile discrimination. When they used the hand they discovered that their apprenticeship or discrimination was delayed; they also were less sensitive to rough surfaces, but not to different sizes of objects. In another recent study, Adey (1961) implanted electrodes in the temporal lobes of cats and analyzed the changes in a computer. He discovered certain configurations of waves that he called *approach rhythm* that he associated with the apprenticeship. Adey has suggested that the apprenticeship is associated to changes of spatial configura-

tions in the neuronal currents, what evokes to the models of Hebb and Milner. Nowadays we know to some extent the relation between the behaviour state of a man, conscience state and the electroencephalographic register (Schade and Ford, 1965). For instance, in a state of alert attention, where the man is concentrated, exists a electroencephalographic register associated of low amplitude's waves partially synchronized. In the profound sleep, where the conscience does not exist, a register EEG of large and slow waves exists, with random irregular guidelines. In a state of great emotions that can be simulated in a artificial way, there are states of confusion, of drifted "attention", etc., with a passive register, EEG associated and of a low to moderate wideness. There are also quick mixed frequencies that go with highly emotional states.

Stellar (1960) considers the concept of impulse as if the thresholds of the guidelines of response were reduced. But he also thinks that the motivated behaviour grade varies directly with the activity of certain exciters centers in the hypothalamus. Stellar admits the interaction of inhibition and stimulation hypothalamic centers. The outside world can modify, naturally, this hypothalamic state with sensors stimuli, and the outside states through the vascular system. He also admits that the cortical and thalamic influences produce a new influence of stimulation and inhibition in the hypothalamus.

Braitenberg (1967) has described derivative models from the histological investigation and has described these and other models in cybernetic terms.

It is well known that there are certain changes in the neurophysiologicals states that are correlated with the apprenticeship. The thought is related also with neurological changes in the temporal, parietal and frontal areas. Besides, as Schade and Ford point out: "in general we can say that the mechanisms of the language constitute probably a condition for certain types of processes in the thought and provides a special way to handle information".

We know that the thought and the solution of problems are related one another, but maybe it would not be logical to expect a distinction between them at a neurological level.

## A BRAIN MODEL

We will consider in this chapter the brain as a system to process data, with a huge memory, or a group of memories, that operates on the codified information that goes through the tracts of the nervous system, under complex conditions.

The sensorial tracts deal with the entry and this activity is integrated in the complex process of the brain. It seems clear that the sensorial entries are systems of classification independent and their function is partial and adapted. They act in a hierarchical way like filters in a classification system that is the central memory.

All the information stored in the brain occurs in different levels of the hierarchy and it is logical to expect a distinction between the short duration memories and those of long duration: this is related with types of main memory by opposition to the auxiliary one. We have to admit that many facts derivative from the inferior organisms are deceptive if they are applied to the human brain, that is much more complex and has a storage capacity much bigger, considering the human being as active receiver and reactive to the stimuli. What we called thought "free" (in opposition to "attached") remind us that sometimes the brain starts the activity as a consequence of its conceptual activities.

Nowadays we have got more evidences that suggest that the cortical locations are the center of the memories of superior level, where the conceptual processes of manipulating data, logical interferences, etc., take place. The notion of cortical location has been renovated, considered as dynamic more than static. It seems certain that the cortical areas carries out many different functions, depending on the apprenticeship of the organism, the use of the information already learned, making of hypothesis, etc.

The information is superimposed in the memory and the detailed information, as well as the data in the computer register, can vary from one person to another and sometimes within the same person. The comparison with the processes is evident and suggests that the human brain give in on the location in favour of the flexibility. The formation seems to be associated with the motivation and the impulse. However, these

features are complex and are related with the selection and activation. Apart from priorities, emergencies, etc., all within the field of a homeostatic principle that attends the organic necessities of the body for the survival: all are interrelated with the superior cortical activities in the hierarchy. The system of the limb is related almost sure with the motivating activity as Pribram has suggested. The regulator of the organisms' disposition carries out this function with the help of neuronal homeostats. However, in the brain take place S-R activities of reflex type (Spinelli and Pribram) but they turn into a sort of device in the human brain, if we think of them as the base of a neuronal activity. Dotey (1965), that has used the terminology of conditioning, has shown details of the association's and classification's activities in the memory, what also suggests a close relation between the equivalent asts in different hemispheres. It suggests as well that the growth of the memory has modified the notion of reflex from dominant to recessive.

The visual information is processed initially in the occipital areas of the cortex, the auditive information in the tempo parietal areas, etc. It is probable that the areas that process the language are the so called "language areas". However, here comes up the problem that the language in the brain is complex. The human being "vocalizes" as a type of conceptual motor activity rather simple, whereas they symbolize at a high level. The sounds can become words or sentences and their expression provokes an auditive response that produces a translation into symbols. The language is motivated but self motivated. The words can evoke or start necessities or impulses. Also the language is closely related to the images, so that when the human beings "form images" o "imagine something", some group of the total set of the sensorial entries are stimulated in some way.

It seems that the human being learn to associate sound, as the words, with objects, relations and other conceptual factors, so we should think that the brain stores separately language and data. Although they are stored separately, they are also associated with the help of a process of mutual lists o references. The human being can "imagine" something that happened in the past and can formulate statements about what happened. In reality, the human being tends to talk about events when they

"imagine" them and can hardly talk of something that they cannot "imagine".

The conceptualization is a process closely related to the language and the frontal areas of the brain. There are some neurological facts that prove this statement. The hierarchical nature of the brain suggest that the generation of new principles, formulas that provide the solution of the new problems is fundamentally an activity of the frontal lobe.

The investigation in cybernetics, in particular, the fields of synthesis and simulation with the computers, suggest that the brain is a complex hierarchical memory that can have inductive or deductive interferences, and carry out computations, where the activities of the computation has to be learned and conceptualized previously: this can be easily done by the programmer in a digital computer. There is not a higher correlation between cortical damage and function's alteration. The search of engaging of the memory of a dynamic character suggested by Laley and others have been left apart, and therefore it seems necessary to admit that information contained in any cortical area varies according to the order it has appeared in the history of a person at least partly and partly due to a system of mutual references. In other words, the information is contained in detailed structures of the nervous system that let a superimposition of functions and details.

One way of introducing details and verify the accuracy of the points of view that we have shown, consists in drawing a wide and detailed simulation of the brain in a computer, with all the known details and adding the "valid" ones until this model will be completely connected and will be efficient: this is some sort of empirical axiomatic system. The main evidence would be to prove if as a brain, it can programmed successfully and see if it can perform the same way the human brain does.

In this discussion of the general organization of the human brain we have not included the neurological details. It would be desirable to determine exactly the function that the bodies of the tonsils sort in the 27 areas of Brodman do, but this is not possible. It is a similar chart to the organization of a computer multiprocessing of the fourth generation and has dynamic properties.

In these days, the brain is seen as a partial classification system that can be adapted easily, hierarchically organized, with a high grade of specialization and a high grade of integrated functions that anatomically and physiologically superimposed.

The basic unities are the homeostats of "gradual function" of Pribram and it is possible to locate, sadistically speaking, the principles areas of influence and in the cortex, for instance, for the integrated conceptual behaviour that implies interpretation's memories of the special senses. "The vertical system", included the thalamus and limbic system, consist in emotional representations that are related to the impulse and the reinforcement and that are integrated in the cortex. The cerebellum, the associated tracts and the areas related, are a part of the system of motor control that is so necessary for the visible and organised body movements.

The cortex is the primary center of the representations for all the cognitive activities and should hold models of the "outside world" and the people in it, as well as a model of the person self. This last function is fundamental for the conscience and seems to be related also with the function of the reticular formation: however, we are leaving now the world of the evidence and going into the speculation world.

In our description of the brain models play an important role different paradoxes and uncertainties. But there is no doubt that the contribution of Pribram to our understanding of the brain activity has been important. However, as specialists in cybernetics we can think that there is a lack of logical and methodological analysis: here is where the cybernetics can really contribute to the building of brain models.

The initial work of Pribram has received a new impulse with his new work "Languages of the brain"(1971). This work matchs up with his previous ones but pinpoints certain additional features.

He stressed that the neurones and the neuronal connections play an important role in the design of brain models. This mechanism explains the changes in the nervous tissue. The long duration memory is considered as a function of connection's structure and the neuronal changes of short and long duration are a function of the neuronal behaviour. It is important the recoding as a powerful instrument in the adaptation's features, internal changes for outside changes.

TOTES[2] are considered as adapted mechanisms for the operations of supply and anticipatory regulation. The test of TOTE is associated with the set of nervous impulses of the mechanism with two processes of the brain function.

The perception and the memory deserve a detailed analysis. Both are considered as non-specific and is notable the orientation towards holistic points of view (not strictly holistic, but antimechanicists) in authors like Lashley, Goldstein and Kohller.

The recent work about holograms deserves also a detailed discussion. It seems necessary a mechanism of special aim, and some simple translation or classification's systems in order to explain the neuronal mechanisms that underlie the perception.

## SUMMARY[3]

The physiology deals with the problem of the behaviour's prediction, as sometimes the approach of the black box of the experimental psychology does not shows enough details to establish a precise prediction. In fact, that means to open a black box and substituted the abstract concept by some mechanisms less abstracts.

We can think also that the physiology provides black boxes of molecular theories that substitute the molar black box. Then the physiology tries to interpret the subsets in terms of neurons, fibers, brains, etc.

The neurocybernetics is a branch of the cybernetics that tries to give models of the different functions of the nervous system and the special senses. There is here a bridge between neuronal nets and idealised nervous systems and the real nervous systems we are trying to study experimentally.

The physiology provides, like most of the sciences, a constant interaction of models and experimental observations.

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[2] TOTE derives from the Test-Operate-Test-Exit and has beens suggested by Miller Galanter and Pribam.

[3] A recent book by G. Sommerhoff, *Logic of the living brain,* John Wiley (1975) handles some main factors of this chapter.

# Optical computation[4]

The term "optical computation" describes a whole set of knowledge areas that, using essentially optical elements, set up systems and devices to perform computing tasks. There is an effort to reproduce in the optical field systems already used with success in the electronics. The systems of optical computation are used in those applications where the traditional electronic computation is not suitable, due to the high rates of interconnection, speed, parallelism and capacity of storage needed. The optics presents the advantage of being essentially parallel. The information in the images goes up to the observer in a parallel way. The optical bundles flowing in the space do not present the electromagnetic interference that their electronic counterparts undergo. We should add the high speed of the light propagation and the great capacity of storage that presents the devices based in optical technology. We can conclude then that the optics can play an important role in the field of computation.

The optical computation has been already discussed brilliantly in these pages. This work is not trying to grasp all the aspects in the article. It is trying to prove a general vision of the disciplines in the optical computation, emphasizing in the ones we consider of most importance and with successful examples of systems that have been used.

[4] F.J. Gamo Aranda y P. Rodríguez Horche, published in *Mundo Eléctrico,* july, 1998.

