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# A Parable of the Pure and the Practical Why We Must Pursue Basic Scientific Research

Talk presented at the Inauguration of the Mesoamerican Centre for Theoretical Physics

Sheldon Lee Glashow

## About the author

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## The Issue

Many representatives of Government, Industry and Academia argue that governments should invest only in research that is likely to generate immediate and specific benefits, either wealth creation or improvements in the quality of life. They find undirected research in particle physics, mathematics, cosmology, low-temperature physics and many other basic sciences to be useless and expensive luxuries that consume resources rather than promoting Economic Growth and Human Welfare. They are wrong!

## Thesis (from a letter to the Economist)

Fundamental physicists would be hard-pressed to point to anything useful that was directly dependent on their theorising. The discoveries of particle physicists or cosmologists are intellectually irrelevant to almost everyone|does it matter how old the universe is or if matter consists of two or 17 particles? If individuals wish to contemplate the universe, let them do it in their spare time at their own expense. It is far more important that we encourage our "best brains" to solve real problems and leave theology to the religious professionals

## Antithesis

Had Faraday, Rontgen and Hertz focussed on solving the "real problems" of their day, we would have waited much longer for electric motors, X-rays and radios. It is true that today's "fundamental physicists" are concerned with exotic phenomena that are not at all useful in themselves. Nonetheless, their work has made and continues to make an enormous impact on our lives. We shall demonstrate how curiosity-driven searches for fundamental knowledge have proven to be at least as effective as direct searches for solutions to specific societal problems, whether from the discoveries themselves or from the frontier technologies they required.

## But our Critic has a point. Consider CERN:

World premiere research facility for high-energy physics; Supported by its 20 European member states; With 2500 full-time employees CERN hosts about 10,000 visiting scientists from 113 different countries.

CERN, among its accomplishments:

- Found the neutral currents of the electroweak theory,
- Used neutrinos to confirm the quark hypothesis,
- Discovered the W and Z bosons.
- Counted the number of neutrino species,
- Created the first anti-atoms and
- Discovered the long sought Higgs Boson last year!

None of these triumphs are likely to contribute anything at all to human health or wealth. Useless Science?

## Not quite useless: Think Technology Transfer!

CERN is a hotbed of innovative technologies involving Accelerators, Cryogenics, Detectors, Electronics, Information Technology, Magnets, Material Science, Superconductors &c. Through licencing or joint ventures, CERN makes these resources available for scientific and commercial purposes. Some examples of CERN's Technological Spinoff:

- 1965 The World-Wide-Web, by physicists but for the world!
- 2004 GEANT-4: CERN's simulation software for physics, space science, medicine and radiology.
- 2003 DxRay, a spinoff company, develops advanced digital X-ray scanners based on CERN technology.
- 2012 \Thanks to scientists working on particle acceleration at CERN, the Geneva International Airport is the proud



owner of the largest solar energy system in Switzerland”  
(Forbes).

But CERN’s primary purposes are to pursue the secrets of Nature  
and to train the next generation of innovators.

## The Many Virtues of Basic Science: I. Clinical Medicine

1894 X-Rays	CAT Scanners
1932 Antimatter	PET Scanners
1950 Nuclear Magnetism	MRI Scanners
1912 Radioactive Isotopes	Brachytherapy
1934 Cyclotron	Particle Beam Therapy
1957 Lasers	Microsurgery
1986 PCR	Forensic Medicine
1928 Penicillin (by Chance!)	Disease Control
1953 DNA Structure	Gene Therapy

Each of these discoveries earned a Nobel Prize!

## II. Basic Science and Information Technology

1888 Radio Waves	Wireless Transmission
1947 Holography	Secure Credit Cards

1947 Transistors	1st Computer Revolution
1951 Integrated Circuits	2nd Computer Revolution
1966 Optical Fibers	Rapid Data Transmission
1976 PK Cryptography	Secure Data Transmission
1988 Giant Magnetoresistance	Disk Readout
1986 High T Superconductors	Energy Storage (?)
2012 Quantum Manipulation	Quantum Computers (?)

All but two of these discoveries earned Nobel Prizes!

### III. Yet More Fruits of Basic Science

1839 Photovoltaic Eect	Solar Panels
1905 Photoelectric Eect	Charge Coupled Device
1912 X-Ray Diraction	DNA Structure
1916 General Relativity	Global Positioning
1938 Nuclear Fission	Nuclear Power
1949 Carbon Dating	Climate Research
1969 Charge Coupled Device	Digital Cameras
1985 Bucky-Balls (Fullerenes)	?
2004 Graphene	?