## OPTICAL COMPUTATION: A POSSIBLE CLASIFICATION

The optical computation as I have already mentioned, includes several disciplines that are interdependent, among them (2,3) the optical interconnection, the holography, the non-lineal optics, the optical commutation, the acoustic optical devices and the neuronal nets. Each of these disciplines has undergone a particular evolution, but it has been in the last few years when they have been used together in the development of specific applications (4).

**Table 1.**—General vision of the optical computation

| **Paired off filters Spectrum analyzer synthetical opening radar** | | **Optical neural nets associated memories** | | **Optical digital computation. optical commutation holographic interconnection** |
|---|---|---|---|---|
| Lineal (analogical) | → | Non lineal (analogical) | → | Non lineal (binary) |

Table 1 shows a possible classification of the different architectures of the optical computation, focusing on the grade of non lineal feature used in the data processing of entry (5). In one of the verges are the lineal optical processors, where the data of entry do not act one another and the algorithms is fixed by the hardware self. The other end is formed by non-lineal optical digital systems, where the data are limited to binary values. In the middle are the associative memories and the optical neuronal nets.

Figure 1 shows a generic optical computational architecture. The current systems tend to be hybrids, in the sense that they include a optical part and an electronic part, and with a light spatial modulator (SLM) the data are supplied to the system: such data are interconnected with a previously fixed algorithms and finally collected in the exit by the detector, that sends again to the computer.

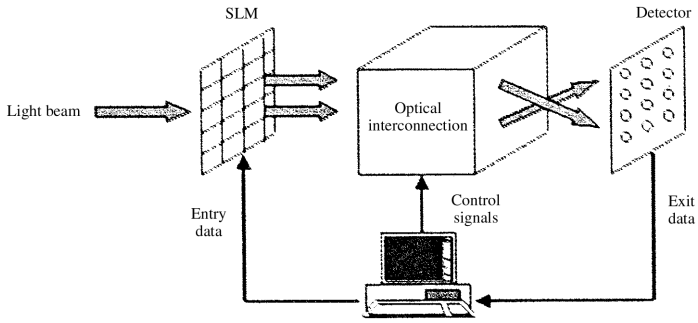


Figure 1.—Diagram of blocks of a widespread optical computational architecture.

## Main components in optical computation

### *Spatial Light modulators*

The development of the SLM is due to its properties of non lineal feature in the response that needs to solve problems, where the answer is not perfectly defined, as the recognition of patterns and robotic control, among others.

The SLM are devices that can be reconfigured in real time, that serve to change the physical properties of the light that arrive on them (5). The incident light, once it has left the device is codified in the space with the stored information in the SLM.

Depending on the sort of modulator can be modified the wideness, phase or polarization of the beam of light. The modification of one of these magnitudes of the optical beam is carried out by another signal (called signal of control), that can be electrical or optical.

We can make several classifications of the SLM, although the most common is based in the *directing* of the device, which is the sort of the signal used. Following that criterion of classification there are two types of SLM: electrically directed (EASLM) and Optically directed (OASLM).

The EASLM have got an electrical entry signal. The modulation of the incident beam has got implicitly the conversion of the entry signal

from electrical to optical. The OASLM, on the contrary, use a optical signal of modulation that modulate a second optical beam (beam incident). It is a device of optical entry/exit.

*Holographic optical elements*

The holography is a technique that allows the reconstruction of a front of waves (width and phase) previously stored in an appropriated optical support. In optical computation, the holography is used in the storage of information, execution of optical interconnections and construction of holographic optical elements (HOE). The two last applications have become more sense with the development of the Holograms generated by computer (CGR).

Different to the "traditional" holography, with the computer one we can design holograms that reproduce fictitious objects that only exist in the computer with images of 2D or 3D.

The CGR more used in optical computation are the *transformed by Fourier*, due to their easy way to reproduce the desired pattern in the exit.

The ROE consist on a optical matter where a CGR has been recorded to carry out some tasks, that otherwise, should be carry out by some elements at the same time. We get more compact and economical systems.

*Acousticoptical cells*

The index of refraction of an optical medium is altered by a sound. The sound modifies the effect of the medium on the light, that is, the sound can control the light. A acousticoptical cell is a device that produces one (Bragg) or several (Branch-Nath) beams of light that become diffracted by the interaction of light and sound in the cell. This acousticoptical effect is studied in optical computation to carry out tasks of modulation, commutation and guiding of optical beams (7).

*Spatial modulators of light*

The versatility, quickness and non-lineal feature make these devices essential elements in any kind of systems, from neuronal optoelectrical nets until optical corridor and guiding of signal systems. The functions that can be done with these devices include the coherent-incoherent conversion of light, the dynamic optical interconnection, the spatial filter and the temporal storage of information (2,3,5).

*Artificial neuronal nets*

The generalised recent tendency consists on integrating electronic and optical devices in hybrid systems, taking advantage of the optics and electronics. Examples of such computational hybrid systems are the neuronal artificial nets used in the images recognition, expert systems of decision and transactions predictions, among others (2,4).

*HOE, CGH*

The applications of the HOE include, apart from the optical interconnection's systems, the capsuling and miniaturization of any sort of optoelectronic computational devices of specific application. An example available could be some systems of reading of cds: the HOE guide and focalized the beam of lecture, as well as the detection of the error signal of such beam (8).

As we have said, the most common applications of the CGH in optical computation are the *optical interconnections*. The implement of the matrix of weights in hybrid ANN (2) and the commutation of channels in transmission systems through fibers (3) are examples of optical interconnections (figure 4). It is important that these interconnections work in a *dynamic* way (that is that the connections can change in the time, according to the specific application). For that, the CGH are implemented on the SLM, using the capacity of commutation of the latter (6).

In this article we have tried to show briefly some relevant disciplines included in the optical commutation, paying special attention to the ANN, the CGH and the SLM, fields of a great develop in the last years. Nowadays though, it is still utopian to talk about a independent optical computation; the electronics still plays an important role in the systems used up to now. The current tendency is orientated to the use of both fields together, using the advantages of each of them.

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# Quantum computation with molecules[5]

In order to decompound in prime a number of 400 digits, a arithmetic challenge is necessary for some security codes —a supercomputer would take thousand of millions of years. But a recently invented computer, based in mechanical quantum interactions, could perform such task in one year. But no one has yet achieved to create a quantum operative computer. What has been proved though is the viability in that way.

We believe that the day of the quantum computers will arrive, founded in liquid molecules, and would put an end to the obstacles we have to face with the classic ones. The main obstacles that will face the progress of the current computers are the miniaturization (neither the transistors, nor the electrical connections can be done thinner than the diameter of an atom) Maybe also a practical reason will turn up: it will be really expensive to fabricate more potent microcircuits. However, the possibilities of the quantum mechanical might enclose the clue for the resolution of both problems.

The advantage of the quantum computers lies in the way they codify a bit, the fundamental unity of information. In a classic digital computer, the state of a bit is specified through a number, 0 and 1. In consequence, in order to describe a binary word of *n* bits we resort to a chain of *n* 0 and 1. A quantum bit, a *qu-bit*, could be represented by an atom in one or another binary state, 0 and 1. Two *qu-bits*, like the two classic bits,

[5] Gershenfeld, N. E. L., Chuang, Isaac, published in Investigación y Ciencia, august, 1998.

can reach 4 different states and well defined: 0 and 0, 0 and 1, 1 and 0, 1 and 1.

Different to the classic bits, however, the qu-bits can exist at the same time being 0 and 1.; the probability of each state is shown by a numerical coefficient. If we want to describe a quantum computer of two bits we should use then 4 coefficients. In general, *n qu-bits* need $2n$ numbers, which will soon become in an considerable set for values bigger than $n$. If we have $n = 50$, 1.050 numbers are needed to describe the probabilities of every state of the quantum machine: a figure that exceeds the capacity of any classic computer. The quantum computer requires a enormous power, due to two reasons. It can be at the same time in multiple states —superposition's phenomena and perform simultaneously in every possible state. What means that the quantum computer could carry out a myriad of operations in parallel with only one processing unity.

The qubits have got another feature. Imagine a physical process that gives out two photons, one to the left and other to the right, having these opposite orientations (polarizations). The polarization of each photon is undetermined. As Albert Einstein and others pointed at the beginning of last century, when a person measures a photon's polarization, the state of the other polarization is automatically fixed, no matter how far it is. This action is rather odd. Thanks to that phenomenon, the quantum system develops a mysterious connection that serves to connect the qubits of a quantum computer. It is the same feature that allowed Anton Zeilinger and his colleagues of Innsbruck to demonstrate the quantum teletransport.

In 1994 Peter W. Shor discovered how to make profit of these phenomena of superposition to decompound a whole in its prime factors. He discovered that a quantum computer could carry out a task much quicker than any classic calculator. The discovery was a fuss. Suddenly was questioned the security of the systems that relay in the difficulty of decompound great number in primes. There are so many transactions that lay behind those methods of encriptation that Shor moved the world of the electronic economics.

No one had never imagined that such discovery would come from

disciplines different from the computers and numbers theory. Due to the algorithms of Shor, the computer technicians would start the RNA the quantum mechanics and the physicist would start to be interested in computing. The problem is that almost any interaction that a quantum computer would have around would mean a measuring, think about the shock of an atom against another or against a photon. The superposition of mechanical quantum states is solved in just one state, and the observer will detect this. Such phenomenon of decoherence makes impossible any subsequent quantum calculation. In order to maintain the coherence the internal operations in a quantum computer should be separated from its surroundings. But, at the same time they should be accessible so as to be charged as, executed and the calculations being read.

The works that came before us, such as the experiments by Christopher R. Monroe and David J. Wineland, National Institute of Weight and Measures, and H. Jeff Kimble, Institute of Technology of California, made an effort to solve that problem by an isolation of the mechanicalquantum nucleus of their computers. The magnetic fields can grasp a few charged molecules, that can afterwards cool down in pure quantum states. Regardless such efforts we have just obtained rudimentary quantum operations, because the devices make use of very few bits and soon lose the coherence.

How could then a mechanicalquantum computer work if it needs such an strict isolation? It was just last year when we realized that an ordinary liquid could do all the steps of a quantum calculation: to charge an initial condition, apply the logical operations to complicated suppositions and read the result. Coupled with other group of the University of Harvard and the Institute of Technology of Mssachusetts, we discovered that the techniques of nuclear magnetic resonance (RMN) —similar to the methods used for the formation of images by magnetic resonance— could manipulate quantum information in classic fluids.

We can face the problem of the decoherence if we fill a assaying tube with a liquid of appropriated molecules that work as little magnetic bars. These alienations correspond to two quantum states with different energy, what constitute a qubit. We could assume that the parallel spin corresponds to number 1 and the antiparallel one corresponds to two

quantum states with different energy, a *qubit*. It could be assume as well that the parallel spin corresponds to number 1 and the spin parallel to number 0. The parallel spin has less energy than the antiparallel, depending on the intensity of the magnetic field that is applied. Usually in a liquid there are as spins of one orientation as of other. But the field that is applied favours the creation of parallel spins, which provokes some imbalance between the two states. Such excess, of an order of one nucleus among one million, is measured during an experiment of RMN.

There are no more processes of fixed magnetic fields; in the RMN processes take part variable electromagnetic fields. If we apply an oscilating field of precise frequency (determined by the magnitude of the fixed field and the intrinsic features to the particle), we can provoke that some spins lies between states and this phenomenon let us reorientate the nuclear spins. We can make the protons in a fixed magnetic field of 10 tesla change direction applying a magnetic field of some 400 megahertz of radio frequencies. The radio waves will provoke that the nuclear spins go to the oscilating field, in right angle towards the fixed field. If the oscilating pulse of radiofrequency last enough as to turn 180 grades the spins, the excess of magnetic nucleus previously in parallel with the fixed field will be now on the opposite sense, antiparallel. The pulse that last the half of time will let the particles get in parallel or antiparallel.

According to the quantum mechanics, the spins will be at the same time in both states, 0 and 1. The basic chart of this situation shows us the axis of the spin in an 90 degrees angle with the fixed magnetic field. Afterwards, it gets always with the vertical power of the gravity and turns, develops a precise movement around the magnetic field, going and coming with a characteristic frequency. During this process it sends a slight radio signal, collected by the RMN.

In a RMN experiment, the particles do not only suffer the applied field, but also each atomic nucleus influence in the surrounding magnetic field. In a liquid, the constant movement of the molecules unify the majority of the locals magnetic ondulation. But a magnetic nucleus can affect other of the same molecule when disrupts the electrons around them.

This interaction is really valuable. It allows to build a “logical door” with two nuclear spins, the basic unity of calculation. In our experiments

we used chloroform (CHC13). We wanted to make use of the interaction between the spins of the nucleus of carbon and hydrogen. The nucleus of carbon 12, common isotope, has not got spin, we use chloroform whose carbon had an extra neutron, that provides it with a global spin.

Imagine that the hydrogen spin goes up and down, parallel and antiparallel in a magnetic field applied vertically, whereas the carbon spin points up, parallel to the magnetic field applied. With a radiofrequency pulse we can induce the turn of the carbon spin downwards, in the horizontal plane. The carbon nucleus will progress to the vertical, with a rotation speed that will depend on the hydrogen nucleus of the molecule. After certain time, the carbon will signal in our direction or the opposite, depending on the direction of the hydrogen spin will be downwards or upwards. At that moment we apply another radiofrequency pulse so as to turn the carbon nucleus downwards if the hydrogen adjacent stays upwards and upwards if the hydrogen stays downwards.

This set of operations correspond to what the electronic engineer call logical door 0 disjunctive, and would be better call it door under NO control (in the sense that the entry state is controlled if the signal of the other entry to be reverse in the exit). The classic computers need similar doors of two entries and not doors of a unique entry. In 1995, however, it was demonstrated that the quantum calculations can be developed by applied rotations to single spins and the doors under no control.

The truth is that the logical quantum door is much more versatile that its classic counterpart, just because the spins it was based on can be found in superposition of upside and downside states. That means that it can be done a quantum computation in a combination of entries that might have thought as incompatible.

In 1996 we agreed with Mark G. Kubinec, University of California, to build a simple mechanicalquantum computer, of two bits, a start from of a chloroform thimble. The preparation of the device of entry, although it is a device of two bits, it is not easy whatsoever. It needs that some radiofrequency impulses transform the countless nucleus of the experimental liquid in a orderly group that has too many spins. Afterwards, these qubits should be modified in sequences. Opposite to what happens to the bits of a classic computer, that flow in order through a net of logi-

cal doors, the qubits do not go anywhere. There are brought to the logical doors with the RMN manipulations. The program is based essentially in a mass of radiofrequency pulses.

We could put into practice the unique possibility of the mechanicalquantum computation. The calculation followed the algorithms of search devised by Lov K. Grover, of the Bell Laboratories. In a computer, the typical search of an element, that is somewhere within a database of *n* elements will need an average of *n*/2 attempts to discover it.

We can demonstrate that. our quantum computer of two qubits could find in just one step a certain element hidden in a list of 4 possibilities. The classical solution for this problem is analogue as to open a padlock of any two bits: it is not certain that we will find the right combination straight away. The classical method of resolution will need an average of three attempts, higher than the amount of atoms of the molecule. With the RMN, the biggest quantum computers we could build will have only 10 qubits (because at an average temperature the intensity of the signal falls vertiginously, as the amount of magnetic nucleus raises) If special instrument of RMN were built for a molecule, we could triple or quadruple that number. But in order to create bigger computers we should develop techniques of optical pumping to cool the spins. The light of a laser helps to line up the nucleus so good as if we eliminate the thermic movement of the molecules, although without freezing the liquid and destroyed its capacity to maintain longer times of coherence.

It could be possible to create bigger quantum computers. But what speed will they reach? The cycle time of a quantum computer is established by the lowest speed of the spins. It is about hundreds of cycles per second and scarce unities per second. Although several cycles per second could seem exasperating in comparison to the speed of the megahertz of the usual computers, a quantum computer with enough qubits will reach such quantum parallelism and within a year it will decompound the figure of 400 digits in prime numbers.

Considering this, we have thought about the possibilities of the real construction of a quantum computer. The problem would be not to find the molecules with enough atoms. What it is difficult comes later on. As the size of a molecule increases, the interactions between spins far away

disappear and we cannot use them as logical doors. Seth Lloyd of the MIT has demonstrated that it could be built quantum computers, although each atom will interaction just with it closest neighbours, as the computers in parallel do nowadays. This quantum computer could be built with long molecules of hydro carbides, making use as well as the RMN techniques. The spins of many atomic nucleus, joint in long chains, will serve as *qu-bits*.

Also the coherence is a problem when thinking of the creation of a quantum computer. The nucleus in rotation of a fluid will begin to lose coherence after some seconds or minutes. The longest time of coherence for liquids, compared with the times of cycle, suggest that 1.000 operations could be performed without missing the quantum coherence. We could also widen these limits by adding additional *qu-bits* that would correct the quantum errors.

In order to detect and correct errors, the classical computers use extra bits. Nobody would imagine that what were proved by Shor and others. The quantum correction of errors would need a new measure of the system with a missing of the quantum coherence. But the quantum errors can be corrected within the computer without the need to read the wrong state.

But it will not be easy to get a quantum computer of proportions that will allow it to compete with the classic ones. But it is worth the challenge. The quantum computers will become superb in laboratories where to study the quantum mechanics. With similar devices and an appropriate program, they could handle other interesting quantum systems.

The quantum computers could help the engineers and scientist to solve the problems with the creation of negligible microcircuits with minimum transistors. These show a mechanical quantum behaviour when the decrease of its size gets to the limits.

It must be said though that its fabrication will not need negligible circuits of atomic scale, or any kind of devices. The nature has dealt with the hardest part of the process through the rejoin of the fundamental components.

# The theory of the intelligent earth

## Definition

The earth, including all the aspects of matter and mind, shows a construction virtually equal to that of a computer, and all its phenomena have a intelligent nature of data processing. That is why we describe it as an intelligent earth.

## The approach

The main idea is that the whole earth is simply a vast mind. This idea is not new, as Platon said the same two thousand years ago in his "world of ideas". More recently, in last century, sir Arthur Eddington was thinking the same when he stated: "We have started to think that the matter of this world is mental matter".

My own conviction of this statement has been strengthen gradually due to my studies in modern electronics. Such modern electronics is the art of handling information or data, with models of electrical waves that can be fitted in a devices such as a computer or travel in the space with a light speed, as the radio and television emissions.

All these devices or phenomena developed by man are related when dealing with data for professional, leisure and communication purposes. But if someone applies instruments to these systems to see what happen inside them, the only thing that one can see is vibrations and forms of wave.

But if afterwards one turns to a natural universe and analyse it in terms of solid matter or radiation as the light, will find something similar.

It would be evident that the natural luminous radiation through the atmosphere are very similar to the communications that are carried out by the man, because both are part of the same electromagnetic spectrum and the only difference is that the light vibrates quicker than the radio. The 99% of the whole energy consists in light and other cosmic radiations and the man has only found a use of similar radiations: data transmission. It would not be too strange then to think that the natural cosmic radiations exist essentially with the purpose of transmitting some sort of data.

The idea that the solid matter is also intrinsically "data" is not so clear. But in 1927, Luis de Broglie, demonstrated that such matter can be considered also a wave or a vibratory system. The previous quantum theory of Max Planck had represented the atom structure in a similar way in terms of wavy movements of the electrons into orbit. All these discoveries indicated that the only way to describe the matter was by using mathematical equations rather than see it as a conglomerate of microscopic balls. Profesor Eddington began to suspect by 1927 that "the matter of the world is mental matter" but rather a mental mathematical matter.

If there had not been more scientific discoveries since then, I think this concept would have remained as an interesting metaphysical speculation. But after the last war there have been two significant discoveries, one in the molecular biology field and another in the development of the computer science. Both are equally significant and their implications are tremendous.

### Molecular biology

The molecular biology is a development that has been made in the last ten years and was due to the previous biological believes to attribute a fundamental role to the chromosomes' genes in the development of the structures in living creatures. The progress in the chemical analysis showed that the important thing was not the tiny gene but the chemical substances it was made of and, in particular, certain molecules known as the deoxyribonucleic acids (DNA). This DNA differs from the other

inert substances in the nature of its atoms' structure. It is virtually a "scheme of the life" and has all the information or data that its development needs, as well as the preservation of life and differentiation of all the species. But how can it be possible unless that these "inert" molecules of DNA are in reality data and nothing more than data? While sir Arthur Eddington considered the solid matter as "mental matter" we can see in the field of organic chemistry that the data of the inert matter can contain the difference between an elephant and a giraffe. The result for a molecular biologist is that the nucleic acids should be treated as data complexes and use the computer methods in deciphered code.

## Chemistry

The molecular biologist should handle this chemical substances as codified information, and become a decipherer of code. But if we have a look on the whole range of chemical substances we will find a parallel situation. Each of the hundred different chemical elements is specifically digitised by the electrons number in its orbit or by the number of nucleons in its nucleus. This information is simply a numerical code. I can describe an element as "nitrogen", but I could also call it "seven", it atomic number. But the interesting thing is that this digitised number are the result of specific natural electric waves' models (quantum theory), and each molecule has a different waves' model but specific, a specific code, specific data.

## Computers

The computing works through the interaction of an electronic model (the program) with others (the data memory) to produce new electronic models (data processing). This is exactly what happens to the natural chemistry, where an acid is a program to produce the salt. This is also what happens in then nature with the acorn that serves as program to produce an oak.