All but one of these discoveries earned Nobel Prizes!

## How 'Atom Smashers' Became Big Business

Cyclotrons were created for pure research: to study the basic building blocks of matter. But these and other particle accelerators contribute directly to wealth creation and human welfare. Some 30,000 accelerators operate today. Very few do fundamental research. Mostly they are used for industry and medicine: Ion Implantation, Material Processing, Particle Beam Therapy, Medical Isotope Production, Food Irradiation, Nondestructive Inspection etc.

Energy loss due to 'synchrotron radiation,' once a problem at electron accelerators, has become a multi-billion dollar bounty. Synchrotron light is useful for many basic sciences, medicine and industry. About 70 of these large, expensive and sophisticated light sources are deployed in 20 countries. Far more powerful 'Fourth Generation' light sources are on the horizon.

## Between Idea and Implementation

GMR Eect to Gigabyte Hard Drives:	3 years
CCD to Digital Camera:	6 years
Transistor to Transistor Radio:	7 years
Radio Waves to Wireless Telegraphy:	11 years
Fission to Nuclear Power:	19 years
General Relativity to Global Positioning:	78 years
Photovoltaics to Solar Panels:	115 years

The latency period have can various causes, among them: Necessity (e.g., solar panels); War (e.g., nuclear power); or Missing Technology (e.g., GPS needs satellites and sophisticated electronics as well as general relativity.)

## La Chance ne sourit qu'aux esprit bien prepare, Research must be done with eyes wide open

### Five Very Short Stories

- Once upon a time a Prince searched for a needle in a haystack. Instead he found the farmer's daughter.
- In 1856 young Henry Perkin tried to synthesize quinine. Instead, he discovered the first aniline dye.
- In 1896 Henri Becquerel set out to prove that the sun emits X-rays. Instead, he discovered radioactivity.
- In 1965 a chemist was assessing the efficacy of an anti-ulcer medication. Instead he stumbled upon the blockbuster artificial sweetener aspartame.
- In 1996, chemists at Pfizer held clinical trials for a new drug to treat angina and hypertension. The trials failed, but an entirely unanticipated side effect on men led Pfizer to market Viagra for male impotence.

## International scientific cooperation a paradigm for peace among nations

Basic scientific research is among the few areas wherein nations of the world cooperate. Modern science emerged as a multinational endeavor: Copernicus (a Pole), Tycho Brahe (a Dane), Kepler (a German), Galileo (an Italian) and Newton (an Englishman) taught us our place in the heavens. Whilst these were all white, Christian, European men, today everyone can contribute to the Scientific Adventure regardless of nationality, religion, race or sex. Among many international collaborations:

- Alpha Magnetic Spectrometer: 16 nations
- International Space Station: 15 nations
- International Linear Collider: 19 nations

- ITER (Thermonuclear Research): EU + six nations
- CERN: Scientists from over 100 nations

## States with Formal Contacts with CERN

Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Estonia, France, Finland, Georgia, Germany, Ghana, Greece, Hungary, Iceland, India, Iran, Ireland, Israel, Italy, Japan, Jordan, Korea, Latvia, Lebanon, Lithuania, Macedonia, Madagascar, Malaysia, Malta, Mexico, Montenegro, Mozambique, New Zealand, Netherlands, Norway, Pakistan, Palestine, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Singapore, Slovenia, Slovak Republic, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, Ukraine, USA, Uzbekistan, Venezuela, Vietnam.

## Five (of Many) Physicists Who Spun Themselves Off

- Allan Cormack: Nuclear and particle physicist, longtime chairman Tufts physics dept., invented the CAT scanner for which he won the Nobel Prize in Medicine.
- Walter Gilbert: Accomplished theoretical physicist became molecular biologist, shared Nobel in Chemistry, cofounder & 1st CEO Biogen, now celebrated art photographer & philanthropist.
- Paul Ginsparg: Theoretical physicist and IT expert, founder of the free online archive for physics and many other sciences. Won MacArthur award for "changing how physics gets done."
- Leon Lederman: Experimental physicist, codiscovered second neutrino & 6th quark, Nobelist, many STEM initiatives, e.g., creating the Illinois Math & Science Academy.

- Andrei Sakharov: Famed Soviet theoretical physicist, human rights champion and Nobel Laureate in Peace, led his government to sign nuclear test ban treaty.

## Technology Impacts Basic Science!

- Steam engines were invented long before they could be understood, thus challenging physicists to develop the science of thermodynamics.
- The 19th century inventions of spark coils (by Ruhmkor), photography (by Daguerre) and mercury air pumps (by Geissler) made many turn-of-the-century discoveries possible: radio waves, X-rays, radioactivity, the electron, atomic number, cathode ray tubes....
- The antenna used by Penzias and Wilson to discover the cosmic microwave background was built by ATT for early satellite communication.
- Mysterious gamma-ray bursts were detected by US Air Force satellites looking for illicit Soviet nuclear tests.
- Supercomputers enable otherwise impossible calculations in both pure and applied science, e.g., the four color theorem.



# Can We Live without Philosophy ?

Conferencia impartida en la Universidad Autónoma de Chiapas, México.  
Noviembre de 2013

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Surprising as it may be to more than one person, the question in the title of our presentation is far from being a simple question as we will slowly come to discover. It is a highly complex problem and the answer that can be provided is the furthest from being simple. Our initial problem, of course, is to understand the question itself, to clear any possible misunderstanding. Which is why the first thing you have to do is try to unravel its meaning, that is, to make it explicit. However, if the meaning of the question is what we have to deal with first, we immediately have to say that it is impossible not to notice that this question has not one but at least two meanings that we obviously need to distinguish: one that I would describe as "trivial" and another, slightly more complex which I would call 'serious' or 'deep'. Before answering our question, therefore, we must consider such ways and do it in the order mentioned.

## The trivial sense

If we take the question 'Can you live without philosophy?' As a mere form of language, as an expression of Spanish in the form of interrogation roughly equivalent to the question 'Is it possible to live without philosophy?', The answer is immediate, simple and obvious: yes, it is possible to live without philosophy. This, however, may not be a satisfactory answer for us because once we realize that, and considering the question, that is, from a purely formal, modal view, the answer is the same for absolutely anything. Is it possible to live without milk? Yes. Is it possible to live without parents? Also yes. Can you live without money, without coca-cola, no meat, no shirts, no car, etc., Etc.? To these and all questions like that, considered distributive but not collectively, you can answer yes, but the reason is obvious: since the question is purely formal and we are not inquiring about its content but that are seeing as a mere question about a possibility, we know a priori that no possible answer can generate a contradiction and, therefore, the answer may be in principle always 'yes'. Of course, well considered, both the questions and the answers are banal in all cases, with one possible exception on which I think is worth attention.

In a wonderful story entitled 'The man that lives', Leo Tolstoy tells the story of young twins whose mother is about to die right at the time of birth, only the angel in charge of taking his soul to pity their prayers and let live a few days of what God had decided that she had lived. In reporting their negligence, God orders the angel

to take the soul of the young mother and punishes her disobedience and sends it back to the land where she shall remain until she learns the three divine lessons. The mother dies and the newborn is taken by neighbors that raise her as one of their own children. One of the morals of this great novelist is precisely that you can live without parents, but cannot live without God . I am of the view that Tolstoy is absolutely right , except that once again the meaning of his thought requires a minimum of clarification for which we will have to recover quickly and superficially some thoughts of the great Austrian philosopher Ludwig Wittgenstein which are relevant to our topic.

In what is his first conglomerate of philosophical notes, “ Philosophical Papers 1914-1916 ” , written in the trenches during World War I, Wittgenstein addresses a variety of issues ranging from the essence of logic and language to the ultimate nature of the world. Issues that gradually lead him to considerations on the “I” . Here , for obvious reasons, we will miss his incredible philosophical trajectory and concentrate on some of the reflections that he gives us . Wittgenstein asked : what do I know about myself and the world? I know there is an objective world , which is composed of facts from which I hide or from which I face. I also know that the world as a whole is not indifferent but , so to speak , I care about it and It affects me. In other words , I evaluate and take a position on what happens in the world. You also know that this world has some problems and that the troublesome thing is its meaning and that the events that make up the world are neutral. For me it isn't, or in other words it has value for me because I judge the events ; I put them in order ; I accept them or reject them . The world as a whole , therefore , has a sense for me , whatever it is . In that sense it is called ‘God’ .