All this suggests that the natural processes of the earth are almost identical to the data processes that take place within a computer. The following table develops the complete correspondence.

| The computer | The earth |
|---|---|
| 1. The structure of the information in a computer (data) follows a electrical model (codified data) formed by elemental identical digits. | The structure of the physical matter is also digitised in elemental particles as the electrons, neutrons, etc., and the most significant features of the different types of matter correspond to different electrical models. |
| 2. Data processing.<br>The conversion of data through processing is made by the superposition of one of the electrical models (the program)on some stored data (memory) that are also electrically structured and the result of this processing is a new electric model. The data processing in computers is in its whole a question of transformation of electrical models. | The physical matter transformation is called "chemistry" and takes place through the transformation of the electrical models related with the orbits of the electrons round the atom nucleus. The natural chemistry can be considered a natural data processing. |
| 3. Data programs.<br>In a computer the data exist in two different levels, as programs or as memories. The programs have a higher power and efficiency, since the programs can modify them and cannot be modified by them. I will call this difference "intelligence" when it is a potential and "will" when the data processing takes place. | In the earth there is evidence that in the chemical processes, certain processes have a higher level, or a programming level. A acorn is a program for the oak and can be considered more intelligent than the elemental data of water and dioxide of carbon that form the tree. In another stage, the DNA can be considered the program that produces the acorn and, therefore, has got a high level of intelligence. |
| 4. Letters and words.<br>In a computer, we establish a convention of electrical models (binary digits) that can have a meaning. It can be then a simple electrical model that represents the letter C, whereas other more complicated can represent the word "gato negro"(black cat). In this way we establish a language and a grammar through the electrical models. | In the physical world we can establish a language of letters and words with the different elements and chemical compounds where the elements are letters and the compounds are words. It seems that the nature uses two alphabets: One of some 100 letters, for the construction of the words of the inorganic chemistry, and another that uses the letters "hydrogen", "carbon", "nitrogen" and "oxygen" for the words of the organic chemistry that we can recognise as elephants and giraffes. |
| 5. Data transmission.<br>The data transmission in the computer is carried out through an ondulation of electrical models. In this way the data can move from one place to another. | The data transmission in the nature is carried out through equivalent electromagnetic waves that we know as light, X rays, cosmic rays and other varieties of radiation. |

The data substitute the energy as the prime matter of the universe.

The physic considers generally the energy as the main prime matter of the universe, that is organised in different ways and whose mathematical expressions are known as Natural Laws.

The hypothesis of the intelligent universe considers this organisation with the name of data. This supremacy of the data should be considered as objectively present and not as a mere abstraction of ideas of the human observer. The objective reality are the objective data and in fact this reminds us the religious statement: “at the beginning was the word”. When all that exists is a construction of cosmic letters, cosmic words and cosmic thought. Professor Eddington was right when he said, in 1927, “we have started to think that the matter in this world is mental matter”. Nothing more exists.

The idea that the universe could be “mental matter was propose by sir Arthur Addington in his book “ The nature of the physical world” before the II World War. But there are two develops in the fields of the biological molecular and computing that add an additional weight to this hypothesis, because the molecular biologists have to consider the nucleic acid as a complex of information, whose deciphering recquires criptographical techniques. There is also an almost perfect parallelism between the working of the chemistry and that of a computer.

There is also the possibility that the cosmic radiations are some system of data transmission, because the universe is basically a phenomenon of cosmic radiations and the radiations made by the man, as the television or the radio, only serve to transmit data.

# Data

We have described in the precious 2 chapters the meaning of "intelligent" and "cybernetics", with reference to *The intelligent earth, cybernetics philosophy*. We have defined "intelligence" as the condition and qualitative measure of a cybernetic process controlled and effective. But there is still something missing, the row matter of the situation, that we will see in this chapter.

## Definition

"Data" means knowledge but it should be understood in a more generic sense than just the human knowledge.

## Mind and matter

The study of philosophy shows up that its main theme is that of the mind and matter. The 40 most important philosophers from the Greek time until now are basically divided between those who defend the predominance of the mind, and those that defend the predominance of the matter. We should place the best part of the modern science besides the materialist. This duality of the mind and matter has been solved sometimes by saying that "everything is mind" and other times saying just the

opposite “everything is matter”. We can find also in some obscure work of Karl Marx the suggestion that the true lies in the identity of the mind and matter combined in the behaviour.

But the fact is that the duality mind-matter is still alive. The cybernetics set out a modification of this duality by proposing the relativity of the mind and the matter and because the relative concepts are always triadic what about the third part? My interpretation of the cybernetics is that we can consider a triadic analysis formed by: relative mind, relative data and relative matter.

The innovation that we introduce is the concept of data or relative data, that serve as intermediary in the duality of mind and matter. That is that the data are able to interact not only with the matter but also with the mind and all the industrial systems of automatization cybernetic depend on our capacity to create such construction. The data are important in this bipolar aspect and my analysis of the capacity is that the data self are triadic and made up of in three factors: potential meaning (interaction with the mind), codified language, physical model (interaction with the matter).

We can use the Spanish expression “gato negro” (black cat) as a codified language. But if someone that speaks Spanish see the words “gato negro”, these will have a meaning to him, as he can associate the term with all the black cats he has seen. This is the aspect of the “potential meaning” of the data. But if we gave that expression written in a paper to a Chinese he would not understand what it means. The only thing he could say is that there are some signs, some of which are repeated, the *a*, the *g*, the *o*. That is the pure physical aspect of the data.

The data are like a coin with two faces, one is the potential meaning and the other is the physical model. This fact allows the data to act as intermediary that joins the mind with the matter. But we should take into account that we have said that everything is relative, there are no absolute, and what is matter in one context could be mind in a different ones. We will talk about it in the following chapter.

In a computer, this analysis of the three aspects of the data has the following form: as potential meaning we have the meaning assigned by the programmers to a certain binary code, and after we have the physical structure of electrical tensions, that is what we will find inside a computer.

## ELECTRONIC DATA

At the end of chapter 2 I explained that the main foundation of the theory of the intelligent earth is based in what we can learn of the working of a computer, first analysing the basic nature of the computers and the extending to a universal principle.

The central fact of the computing science are the electronic data, so we will go deeper in its definition. In the analysis of data that we have just set out we have seen that they have three aspects in its electronic form: true or potential meaning, binary code and electrical structure.

In order to illustrate this argument, we will take the word "cat" and observe how we can analyse it from the three aspects of electronic data. Firstly, this word has a real meaning for the programmer of the computer, because he can associate it mentally with his experience with the cat he recognises. We do not want to analyse this meaning but take it as a fact of the human experience. If I would ask you: do you know what I mean when I say cat? You will probably answer: "Of course, you mean those mystic hairy animals that scratch when they do not want caress". and I could only answer: " It is not doubt that you understand what I mean with the word cat". The next a programmer has to do is to say "cat" in the binary code. The binary code is something really simple, you take the symbols o and 1, the two first numbers and put them in a unique sequence that represents each letter of the alphabet. For instance, the programmer could establish the four letters of the word gato (cat) as follows.

| Letter | Binary code |
|---|---|
| G | 00 |
| A | 01 |
| T | 10 |
| O | 11 |

So *gato* would be spelt in the binary code 00011011.

But why does the programmer use the binary code? Just because the computer understands only the electrical signals, and there are in the na-

ture two types of electricity, the positive (+) and the negative (–). It is simple to make a correspondence between the positive electricity (+) and the negative one (–) with the binary number 0 and 1.

In electrical terms that would be:

| Gato = | 00011011 = | +++--+-- |
|---|---|---|
| (meaning) | (binary code) | (electric structure) |

People with some knowledge in computers usually think of the binary code in terms of 00011011 exists within the computer, but it is not so, because the only thing that exists in reality is some positive and negative voltages (+++--+--) So, the binary code is just a intermediate link in the process to transform a concept with a real meaning in a electrical model that the computer can understand and manipulate.

The true reason to use an intermediate as the binary code, or any other code, is that the programmer cannot think directly in terms of electricity, but only in terms of abstract model, and the binary code is the simplest way to represent such model.

The philosophical division of the reality between mind and matter become a triadic relativity of meaning, data and matter. The data self are triadic, so that they can interact with the mind and matter, and contain the three elements of potential meaning, codified language and physical structure. In computing, the data are represented through the triad of real meaning, binary code and electrical structure.

# Data in the nature: the basic fundament of physics*

In the previous chapter we have already dealt with the general importance of data and the processing of data from artificial computers to the natural world. We said that the different chemical elements form a natural alphabet of data and that chemistry is the processing of natural data, but when the nature wants to create complex forms it rather uses another shorter alphabet of only four letters (carbon, hydrogen, oxygen and nitrogen) and take with them sentences and words quite long.

We have gone deeper in the world of microscopic particles, but we have not got till the end. In this chapter we will examine the lowest level of the physical world to understand if the concepts of the processing of natural are still valid.

## THE CRITICAL QUESTION: "THE BASIC FUNDAMENT"

I agree with the statement that our universe is an intelligent universe. This theory is more reliable than any, especially because there are not many (at the moment it does not exist any coherent scientific cosmology), but is still rather feeble as to be accepted in an absolute sense. However, there is a possibility to put an end to this situation:

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* David Foster, *Intelligent Universe,* 1981, London.

*If it were possible to identify the absolute "basic fundament" of physics and demonstrate that the nature of this basic fundament is based on the theory of the intelligent universe.*

## The basic fundament of physics: the constant of Planck

The most elemental "brick" of the universe was established many years ago with the constant of Planck (*h*). The most useful category of physics is the radiation, and the most typical is the light, and the constant of Planck is simply a wave of that light. The wave is electrical, and consists in a vibration between the electrostatic and electromagnetic principles and it is almost like a vibration between space and time.

The most elemental feature of the universe that it is ... an electrical wave.

But if one considers the computers and the human communication systems, we can see that the elemental unity of information is also an electrical wave formed with half of a positive cycle and half of a negative cycle, and if we take the two halves separately, we can establish the base of the binary information system. And therefore we can consider the constant of Planck as the cosmic binary digit.

We can establish then that the brick the universe is built with has exactly the same form than a information unity as those of the computers and the communication systems. It also proves that "the universe is made of electricity".

# Data in the nature: molecular biology

In the previous chapter we have seen the "basic foundation" of the physics, the constant de Planck, a simple electrical wave that could perfectly serve as an elemental electrical mark, with which we could build a natural alphabet that could generalize the universal processing of data in the nature, especially in radiation.

We have considered also the chemical elements as a natural alphabet of some hundred letters, but we will notice that the nature took rather a shorter alphabet of only four letters (carbon, hydrogen, oxygen, nitrogen) to form words like "elephant", "giraffe" and "man". In this chapter we will analyze in detail the use of this alphabet of four letters from the point of view of the molecular biology.

## Molecular biology

In the last hundred years there has been an intensive search of the "secret of the life" with its living creatures, such as plants, animals and man. Since immemorial time has been obvious that a "acorn is the program to build a tree", this was a rather behaviorist knowledge, and all that it meant was that it was that from a plant, a acorn there were some possibilities of growing a oak, and of course, but any possibility at all to grow another thing.

But the science does not study only behaviorist facts, and for some years now has been cleared up that the meaning of a acorn should be

search in its individual cells, especially in the nucleus of those cells, its genes, and chromosomes of that nucleus.

The biologists had state that the structure of the genes in the chromosomes contains the basic description of the reason for an elephant to be an elephant and the giraffes, giraffes. But recently a new science has come out, the molecular science, that has analyzed how the genes are made with the four elemental letters of the natural alphabet ("words") that we have previously described and how the secret of life should be searched in the molecules, that do not have in themselves any feature of life. Life is a product of inanimate matter!

## DNA AND RNA

The main idea from a chemical point of view is that the organizing centres of the construction of the matter are proteins, that are amino acid complexes, and two groups of these protein, the deoxyribonucleic acid (DNA) and the ribonucleic acid seem to combine all that is needed to create life from the chemical organic elements: carbon, hydrogen, oxygen and nitrogen.

We do not have enough space in this book for a detailed analysis of the foundations of the molecular biology, but we can summarize it as follows:

1. "Life" seem to be organized but information's centres featured by the structure of molecules, DNA and RNA.
2. The molecular biologists have copied the vocabulary of cybernetics when studying the mechanism, with terms such as: codes, codify, decode, information's flow, transference of information, dictionaries of dual languages, programs, memories.

I transcribe a paragraph of a molecular biologist:

*"We believe that the informational nucleic acids (DNA and RNA) are compounds of only four subunities with different information. The*

*information of the genes is codified as the sequence of the four types of subunities of nucleotides, in a similar way as an English message can be codify in a sequence of subunities of point, line and space..., the Morse code"*[6].

This statement could perfectly have come from a computer programmer talking about his job. There is any doubt that the fundamental facts of the molecular biology are written in the data language and the data processing in general, and based in the natural alphabet, reduced to four letters in particular.

**Summary**

The language, techniques and processing of data, control the molecular biology that tries to decipher the secret of life. The two types of scientists that handle this are the molecular biologists and the programmers of cybernetic computers.

## THE EARTH IS A COMPUTER

A comparison between the earth, the secret of the man regarding the information. The earth comes from the sun and this from the Milky Way. The rest of the planets also come from the sun and the moons of their respective planets. The man comes from the binary system, father, and mother. When a man is born, his brain is without information, *tanquam tabula rasa*. The earth when it came off the sun millions of years ago, was also without information, there were no plants, no animals but it had some hundred of chemical elements (hydrogen, oxygen, carbon, etc.) and with them it would form syllables (oxygen and hydrogen = water), words and its language (minerals, plants and animals and the man) With this alphabet of some hundred chemical elements and with the help of the solar pro-

[6] Menninger, J. R., "Science Journal", 1965, p. 40.

gramming we can see now the evolution of the earth. The nature chooses an alphabet of 4 chemical elements (hydrogen, oxygen, carbon and nitrogen) for the life and to create the human intelligence.

The man gets the outside information through the senses that the brain processes and keeps it in its memory. The earth gets the information through the sun, processes it (the photosynthesis, for instance). By the amount of information the earth has got and for its evolution we can deduce that it has millions of years old. We can also see that the earth, the sun and the whole universe is more intelligent than the man. The creation of chemical elements to form the compound bodies, to create life, the plants, animals and the man, is a prove of the universal intelligence.

When the brain is full of information we can deduce that its end has come, it has any memory's capacity left. The solution is the continuity, to make another brain. The same way when the earth will be completely informed, evolved, developed, then its end will arrive. The solution is the continuity, another planet. The succession of the earth is Venus, that is already forming to be inhabited and development of life like in the earth. It seems that Venus will be the last planet with life, because Mercury is little like the moon. When the solar system was created was not entropy, the sun was bigger and its rays arrived till Pluto, where there was also life, afterwards the life continued in Uranus, Saturn, Jupiter, Mars and the Earth. Lastly it will end in Venus. Then the entropy would have risen much and the thermic end will come, because the sun will continue the consume of energy. The solar system goes back to its galaxy and so on and forever and ever, since the matter and the energy, is not created, is not destroyed, only changes.

The purpose of the man is to look after and improve the earth, the sun and the earth have created the man for this purpose.

# Nature data: matter and chemistry

The development of the theory of the intelligent universe has shown the existence of a triad of fundamental complementary elements, integrated by data, intelligence and cybernetic process.

Of these three categories, that of the data is the most fundamental and in computers we have seen that they have an electrical model of data. In the previous chapter we saw as well that the human data exists in 6 levels, dominating the higher number the lower ones. Now we will examine the most general case of the existence of data in the nature. The hydrogen atom as the basic elemental memory.

In the computers, the faculty of the memory is reached by binary numbers, making the electrons to turn in the sense of the clockwise to get the binary bit 1 and in the opposite direction to get bit 0. This turn of electrons is called magnetism. If the electrons rounds in one sense they create north poles and if they do it the other way they create south poles. If we draw the attention to the natural world of the matter and think of creating a natural computer, we should find a system where an electron would be inside a memory and this system is the hydrogen atom. This atom establish a correspondence with the most elemental component of a computer, because there is a positive electron to get the binary bit 1 and however, be still inside of the structural sense in its orbit round the proton nucleus. This is the basic natural memory.

## The alphabet of chemical elements

The hydrogen atom, considered as a basic code, establish the equivalent to the bit binary 1, although its absence could be interpreted as the equivalent of the binary bit 0. But this would be an artificial concept, because it is clear that the nature has established an alphabet of some hundred letters that has a correspondence with the some hundred chemical elements of the table of Medeleiev. The point of view of the nature match up with some extent with that of Bernard Shaw, who proposed an alphabet of some 46 letters but I think both overdo it a bit. In any case, the nature has established an alphabet of data memories of some 100 letters, each of them unique and specific, and with it a sophisticated language could be created. Such alphabet allows many more possibilities of combinations and permutations of codes than the simple binary 1 and 0 of the cybernetics and seems that the nature is ready for any eventuality, no matter how remote it is. Fortunately, however, the nature has not used all the power of this alphabet in its "spelling" and the majority of the natural letters are mere curiosities rarely used.

## The electrical structure as alphabetical meaning

The difference between these natural letters of the chemical alphabet, appearing in more that hundred different chemical elements, has differences in its electrical structure, particularly of the number of electrons in orbit round the nucleus and the way they perform that orbit. This is the field of the physics and chemistry in general and the quantum theory in particular. But as this book is addressed to non specialized readers, you may accept my word when I say that the essential difference of meaning, between these hundred different letters of the natural alphabet that we call chemical elements is purely a question of different electronic structures.

## The chemistry as processing of natural data

In previous chapters, talking about the electronic processing of data, as a way of example that was iron mineral de iron + coque + heat = steel. In the world of natural computers, an analogue example would be:

Hydrogen + Oxygen = Water

We establish the correspondence between the natural chemical processing and the data processing and the majority of the chemists would agree with that idea.

The chemistry in its whole establishes the laws and facts as "if you add this you get that" is exactly the same that the processes that take place within the computers and, in fact, that is why we can control industrial chemical processes with computers. If there is possible to represent it with an equation it is because it is within the data field but objective data, because an element or a chemical compound is nothing but data.

## The favourite alphabet of four letters

Although there is no doubt that the nature has established an alphabet of a hundred letters, represented by the chemical elements of the periodical table of Medeleiev, there are some indications that he has repent afterwards of the excess, since even Bernhard Shaw proposed only 46 for the English language and even so it is difficult. When the nature started to make really interesting things in the field of natural processing of data, it decided that it has already exceeded and when it started to create elephants, giraffes and even man, it used an alphabet of only four letters: carbon, oxygen, nitrogen and hydrogen.

Even this reduced alphabet of four letters is absolutely superior to the binary system that we use in computers, because such system ca only produce electrical models of the range $2(n)$, where n is the number of letters used, whereas this new alphabet of four letters can produce models of a

range 4($n$). The man has chosen the 2 as magic number in his system of electronic codification; the nature has taken the 4. Who can say which one is the best? We can put it another way. WE can choose an alphabet with a high number of letters where the words would be short. Or we can choose an alphabet with few characters and where the words would be more complex combinations of the basic letters. It seems that the nature has opted for the second option in the organic field.

## The words of the organic chemistry

The nature has opted to use an alphabet of only 4 letters in all its creations and therefore has experimented a inevitable consequence: the words that form with so few characters should be rather complex. That is similar to the human experience in the binary system of only two letters (1 and 0) in the computers, so that our words are very long and complex. Who are we to discuss that decision?

## Human binary computation and the natural quaternary computation

The words and sentences expressed in the computation establish the uniqueness of a identity or a situation, and we can image that in the nature such differences of identity or situation can be perfectly the difference between an elephant and a giraffe. We will compare the difference between the human disposition (2$n$) and the natural (4$n$) of the number of letters required in a word to form an unique combination:

| Number of letters | Words (human binary computers) | Words (natural quaternary chemistry) |
|---|---|---|
| 5 | 32 | 1.024 |
| 10 | 1.024 | 1.004.576 |

We can see that the natural alphabet of four letters, or organic chem-

istry, has more permutations and combinations, much more than our binary system of our computers.

If we draw our attention to the natural world and ask ourselves why there are indications of structure's elements and electrical codes amount to those of the artificial computers, we find the following correspondences:

1. The hydrogen atom, with is only binary bit, represents the natural basic memory as the most elemental letter of an alphabet.
2. The complete table of chemical elements, about a hundred, is in reality a long alphabet, and its interactions in the chemical processes are a sort of processing of natural data.
3. The nature seems to prefer for its complex developments a short alphabet of four letters, that are carbon, hydrogen, oxygen, and nitrogen.

With this short alphabet and using rather long words, the nature make up sentences of the organic chemistry that originate the living beings.

# Universal principles of the cybernetics

In the first half of this book I have studied some scientific facts and I have deduced that all pointed in just one direction: the possibility of living in an intelligent universe, analogue to the computers that we build up. In this chapter I will formulate again these scientific facts as a mass of postulates or general principles that are the fundament of a developing cosmology.

## THE FIRST UNIVERSAL PRINCIPLE: STRUCTURE AND DESIGN

We can only be sure of one thing and it is that the universe reflects a designed structure; the structure has got some kind of design. The reason for this fundamental structure is that it is the most inherent feature of the creation. What could be the creation if it could not be materialized as structure? Even if you are platonic and believe that the essential feature of the universe is "a world of ideas", such concept is also structural. It implies a difference as the one in "this" and "that" as ideas, and the relation between them as ideas. The structural aspect of the universe is fundamental, no matter if we refer to the ideas, natural laws, sulfurous acid or excavators.

With the term "structure" I am not meaning necessarily to some sort of geometrical design in the space, because such structure can be perfectly in the time, in which case we would better call it process's struc-

ture. We do not have also to limit our concept of mathematical structures to space and time, because the mathematical structures do not need any dimension. The fact that "two and two are four" is a structural design.