Lets return to Tolstoy : it is clear that what he says , namely , that you can live without whatever else except without God, seen in the light of the wittgensteinian clarifications it is almost a triviality , since what Tolstoy would be saying is pure and simple- there is no human life without meaning . God , that is, the meaning of life , is like his shadow everywhere he goes. The meaning of a particular life can be horrendous , contradictory, failed , successful, etc. . , But it is always given , because it is precisely the most unthinkable that a human life is completely devoid of meaning. God , as I said, the sense of life, can be failed , contradictory , negative, etc. . , But still remains the sense of this or that particular human life. To say that a human life could be totally meaningless is tantamount to saying that there is someone who is in the world and it does not affect it , like a stone or a river, a mere physical object. That is not conceivable . Now, if we identify ,

as does Wittgenstein, God with the world and the meaning of life is clear that the only question of the form " Can you live without ... ? ' , In the sense of ' Is it possible to live without ... ? ' , to which the answer is ' no ' would be the question ' can we live without God ? ' . For all others, whatever they are , the answer would be a definite " yes " . The problem then is, as I pointed out , that the questions at hand would be wholly trivial and without cognitive interest . But then if what applies to philosophy applies to anything else, the positive feedback has no value and would demonstrate that all you did was answer a trivial question . Claiming that it is possible to live without philosophy in the same sense that we cannot live without football advances nothing in our efforts to understand, and we still do not know if you can actually live without philosophy.

## The serious meaning

Fortunately , there is another meaning to the question ' Can you live without philosophy? ' , Which is what makes it interesting , in relation to which the answer ' yes ' certainly no longer can be offered or with the same speed and with the same security . You might think that what I propose to do is replace the formal scheme ' Can you live without X ? ' To the question ' Is it worth living without X ? ' And show that in this case we cannot immediately offer an irresponsible ' yes ' to all questions that may arise . For example, is worth living without love, without affection? , without absolutely enjoying anything, without having any success at all, no prospects and no illusions about anything? The answer is not obvious , but most likely at least in some cases there has to be a resounding ' no ' . Our question , therefore , would have transmuted and what we would now be asking is whether it is worth living without philosophy. However, although this line of thought is interesting and a few words would lead us to the end of the job , what I wish is *prima facie* is rather to defend the idea that , regardless of whether or not it is desirable to live without philosophy , the fact is that it is simply impossible to do so and that philosophy appears in our lives and it is required for them like it or not . In other words , I intend to argue that philosophy is indeed not dispensable . Let us see if it is feasible to prove it.

To start building our point of view , I think I would have to agree about something , namely , that we try to give the answer to our question which must be a function of two things :

- a) conception of the human being that we make about ourselves
- b) the idea of philosophy that we have forged .

This is , I think , obvious. Anyone can develop a conception of human beings which agrees with their philosophy is seen as an irrelevant product, a waste of time , an unproductive activity, etc. . To me it seems intuitively obvious , however, that a view like that removes itself , since it is decidedly paradoxical: a conception of itself as a “philosophical” product. But how could philosophy be used to reject or cancel philosophy ? This view , therefore , is not viable. We have to choose other argumentative strategies . Therefore lets consider our issues in the order that was mentioned .

**a) The human being.** First ask ourselves : how can we consider ourselves ? It strikes me that we may be , first, biological beings . If we consider ourselves solely as biological entities, that is, as beings who prove biology, then it is clear that we can say with confidence that we can live without philosophy . The problem with this is that we can ensure that no one is to reduce its conception of human beings to purely biological beings . Someone who only sees their peers in muscles , bones , tendons, nerves , nail , instincts , etc. . , Would be something like a monster. In response , therefore , the “biological option “ does not help us.

Similarly, we can see our neighbors and ourselves not only biological beings , but also psychological beings , ie beings besides their biological characteristics which have or enjoy what we call ‘ mental states and processes ‘ . I mean, we all have a psychic life ( images, memories , aspirations, volitions , beliefs, desires and so on) . That’s a fact. But from this perspective, for example considering humans only as biological and psychological beings : could we say that we can live without philosophy ? Sure, except that once again no one has done such a limited conception of people : nobody believes that their parents or their children as mere biological machines with a psyche . Counting only on biology and psychology, there is still much to enjoy a minimally acceptable view of humans. So once again , yes we can say that you can live without philosophy but only on the basis of an incomplete , falsified or distorted ridiculous conception of the human being. We need , therefore , to go ahead and complete our picture by trying to provide an answer to our question that it is sensible and convincing .

Advancing in this direction, can add to the biological and psychological the social dimension of human beings . It could be