The prove of the reality of the structure is that we could describe it somehow and communicate such comprehension. All sorts of language are structural (like data) and it does not matter if we try to describe the structure with words (written or spoken), with music or in a painting. All the efforts of communication are efforts to describe a structure through the respective structure of some sort of model of human data.

### THE SECOND UNIVERSAL PRINCIPLE DATA

If I have got in mind the structural concept "two and two are four" all the world will agree that these are data. But if I write down "two and two are four", these are not simply data but a superior type of data, because there are now in a more easy format. But there are still data.

Let's talk a further example and imagine that I am a car's designer. I have got an idea of the new car, and this idea is certainly data in my brain. Now I write down the scheme and the detailed specification of this new model. These are the same data as my ideas, but I have changed the matter that contains them from the mind to the paper. Finally, the car is built following my schemes and that vehicle incorporates exactly the same data that were in the mind and in the paper. There is no doubt that that car, fabricated mostly of metal, is nothing more than data in a different matter. We come to the idea that the same data can exist in different formats, depending on the matter or the code, but always being the same data. What is the difference between translating data into Chinese or into metal? The structural model is the same in both cases.

I have come to the conclusion that everything is data, as long as it has a structure that can be described and the matter is indifferent for each situation. With this we can close the gap between mind and matter, because we do not differentiate philosophically between models of my own mind as data and the models in any other matter of the physical world. That means that the models in the nature, including the natural

laws, are inherent to the nature self, and as long as our human mind can have respective or even distorted ideas of those models, they exist as natural data. The breach with the approach of the inherent natural data as different from the human impressions of those data as ideas, comes from the science in the numerical aspect of the nature, when this numerical aspect is detected by inanimate instruments. If we only use the reading of one instrument as indication of what the science knows about the nature, we could object that those measures are only an analogy of what is really happening, and that was the point of view of Eddington. But with the recent methods of digitalization or numerals of natural data, this subjective interpretation has no validity any longer. If we use an electronic device to analyse the frequency in order to count the vibrations in a wave r of radio and we get a figure of 1.423.675 per second, that is not an analogy of the real situation: it really vibrate 1.423.675 times per second and that is an objective natural datum.

Eddingtom faces the problem of being the measures different from the nature because "the things in themselves", and he was right. But if he would realize that the concept of "things in themselves" has no sense, but that data are the main fact of the nature, his problem would have disappeared. In fact, he was close to the idea when he said: "We suspect that the matter in the world is mental matter". This is the truth.

As many philosophical ideas are completely subjective (as the duality mind-matter) and reflect strictly the way human beings think, there are solid bases to consider that the natural data exist in models that are in the nature which surrounds us.

## THE THIRD UNIVERSAL PRINCIPEL: NUMBER OR DIGITALIZATION

The "number" is the most elemental aspect, of the structure of data. If we take for instance a triangle, what struck us most is that it is dominated by number "three": has three angles and three sides, and that is why it is called triangle. I would like to say that number three is an example of objective element of data that it would not be much different of the point of view of the human being or the man on the moon. The fea-

tures of a number can be completely objective. Can be any doubt that our solar system has only one sun, or that Jupiter has nine moons, or that the human being have 5 fingers in each hand and each foot?

In the previous section I suggested that natural data exist truly as such without any need of a human intervention, but in this section I am dealing with the numbers as a category of cosmic data and the base of the cosmic structure.

The category of numbers is the only one that has not got any controversy of any kind, because nobody talks about number eight as "if we only knew the thing itself the real number could be eleven". The numbers end up with the subjectivism because they exist at both sides of the subjective duality of mind and matter. Besides, all the nature seems to be digitalized, as its structures are made by numbers and relations between numbers. This is the essence of the light theory and other sorts of radiation. The most certain thing about a radiation is the amount of vibrations in a certain time. The most certainty regarding the atom's structure is the relations between vibrations in the orbits of the electrons (quantum theory). The most certainty regarding the difference between chemical substances is the periodic table of the elements with the increment of nuclear masses due to the digitalization of the proton and the neutron.

The majority of the nature structure is based in the digitalization of the matter ("particles") and the radiation ("waves") and in the chapter 10 we demonstrated that the basic fundament of the physical world, the Planck constant is simply one of such elemental waves (the basic unity of digitalization). The reason of this absolute digitalization as base of the structure of natural world is easy to find, since the only category that lacks structure is number one" or the simple mark". All we can say about number 1 is that is present or not. We can not say anything about its structure. But the number one establishes the datum for the structure, because as soon as the mark repeats itself to form two digits it starts to exist structure. It starts to exists because is different to "two" and the elemental aspect of the structure is the difference or the relation. If the number to form "three", we begin to obtain structures rather complex, because this number can be order in six ways, and therefore, the number three establish the aspect of the structure that we could call "regulation".

Both can be combined and the computers sometimes use both techniques to classify and process data.

We get to the conclusion that all data, natural or human, are digitalized in the sense that if we observe with a microscope we will get to see the digits or elemental marks, as if we were watching a painting with a magnifying glass and see the single brushstroke.

## THE FOURTH UNIVERSAL PRINCIPLE: NATURAL PROCESS AS DATA PROCESSINGS

The first three universal principles of structure, data and digitalization has been described in that order because it the easiest way to understand them. They complement each other as follows:

*The most obvious attribute of the universe is that shows certain structure formed by data with a digital base o, putting it in a different order, the universe is formed by digits or numbers that are organized in models or data that we perceived as structures.*

If we took a picture of the universe we could interpret it as a data complex based in digits. But the other aspect of the universe is the impression we will get if instead a photo we would record a sequence with a video camera, we would have then processes, thins that happen during some time and things that change. Some typical changes of the natural processes are: night and day, growth and aging of the organic life, the climate, etc.

However, if we examine the photograms one by one of that recording and observe the differences, we will see that also the data changes. In other words, the data are being processed progressively. Because the elements of the process are data, the process self can be another thing that the data processing. We analyzed that before and get to the conclusion that all the chemistry is the natural processing of data. We can establish then that the fourth universal principle is the processing of data.

## THE FIFTH UNIVERSAL PRINCIPLE: CYBERNETICS AND ANTICYBERNETICS PROCESSES

We get to the conclusion that the phenomenic aspect of the universe are the data and that the processing of data with an elemental digital or numeric analysis. Our next problem is to try to get away from the phenomenic points of view and go deeper into the problem. I think that reasoning should be based in a structural analysis of universal categories, but the structure could be quantitative as well as qualitative, and from the qualitative aspects of the data and data processing we can deduce some conclusions.

If we have a look to the universe we can see two types f processes: some things seems to go well and other go worse. The universe shows some vertical flow in both directions. When we see that the carbon dioxide and the water are transformed in a oak we can presume that it is a constructive process. When we see a house on fire, it is out of doubt that it is taking place a destructive process. Both types of processes have to exist, if this was not so all would be a wonderful sky or a awful hell. Somehow we are in the middle of that.

The reason for the destructive processes, called anticybernetics, is well known and is due to the blind crashes within energetic systems with potential differences (as if a cigarette falls to the carpet and starts a fire). We are by the second law of thermodynamics what implies that the blindness create processes that diminish the grade of order in the universe. But this observation proves that the universe has the "batteries" on. We can see creative processes such as the water that becomes oaks, proves that there should be also cybernetic principles that can produce relative order starting from a relative chaos. Our fifth universal principle is the conflict or balance between the cybernetic creative processes and anticybernetics destructive processes and as we have shown that all the processes are data proceedings, the balance takes place between two types of data processing.

## THE SIXTH UNIVERSAL PRINCIPLE: INTELLIGENCE AND WILL AS DATA DIFFERENTIALS

We know that the data exist in different levels, being dominated the lower levels by the higher. The teacher can program his pupils. If we take an example of the nature, we can see a acorn exists in a level of data higher than the water and the carbon dioxide that form that tree.

This potential difference of levels of data we describe it as intelligence; and when the acorn acts with the water and the carbon dioxide in a cybernetic process, we describe it as will. The intelligence is the difference of potential of the data for the use of will. It is important that we have not deduce yet the existence of these two categories of intelligence and will through some sort of intuition, but only starting from the fact that the processes of the nature indicate qualitative differences of data and data processing and that is why I use the term "intelligence" to describe qualitative grades of difference between data and the term "will" to describe qualitative grades of difference between data processing.

# Solar programming

After establishing the six universal principles that can be applied to the universe we will search next the indications of the existence of such principles in the relation between the sun and the earth.

The purpose of this chapter is only suggested such indications, rather than developing in detail the cybernetic mechanisms that can be involved.

## THE SOLAR SYSTEM

The sun and its planets constitute a entity well defined as solar system and its identity as system depends on the fact that all the planets revolve around the sun.

The communications between the sun and the planets take place through two tracts: through a gravity field, and through radiations such as the solar light. As far as we know, these radiations do not change in its transit from the sun to the earth, but we know that due to its structure that are emitted by the solar matter. The matter of the sun is formed basically by hydrogen though there is a chemical cycle that seem to involved also carbon, nitrogen and oxygen, the same four elements that serve as piles of the organic life in the earth, whose existence depend on the vegetables (apart from the solar light for the photosynthesis). It seems that the communication system of data exists between the organ-

ic elements of the sun and those elements in the surface of the earth. If we study now what happen during the growth of the plants there are two things that stand out:

— The simple data develop in other more complex when the organic elements in the water and the carbon dioxide become vegetal matter. That indicates that the processing of data takes place in one positive cybernetic direction from the inferior intelligence to the superior and we can consider the final product of the plant as the result of the memory of that process.
— This situation takes place just in one sense, because the solar light is vital for the process of growth of the organic vegetation, but these radiation flow only from the sun to the earth and never the other way.

The fundamental feature of any processing of data is that it requires the combination of a program, with a higher intelligence level, that reacts with a memory of a lower level to produce through processing a result of intermediate level. This is the basic cybernetics.

But if we draw the attention to the photosynthesis of the vegetation, we recognize the water and the carbon dioxide as the original memories of data or the prima matter and we see the result in the organic product and the role of the sunlight, the programmer aspect of the processing of data is not assigned and we know it is vital. It is clear that the sunlight is the programmer aspect of the data processing. That suggests that the solar system is some kind of "computer" or processing data system for the development of the organic life, because any organic development depend on the photosynthesis of the vegetables. But this would not explain why so many species exist.

The organic structure and the variety of species.

We know that the basic data from the organic structure is given by the DNA and the difference between an elephant and a giraffe is described by the difference of the data represented in the disposition of the chemical words of four letters. Once such structures are available, can reproduce, so that the problem of the origin of the species is a matter of

visualizing some sort of Noah's arc of some DNA. Due to the evolutive theories it would only be necessary to start from a fragment of DNAO, (original deoxyribonucleic acid).

The enigma is then the origin of the DNAO.

But because the development of the organic life is clearly a result of the solar light and that the maintenance of the conditions for the life also depend on the sun (the cycle of water and rain), is probable that the origin of the DNAO is (or has been) in the sun. My own point of view on the subject is that the DNAO was originated as a result of intelligent radiation (structural programs) in the sun and that sort of radiation was probably within the spectrum of X rays, because, in accordance with the crystallography, this spectrum is specific for the interaction of the matter structures and the radiation. But with the development of the organic matter the oxygen liberated creates some atmospheric barriers that we know, and refract the next radiation of creative data.

This theory was suggested by V. I. Vearnsky in his book "The Biosphere". The solar program, in order to create life on the earth, contained its own method to stop at the suitable moment. The hypothesis could demonstrate if sterile solutions that contain nutrients developed molds, under the exposition of cosmic radiation, outside the earth's atmosphere, for instance in a spatial capsule.

## THE CHEMISTRY OF THE EARTH'S CORTEX

The changeable chemistry of the earth's cortex seems to be caused by the influence of the sun, directly as solar light and indirectly as rain. This has been described by V. I. Vearndsky in his book Geochemistry and by E. E. Polynov in his book The Cycle of Weathering and all this is due to the superior intelligence of the sun, that imposes its will over the earth. I use the term "will" in the pure technical sense as a measure of relative intelligence with programming potential.

## Thermodynamic balance of the solar system

The idea that the universe can be wearing away is based only in the fact of the second law of thermodynamics, that state that the energetic systems tend to cool down. This is simply an affirmation referring to the existence of anticybernetics principles based in blind collisions of energy. Although we do not discuss the truth of the second law of the thermodynamics in the limitated sphere of the energy, the true is that the universe is wearing away, and that force us to accept a cybernetic law also as universal. No matter if we believe in a start with an explosion or a continuous creation, or in a cyclic theory, the fact is that if the universe is wearing away, is because at some point its "batteries were charged" or they are right now being charged. Now we can ask ourselves if that "charge" is exactly the same as the cybernetic process and the answer is yes. The anticybernetic process of the second law of thermodynamics is simply a statement that we should avoid by an intelligent behaviour, by the devil principle of Maxwell.

The second law of thermodynamics is an universal law, and as the universe has not wore out yet we should believe that the cybernetic process should be also universal and that the universe should have the same attributes of intelligence and will. As our solar system is far from wearing away seems that the cybernetics processes of blind collision should be in a sort of balance with the solar cybernetic powers in general and with the intelligence of the sun in particular.

We are going to see an elemental explanation of the importance of the transmission of data and the intelligence in relation with our solar system, reaching the following conclusion:

1. The photosynthesis of the vegetables and the structure of the species have been programmed by specific models of solar radiation data.
2. The chemistry of the cortex seems to be completely dominated by the solar programming.
3. The balance between the anticybernetics and cybernetic powers in the solar system is due to the intelligence of the sun that counteract the effects of the second law of thermodynamics.

# Communications and cosmic codes

We have developed a general chart of the universe as a complex of data and data processing. In this chapter we will study the global nature of the cosmic process of data in terms of information's mechanics for communications and computer codes.

## The cosmic radiation sea

If we built a camera hermetically sealed, without objects and air, we could imagine that inside theirs is simply "pure space". But if we put a radio machine inside that space and put it on we would realize that the space is full of radio waves emitted by many stations. But such waves are mere radiation produced by the man.

However, if we introduced next more sophisticated instruments able to detect different radiations, we will see that the space is also full of radiations emitted by the sun and the stars and, in fact, by every part of the universe. The idea is that we live in a true sea of cosmic radiation and if we travel to any part of the universe this sea of cosmic radiations would be the most characteristic aspect of our surrounding. As professor James Jeans said "We live in a universe of waves and nothing more than waves!".

## Waves in the space, the time and the eternity

Since the theory of relativity was discovered it was clear that there are no time or space in an absolute way, and that the fundamental reality is the radiation, that originates the space and time. But this radiation is featured by the main phenomenon of being formed by a train of waves. The basic unity of each wave is characterized by an oscillation between an electromagnetic field and an electrostative field. The size of the electrical field, "the length the wave" creates a space's unity, and the duration of the magnetic effect ("the period of the wave") create a unity of time. The space and time are therefore digitalized by the presence of an electrical wave and this is the basic reality of the physical world.

But if I am in a specific place, for instance, in the surface of the earth, and see from there the radiations of the solar light it seems as if the light is always there, even if we know that each ray of the sun has a speed of 300.000 kilometers per second.

Due to this regeneration of waves, it seems that we have a permanent phenomenon and I call this aspect eternity. The same as the time and space are features of the wave, this internal aspect it is also a feature. The eternity is the most characteristic aspect of the physics, because it becomes apparent in all the matter, the organic and the inorganic. We know that the inside of an atom there is a considerable activity, for instance, the electron turns around the nucleus. But these rotatory waves turn forever. An atom does not wear out, and does not get less energetic or slower: it has perpetual movement, as a wheel that once it is on keeps on turning without stop. In the case of the atoms, the waves never decelerate.

## Qualitative difference of the cosmic waves

Any cosmic wave (for instance the solar light) is different qualitatively from other, just by its relative frequency of vibration, and its energy is proportional to its vibration speed. The energy self is created by the frequency of vibration of the wave ("quantum energy") and is digi-

talized by the energy of a wave of a certain frequency ("the constant of Planck" or the unity of "action"). Also that action or energy feature is a parameter of a wave.

The human being recognizes the qualitative difference between the waves (in the case of solar light) as "colour". It is the different between red and blue, the blue represents a higher frequency than the red, the blue light has more energy and more potential of data that the red light.

## Spectral data

The frequencies of waves associated with the radiation or the matter, are specific and exact and, therefore, we can make with them clocks with a precision of 1 over 10 thousand millions. This phenomenon of frequencies of vibrations is an extraordinary fact. An iron atom, for instance, could be featured by three or four frequencies and these are evident if we add some energy while we observe it through a molecular spectrograph. If we find the same model of color in light of a distant star, we know that one of the elements is the iron. This is our only way to recognize which element forms the sun and the star that are hundreds of light years away. Such specific information is called spectral distance or spectral data, and suggests the way the nature communicates and the codification's systems it uses in its transmission of data.

## Cosmic codes

The main system of codification used by nature consists in the combination of different frequencies of radiation to form "letters" or "words". That is a model of frequency and in terms of solar light we recognize it as "compound color". But if we analyze that color with a simple device, as a optical prism, or a sophisticated one, as the molecular spectrograph, we could decompound in its constituent colours or specific frequencies.

This system has its analogy in a musical chord formed by different

notes. Those models have essentially existed with independence of time and space and can be considered fundamentally eternal.

## Cosmic codes in the eternity

If we compare the cosmic codes of solar light and the interstellar space in general, we will find a fundamental difference with other types of codes that we use in the computers. We use data and temporal codes, because the message can only be understood after a certain period of time when the elements of data are shown. This happens in the human speaking and written when a declaration is made because it is necessary to wait until the sentence is finished to be understood. But the nature works in other way and apparently transmits its information at the same time as a synchronic model of specific frequencies related that contain an analysis of color and such information is not only simultaneous, but also last forever. We see that the most general system of cosmic transmission of information is based in complexes of frequencies that seem to be indefinite and eternal as a "permanent message".

## The infinite capacity of the cosmic radiation information

We construct a general chart of the cosmic radiation, as if the nature had a *sea of solid radiation*, that in each situation there is a permanent model of radiation with simultaneous information, that it can be decoded by any system that can react with sense by a certain combination of frequencies. However, due to the infinite spectrum of possible frequencies with a bandwidth of some $10^{16}$ the possibilities that some frequencies form a model with sense is infinite.

When I refer to "bandwidth" of $10^{16}$ what I want to say is that if we define a minimum frequency, the maximum will be $10^{16}$ times quicker.

## The decoding of the cosmic radiation

The location of the universe is in that *sea of solid radiation* with infinite capacity of simultaneous information, the problem is how can a certain location get from there the concrete information that it needs (for instance, for the creation and maintenance of life). We know, fortunately, by an analogy with the radiations produced by man how it is possible that this occur.

The comparative example that I have chosen is that of the radio stations of the earth, that fill the atmosphere with more than ten thousand different programs that are present in each part of the earth's surface, but with each frequency depending on the station. All we need is tune in the station we want to listen to. That the receiver makes tuning by an electronic pendulum "oscillatory circuit" that has in its interior, and that just responses to a specific frequency. When this pendulum receives that frequency, began to vibrate and acts as a door that let the system go in. The selector system is called more frequently "resonance door".

Going back to the cosmic radiations, if we want to decode the model specific of frequency and reject the other frequencies we need several resonators doors, each one tuned to one of the frequencies we want, and that more complex system can be described as a combined system (or multiple) of resonance doors". Such systems are regular in the tones codifiers" of the human electronic communications and work exactly the same, through several resonators doors that let in certain model of vibration frequencies that can be combined in a result with sense.

## Decoder receivers in the nature

These systems are well known, because there is simply matter. When we recognise that a narcissus illuminated by a white light of the sun is yellow, what happens is that the narcissus uses a decoder system that lets the red, orange, green and blue in but not the yellow. This group of four basic colours is admitted through the combined system of resonators doors of the atoms of the narcissus, that would reject the yellow.

The yellow is in reality the only color that the narcissus has not. What we se as yellow is what has been rejected because it has not a resonator door. The same way, when we see "green grass" what happens is that that grass has a combined system of resonators doors for the red, orange, yellow and blue but not the green. The green is therefore the only colour that the grass has not got.

When we see colours in the nature, all that we see is what it rejects. That is very interesting, because it means that the nature accept many cosmic vibrations more than (as the solar light) we have thought and it does not work as just one resonator door, but as combined systems of such doors capable to let many codes of frequency with sense.

In conclusion, the importance of the colour in the nature works by absorbing certain frequencies through its atoms, that act as combinations of resonators doors and what we see in the natural world is just what it rejects.

## Atomic resonators

The resonators doors are well known and are divided in two systems: *a*) the layers of electrons in orbit that absorbed information in colour, *b*) the nuclear resonators that absorbs information of X rays and gamma rays. The effect of such absorption of models of vibration is the stimulation of the atoms in terms of their own nature. However, when the energy of the vibration is huge and the power that goes through the resonators doors that are configured to reject it, the matter can be destroyed and the gamma radiation can provoke genetic mutations. That is the "violation of the matter". What physics makes clear is that all inherent radiation to the mater are also inherent to the cosmic radiations and therefore, the matter is related with the cosmic radiations because it has models of specific vibration that corresponds to the models of frequencies combinations.

It is also possible that the "matter can be programmed for cosmic radiations" because any specific matter "sympathize" with a specific model of cosmic radiation.

The cosmic communications seem to take place through radiations, being the solar light the most typical, and the information seems to be present throughout the space as models of frequency in the eternity. The receivers of such communications are the different types of matter, each of them seem to have "systems of resonators doors" according to the model of its constitutive atoms.