argued that people not only exhibit biological and psychological processes but are also necessarily gregarious beings who need others, and have to interact with others. We could express the idea in this way : a purely biological and mental being is still a human being. We can then rethink our question, considered this way- that is, as social beings - and assuming everything that psychic life and biology involve : can we live without philosophy? I believe that , subject to refinement but as an answer for the sake of argument, would have to admit that maybe yes, yes in extremis . However, in the best of the cases the price fo endorsing a conception of human beings as being bio -psycho- social would be too high a price that virtually no one is willing to pay . Why? Because it would have to have a conception of humans as Neanderthals or perhaps as Stone Age men like our caveman ancestors , assuming them as pre - humans. Perhaps our ancestors , and it is highly disputable , were biological beings who were endowed with a certain psychic life and lived in groups and that was it. In that case , they may be the only members of our species who could say they did not need philosophy. But the question we now ask is : does anyone identify us , here and now, with them? Could someone live like caveman ? Can someone today reduce their conception of people, including themselves ,to mere bio -psycho- social beings ? I doubt it. Now, what this question highlights is that something very important is missing in our conception of man and that a vision of humans in which we just see it exclusively in their biological , psychological, and social dimensions is too poor compared to what is currently available . The important point for us is precisely that it is only on the basis of such a poor conception of human life which we are considering that you can continue playing with the idea that it is possible and worth living without philosophy . Obviously , something is missing . The question is : what?

**B) The language platform.** The perspectives of humans that we have briefly mentioned keep us in what we call the “natural world.” In fact, neither as biological beings , nor as psychological or social beings do we differ essentially from other animals, especially the upper primates and even other species of animals. Elephants, for example, have a formidable memory ( actually better than human ), Tigers have beliefs ( right or misguided ) about their potential prey, hippos can have severe pain , ants and bees are needed between them and cooperate with each other at work , gathering food, in the defense of their homes and so on indefinitely . But if this is so, then where is the specificity of the human? Where and how does it appear ?

I think that the answer is self-evident : the fact is that in addition to biological, psychological and social beings we are also, essentially, in a precise sense that does not apply to animals , linguistic beings. It is the platform of language that opens possibilities specific for us. It is true that members of many animal species develop more or less precarious communication systems and warn each other about hazards , food , rivals, etc. However, these rudimentary communication systems are not strong enough to allow the use of “language” in the strictest sense of the term . What is that sense ? In relation to the interests that we pursue at this time , the fundamentals of language is that it opens up the spectrum of thought. It is not the same to roar to call attention to a gazelle than to express something like:

Never was knight  
Ladies as well served  
As it was Don Quixote  
When their village came .  
Maidens cared for him  
Princesses of his roncino

I do not need to argue , I suppose, that something like a poem is decidedly beyond any possibility of expression of any animal. It is thus with what you might call the ‘ realm of thought ’ that we are in the essentially human world and the peculiarity of the members of our species, Homo sapiens sapiens. Now in that realm , it is important to emphasize that its source or its roots in language. The concept of thinking, so important for our purposes, is complex and therefore very fast and somewhat superficial, and we have to do a bit of philosophical logic in order to clarify it and thus be able to articulate our response to the original question .

Perhaps the first thing to say is that , apart from being complex and not easy to grasp, the concept of thinking is also ambiguous. What I mean is that the term ‘thinking’ is used in two different ways , ie, it has two meanings which point to two different things.

**A) Cartesian Thought.** It is a fact that in colloquial language that the word ‘thought’ refers to a process that takes place in the heads of people . In this sense , thinking is a mental or psychological process , which in one way or another is connected with the brain and its functions. Thus understood , a thought is an activity of the mind. It is called , for known reasons which are not worth mentioning, ‘ Cartesian thought’ . This is thus a phenomenon of human subjectivity and in this sense we can say that everyone has their thoughts.

**b ) Fregean Thought.** There is, however, another sense of 'thinking', which is what really concerns us here . In this second sense, we speak of thought to refer to the semantic content of a sentence, that is, is what the sentence means , its sense . In this sense of 'thought' we cannot say that everyone has their thoughts , since thoughts in this regard are public and shared goals . This is not very difficult to understand. We have on one side signs , such as in the Spanish sentence ' I'm in Tapachula ' , the English sentence 'It is raining ' or Polish the sentence ' Mieszkam Meksyku ' . These are the signs , but everyone understands that such signs do come with their senses. The signs are, as it were , the vehicles of the senses. These senses are thoughts. We use signs , written or oral , to convey thoughts. The signs themselves do not interest us, unless we make them semiotics, which is not the case. In general , what we want is what we can say with them. What we can say, what speakers transmit and capture , what can be translated from one language to another are thoughts. The thoughts do not belong to any particular language because, obviously , we can express exactly the same thought in different languages. I guess that we all understand that we can say exactly the same in Spanish , French, English, Russian, Tzeltal , etc. . 'It is raining ' is exactly the same as what the French mean when they say ' il pleut ' , the same as the Poles say when they say ' pada deszcz ' and when we say ' it is raining ' . That all these sentences express different languages, what all of them have in common is the thought in this second sense. By thinking in this sense we can call ' Frege thought ' , in honor of the great German logician Gottlob Frege . Thus, if in the first case , ie, in the case of Cartesian thought this is basically a process , a mental phenomenon , something happens as it happens to someone ; in the second sense, that is, in the sense of Frege thought, what we have is an abstract entity , an object that is neither material nor mental but logical.

In light of these clarifications, we are now in a position to show why the linguistic dimension of the human being is simply crucial : it is from language that comes "the sense", in the sense the thoughts, and in the thoughts both representation of the world as well as self-representation . In other words, it is because we have language that we have an idea of reality and, above all and more relevant to our topic , we can get a sense of ourselves and of our position or attitude towards the world . It is only with language where all of these possibilities of expression are contained, such as referring to someone , remembering the date of a particular event, the creating of illusions about such and such situations, etc. . However, it should be understood that thoughts usually do not come by themselves and certainly we want to have clusters of thoughts that are certainly

consistent, but not only that. Through and through our thoughts (in the Fregean sense) not only describe reality, but we form pictures of it or, as I prefer to call them, conceptions. Through these "conceptions" we (so to speak) "interpret". Naturally, the important thing about is that they are convincing. We want to make ours the best possible. Regardless of the latter, the crucial point for now is that it is virtually impossible to have a language as a linguistic being, without a formed or unformed worldview and a conception of self. In other words, we cannot be linguistic beings and form no conception of reality. Therefore, we cannot be linguistic beings and not create philosophy. As soon as we started talking about "ideas" we are already talking about philosophy. Naturally, the conceptions that language users can form both the world and themselves range from many points of view that may be more or less simple or complex, consistent or absurd, boring or sexy, simplistic or interesting, etc. But regardless of the latter, the fact is that we already have a well-grounded answer to our question of whether it is possible to live without philosophy. The answer is that linguistic beings, as we are, cannot live without philosophy, meaning 'philosophy' in this case is the formation of conceptions of reality and self. Let's try to dig further into this.

We talked about "conceptions of reality." We need to be a bit more precise about that expression, and the first thing that I would like to draw attention to is the fact that there is an important connection between the "philosophy" that you endorse or you can create, and the existence one takes, i.e., between the way of seeing the world and the way to face it and live it. In other words, there is a sense in which the quality of life of a speaker is a function among other things- the quality of their world and life. At this point the importance of thinking in the sense of Frege is manifested, as well as what might be called 'practical consequences'. We can then clear up a misunderstanding: it is clear that philosophy has no "practical consequences" in the sense that we can have it breaking stone or repairing the brakes of a car, but if we were wrong in what we have been holding is unquestionable that philosophy has practical consequences of primary importance, only in a less visible way, but much more general and all-encompassing. Indeed, depending on the conception that one has to treat people, animals, plants, etc., in one way or another, this will have an impact on your life. We are therefore authorized and need to maintain that is a total misconception that only those who use hammers and nails do something "practical." Claiming something like this is to be a victim of a radical misunderstanding. A thought, however abstract it is, is also practical, just in another way.



Secondly , it is important to understand that when we are talking about the ideas that everyone , so to speak , drags around with themselves, we do not want to be implying that these conceptions are consciously developed theoretical constructs which are particularly convoluted . That indeed is true of very few people. When we talk about the conceptions of the world and of life that people endorse, what we have in mind are the general concepts that are implicit -that is, from those who are observed can draw from both what they say as much as from what they exhibit through their behavior. We can talk of someone who acts “ in bad faith ” , although the person of concern will not preach right and left that they were acting in bad faith. Their bad faith is something that is shown , that others can detect and face which they react.

In short , speakers generally go through life with their “ philosophies ” , often without realizing them but letting themselves be guided by them. With such a result, perhaps we can begin to connect the dots .

It is relatively clear that a fundamental criterion for judging ideas is that more or less the complete character of the idea of man is at stake . This is important because it shows us that if someone endorses a purely “ naturalist ” conception of people - that is, if you merely see them as biological, psychological and social beings -we can infer that its design will be poor, disappointing and most likely cause harmful effects or at least be negative . Because , let’s ask : what kind of existence can someone have who endorses a conception such as this? What ideals of life are associated with a concept like that? I think it is not very difficult to visualize. If we imagine a case of successful domestic life ruled by the naturalistic conception or ones own values, what we would see would be that the person in question could become an athlete ( biological health ) , a man who leads a pleasant life (subjective satisfactions ) and someone who is socially successful ( social success). That would reduce the “success” of someone who endorses the purely naturalistic conception of human beings . It might seem like a lot and it might be found very attractive to more than one person, but it is immediately obvious that such a life even if fully successful (which , I think, would be virtually impossible for reasons that would be very difficult to provide ) would be negligible and even hateful in its ways. Why? Because by not taking into account the linguistic aspect of the human being , the conception in question would be impoverished or skeletal , extremely incomplete, as the subject would have forgotten everything that they have done thanks to the linguistic dimension