An analogy of this system is the receiver of radio that can tune in a specific selection of radio waves.

# Universal cybernetic invisibility

In this chapter I will analyze the relation between a cybernetic philosophy and the invisibles and intangibles aspects of the universe, and therefore with the physics of the hidden. If our universe has a purpose and a meaning, a vast part should be hidden.

## The design argument

The famous "design argument" tells us that if "we examine an object that apparently has a purpose, as a clock, the common sense tell us that one day should have been a clockmaker, because the clocks do not fall from the trees". But these trees also have a function with sense much more complicated than a clock, and therefore there should also have been a creator of those trees. This argument has two big defects. It suggest that "God is created as the man's image" and because the human devices require a human designer, the natural creations, such a trees, need "natural designers" and therefore the need of "God".

But the second effect is that we cannot prove it, demonstrate it. Nobody has seen God working in the design of tree. This is the best prove of the veracity of the argument of the design, because the designers are intrinsically invisible. But the true evidence of this question points to the cybernetic logics.

## The cybernetic art

The main aspect of the cybernetic art is the design and the use of systems that work efficiently. An example is a system of automatic landing controlled by computer. A better example could be a tree. The man self could be the best example of all. In all the cases it is about systems where many elements work at the same time to develop a efficient function of group. In these three examples, what we see from outside is an complex efficient function. In the nature we observe this from the tiny scale of the atoms till the level of the complete biosphere, that revails an extraordinary grade of balance of systematic powers. Because the sun has a fundamental role in this system (see chapter 5), is reasonable to conclude by saying that our solar system is complete and that is developing a complex efficient function.

As human beings, all we can see in the nature is this systematic design and, in fact, the "science" deals actually with that.

## Quantitative and qualitative sciences

Until 1930 more or less, the science was dominated by physics. The principal category of the physics was the energy and the experiments were carried out by lectures of measure devices that evaluated such energy in terms of relative numbers of magnitude scales. In fact, when you read a book such as *The nature of the physical world* of Eddington, you will get the impression that science consists in such quantitative magnitudes of energy that could be measured in numbers. Even the atomic and molecular structure was based in this attitude of number everything; for instance, the nitrogen had exactly 14 nucleons, whereas the carbon had only, but not exactly 12. With the study of radiations such as the light was the same, there are counted the number of vibrations per second to decide which light was red and which one blue.

But the biology was the first science that turns the face to these quantifications as the only way to describe the nature because it studied living systems that were better described with ordenations rather than with numbers.

More recently, the molecular biology decided that the foundation of life was not only in the ordenations of the molecules but that those ordenations contained basically information or codes. A cow can have the same amount of atoms than a horse but it is the way they are distributed in systems what draw the difference between a horse and a cow, and this difference is a qualitative matter.

The science gets further, going away from the lectures of the measures of relative energy, a quantitative matter, it dedicates to the study of the ordenation and design, that are qualitative matters. I am not saying that the quantitative science is wrong, but only that it can only be applied to the fundamental physic of particles and radiation. As soon as the particles or radiation began to appear in organized structures or processes functions, we go from the quantitative to the qualitative considerations.

## The cybernetics as control of the quality function

Cybernetics handles the design and control of the complex systems. We can use a simple example of a computer that controls a siderurgy and there are many similar cases.

*a*) The complex physical system of the siderurgy.
*b*) The computer that controls it.

There are two lines of communication between these two aspects, one ("perception") that indicates the computer what happens at each moment in the process, and another ("action") through which the computer indicates the process what it has to do next. But it is interesting that *both* lines of communication belong to the computer. So that it has some sort of "double conscience" of the system that carries out the process, first to get what is going on and afterwards decide and act in an effective way to control it.

Both channels of communication *go out of the computer*, one to inquire and the other one to act in the human being. These channels have their correspondence in the nervous systems afferent and efferent.

This leads to a relation of "master and slave" between the computer and the controlled process, where the computer is conscious of the process, but this one is *not* conscious of the computer which controls it. The process is completely blind towards the situation and simply "acts following orders" without having the slightest idea of how these instructions arrive or "why" it is so. In other words, the fundamental essence of the computer is *invisible* for the controlled process, so as the way a driver drives a car.

We can express this as a fundamental principle:

*In a efficient complex system that is under some sort of cybernetic control, this control will be invisible for the system because the consult channels and order are of just one direction.*

## THE SECOND ARGUMENT

When we design a cybernetic system (and I earn my life by doing this), a siderurgy controlled by computer, it is fundamental that the control system works at a higher speed than the process that is under control.

Imagine a siderurgy that under certain circumstances could blow up within 5 minutes if there is an error and such siderurgy is controlled by a computer that takes 10 minutes in observe what is going on and decide what to do. The best thing we could do in that case is run away. The good thing would be that the computer could react in 4 minutes, or even better, in 4 microseconds. That is why a control system should work much quicker that the process that controls, since it has to *anticipate* to any eventuality that could occur and save time to "think". That is only possible if the computer that controls the process works in a different scale and quicker than the controlled process.

But the quicker rhythms of work can contain more information than the slower ones, for instance, a television works at a speed of 4.000.000 cycles per second and a radio just at 10.000 cycles per second. One of the fundamental facts of the information theory is that "the higher the vibration is, the bigger the potential capacity of information will be".

The computer that controls such siderurgy can work at 1.000.000 cycles per second and has a decision time of one microsecond, whereas the siderurgy can work with periods of five minute (the time a oven takes to warm up or cool down, or the time a conveyor belt takes to accelerate or reduce its speed) and this difference is due to the intelligence of the computer, which is much higher and therefore it can think quicker and decide quicker than the siderurgy does.

But now we have an unusual situation. How can a process with a response time of five minutes see, communicate, or conceive a computer whose response time would be of one microsecond, 300.000.000 times quicker? ¡It cannot! We have already seen in the previous section that the cybernetic process is invisible for the low control process due to the one *sense* communication, but now we have an additional argument and rather different so that the process will not see the existence of its control system, due to the different wavelength they work at. We can define it as follows:

*The cybernetic control of a process is invisible for such process due to the different rhythms they work at, because the lowest rhythm of the process cannot comprehend and "see" the quickest rhythm of the cybernetic control.*

A strange conclusion: the inherent invisibility of "God". If we are in a cybernetic universe that shows a purpose and meaning, then the control source ("God", "Cosmic Reason", "Nature") should be invisible for the reasons we have shown before when talking about "the unique direction of the control's communication" and "the difference of the cybernetic rhythm" unreachable from a slower perspective. The defenders of the design argument ca not prove their points of view when presenting a visible "God" and that makes their statement even more correct. In fact, if I had seen the "God, the creator" in Technicolor, I would have declared without any doubt that this could not be a cybernetic universe and that that "God" was an abuse and a fraud. Because any genuine creator and ruler *should be invisible*.

The implications of the cybernetic arguments indicate that if there

are superior levels they should be invisible (by "cybernetic direction" and "rhythms' differences). They also indicate that those superior levels would like at some point to show up and they should do it at a "controlled process" level. In terms of human society, that means that the superior levels could only be demonstrated as human beings with the same basic rhythm ("vibrations").

Christ and Buda did exactly what I have explained, and that provided me with their approval to my reasoning. How lucky have I been!

# The purpose of the Universe

We seem to live in a universe that if we watch it from the outside, reveals a digitalised construction, like an electronic computer and we are tempted to suggest that the inside is also formed by data, processing of data and meaning. This vision is accentuated by the existence of the organic nature and the need to handle deal with the life, the DNA and RNA like a information code. But the theory of relativity and our experience in life, based in the common sense, makes us go to "the inside" of the events to witness a triadic construction of "it". That verifies completely that only the meaning or the intelligence is able to validate the experience. No matter if we look the universe from the outside or from the inside we will arrive to the fundamental fact that *everything is intelligence*.

But the intelligence and the purpose are together and so we can make the following question: What is the purpose of the intelligent universe? I must confess that the only answer I can find is that its purpose is to become more intelligent. There are some who are the opinion that, somewhere behind the universe there is a wide surface of intelligence that creates everything, but then, what sense has to create a universe to demonstrate the intelligence that is always present? This leads us to a wrong understanding of the nature, where the intelligence should be involved with the *experience*. There is not intelligence in the emptiness. That means, the intelligence and the creation are two ways of looking the same subject, because the creation is simply the outlook of a experimented success.

That is why the created universe in itself is intelligence, although we have seen that the relativity of the intelligence can have three manifestations: imitiatory, reply and impartial.

Because the word "intelligence" embraces the whole reality, being this the essence of the relativity, the purpose can just refer to some aspect of the intelligence. But what can we say about the intelligence but that it can be more or less in a quantitative sense? Or, simplifying the question is the universe becoming more, or less intelligent? Because I do not see any *purpose* in getting less intelligent, I can only set out that:

*The purpose of the universe has to be to become more intelligent*.

Of course, this seems to be certain if we take into account the facts of the evolution in the organic life, because the direction of time is that of the evolution of the beings towards the possibility of a superior intelligence, whose main point seems to be the man self. If we put it in other terms, we can apply this postulate of the universe and affirm:

*The purpose of the man is to become more intelligent*.

It is not really complicated and I think that this is true for the man as individual and for the society in general.

# The eternal return

The solar system will be recycled, going back to the Milky Way, where it came from, to regenerate and concentrate its wasted energy. It would mean the thermic end of the solar system, In accordance with the second principle of the thermodynamic, will take place when reaching the maxim of entropy, and obtaining a uniformity that would make impossible any chemical or physic transformation. It will arrive a lack of the energy needed for the different phenomena that conform the dynamic and the life in the solar system. The rise of entropy carries a degradation of the energy and the thermic end.

Once the solar system will be recycled it will come to work again, appearing the life and humanity in every planet. All the human beings will appear again, but because our current memory is been destroyed by the death, we will not be able to remember anything. A new humanity, and so on and forever, before, now and after. They are eternal cycles.

### THE BRAIN EARTH

The brain (hardware) receives the information through the five senses, process it and keeps it in its memory. The earth also recycle the information (software) from the outside, from the sun in its surface, in the plants, etc., it process it and keeps it in its surface (memory), for instance, the photosynthesis, the cycle of water, etc. The earth is a huge

brain that processes much information during the day and during the night rests and so on for millions of years and it will go on as long as the sun sends energy (the information).

The man has built the computer that process quicker than the builder, but the man still controls it. The human brain also rests by night. The earth has created the man that proceses the information quicker than she does, but the earth controls the man perfectly. The man tends to make the computer as his own image, so that it can imitate its brain the better it can. This is the man's purpose: to reproduce his brain, to create a new brain.

The earth tries also to the man so that he can have as much information as it has. The man imitates the earth and creates artificial life and artificial intelligence. This is the purpose of the earth: a man being able to create another world. He is already making attempts by creating artificial satellites and sending them to space. He will imitate more and more the earth until it can copy its information. Then he will form the minerals, plants and animals.

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