of human life, and so, would put aside at least the moral , aesthetic and religious aspects of the person. For those who endorsed the crude conception , that is, naturalistic and scientist , the human being, the horizons of life are marked by the personal objectives of biological life , psychological life and social life and there ends the horizon of reflection . What is problematic about this is , as I said, in that landscape it has not yet made the appearance of neither the moral life, religious life, nor aesthetics and probably many other ways of being human . While ideally , therefore , the “naturalistic” is extremely impoverishing and therefore a certainly undesirable way of life.

Now, with thoughts and conceptions more or less the same happens as with manual labor : they can be both good and terrible quality . Obviously, it is desirable to have the best possible design, but do you determine which design is better? I think that while we certainly cannot get results in this context that exhibit mathematical certainty , we do however have criteria which when used allow us to prioritize concepts with relative ease. It would be a mistake to think that it is not reasonably possible to choose between one concept and another -it's all a matter of subjectivity or arbitrariness. It would be childish , on the other hand , think that we can articulate the perfect design . There is no such thing . In relation to the concepts that we need to develop is a sensible idea of perfection , not merely something fanciful . The German philosopher , Friedrich Nietzsche, rightly argued that the idea of perfection is a comparison . It makes sense that a more perfect conception is one that better explains the facts , because it is more structured , because it requires fewer assumptions, etc., But what does not make sense is to say that there is a conception that surpasses the views of all others . Such a statement does not point to anything, since it is involved in a spurious and useless idea of perfection . Now this is precisely what happens with the conceptions that we have been speaking about: we all start with the most trivial , the crudest , most primitive (in my opinion, the “naturalistic” vein) - but gradually , based on argumentation , reasoning , speculation , knowledge, experiences , failures , discussions, etc. . , we are polishing, honing , and perfecting . The important thing is that the more perfect our conceptions , that is, while they are less exposed to objections , the better our lives and the less we will be unhappy . The refinement of our thinking , therefore, is an issue that cannot simply be ignored, since it is one of the main areas of our life. Let's look at this in more detail .

When we leave the basic primitive conception , that is, the naturalist conception, and head down the path of refining our vision of

reality we automatically fall into the field of intellectual competence. Here it is important not to lose sight of the connection that exists between our thinking and our lives.

You have to understand that, since we are in terms of what each person does with his life, the factor that determines how far you want to go in our process of intellectual or philosophical refinement is just how useful we are which ultimately means how satisfied we are with our respective lives. We have to admit that it is perfectly possible to live a primitive, fragmentary, inconsistent worldview and still be happy. Against that, all I can say to someone who leads a life led by a more refined conception is something like: happiness is something that I do not care about, it does not attract me, it is no good to me. I will not be happy that way-but nothing more. In his famous *Tractatus Logico-Philosophicus*, Wittgenstein put it this way: "The world of the happy man is distinct from the world of the unhappy man."

It seems clear that if our conceptions of our people, others, animals, life, etc. systematically leads to conflicts, the sensible thing would be to modify them, but as I said, ultimately that is something that is determined by each person in their own case. So important is philosophy in human life that people often prefer to continue having problems with the world rather than alter their conceptions, that is, to admit that their ideas are poorly developed and structured, that their thinking is wrong, that their philosophy is wrong. For example, someone may be satisfied with their naturalistic worldview and their life and never understand or accept that their worldview is limited it is extremely conflictive and therefore that it would be convenient for it to be overcome. Thus, when it is not feasible to make the subject in question understand that his life is poor because his thoughts, world, and philosophy is of poor quality, philosophy as it is understood as a slightly more refined activity may not flourish. In this sense of 'philosophy', that is, as a permanent intellectual activity of clarification and systematization of our thinking, we must recognize that although you cannot live without it, it still has limits. What happens with this phenomenon is similar to what happens with psychoanalysis: for someone to seek the assistance of the therapist you must first recognize that you have problems, that you do not know how to deal with them and that you need help. It is important, therefore, that the individual may come to feel dissatisfied, unhappy with his life. Not because of others, but because he understands or at least has the intuition as to what needs to be examined which are their attitudes, their lines of behavior, their values. What we can say now is that if this state of dissatisfaction does not occur, philosophical

progress becomes impossible and , therefore , the persona does as well . This brings me to another topic.

We speak of intellectual progress and the development of our conceptions , but how can we perfect an idea , a concept , a “philosophy “? The answer is simple: there is only one method: using reflection , for which the exchange of ideas, discussion (not litigation ) is indispensable. Often these discussions and these reflections occur after conflicts that we generate ourselves and are the trigger by which our reflection begins. Suppose a person stands up another., and the one who was stood up encounters his friend, the friend says something like “ I was just playing dominoes and I was very comfortable .” Obviously , that’s not a satisfactory answer and may even be an insult -mockery adding to the offense. But why? Why not, at least at first glance , would one disapprove of such behavior ? The interesting thing here is to notice that when trying to answer this question, what we are doing is philosophy albeit in a precarious , non-technical manner. We see then that at the root of such conduct we find an ethical principle such as “to do what generates pleasure“ , but since we found that the behavior of someone using that principle leads to problems, we infer that that principle, as appealing as it may seem, cannot be accepted in a crude way . We then have to amend it, gently refine it . We could then propose an alternative principle as “we must seek pleasure , but not at the expense of other people’s discomfort .” In this process we walk slowly from an almost automatic or spontaneous conception of a primitive philosophy to a philosophy that is a bit more refined, perhaps more technical ; a basic philosophy of life towards a vision of an increasingly structured , refined, justified life. Do we need to live –soaked in technical, professional philosophy? Of course not, although it is obvious that some contact with it will always be useful and helpful . For example , if the average citizen really knows about platonic love , that is the myth of the cave , that it is the categorical imperative , they would understand that there is a difference between statements of value or duty and statements of fact , etc. . , their world would be much stronger and , therefore , better regulate their behavior and therefore they would live better, not waiting for other things or reactions that it is logically impossible for them to receive-adjusting their lives to the facts of the world with greater success . They would then would be on the path of wisdom.

This leads me to say a few words about the value of philosophy beyond its purely primary or primitive stage . The value of philosophy is felt every time we reflect on our existence and we aspire to a correct conception not derived directly from practical considerations . The

wonderful world of philosophy appears to us as soon as we inquire about living, what do we live for, what is really worth it, what is beautiful and good, what is it that under no circumstances we should do, how is the world considered as a whole, how is knowledge possible, what is the relationship between mathematics and the material world, etc., etc. . It is highly likely that the vast majority of professional philosophers would like to argue that philosophy has a per se value, ie a value in itself, which by the very greatness of the subjects justify themselves; that they are the most important issues, the most sublime, etc. . I would like to adopt here a less romantic and more pragmatic view. I think, consistent with what I've been saying and contrary to the common opinion of people, that philosophy is valuable precisely because its consequences, that is, for the practical applications that it has-by the fact that thanks to it, one way or another, it shapes your life, even if the conception that you achieve can always be improved upon. The classic and perennial issues of philosophy are precisely those which require meditation, and it is when our thought comes into contact with these issues is when we give personal guidance to our lives. Our philosophy is the product of the activity of our mind when it deals with universal themes of interest, issues that due to their generality and abstraction cannot be studied scientifically. We distinguish the naturalistic platform above the linguistic platform. I would say that the issues that arise from the second science has nothing to say. There is no knowledge of good and evil, a science of beauty and art, a science of divinity, a science of abstract entities, a science of "I", etc. ., But it is precisely these issues that science studies which are intellectually more attractive, more exciting. Those which in one way or another are related to what we might call the ' meaning of life ' . And this brings me to one last point I want to quickly consider.

I quickly argue that the more deeply we include philosophy in our lives, the freer our lives become. Philosophy makes us free because we act not because we are subjected to external pressures, and therefore, to causal determinations, but because we got results that leave us intellectually satisfied and which we chose ourselves. Ask yourself: Who is more free: someone who is forced to do what your boss expects of him, even he benefits from their obedience, or someone acting because they convinced themselves that they have to respect this or that principle or because they are convinced that it is absolutely impossible to perform this or that action, even if doing they would benefit from it? Freedom, as everything, has a price, a price that I see worth paying. Why? Because by acting freely what I do is give my existence the face that I want to give it and by

proceeding in this way what I do is give my life the meaning that I want it to have. If someone acts out only for the interests of the moment, by the pressures of context, fears that others cause, their needs and requirements, etc., this person never acts freely and the meaning of his life will be what others will have configured for it. The sense that imbues my life moral action is precisely free action, therefore, what the subject in question really wants. For my part, I admit that I am convinced that freedom is worth the price you pay for it.

To make it clear that our lives are regulated or controlled by our respective conceptions, ie, that thought is not harmless, we simply note that the views of which individuals are forged are connected with two other notions whose importance cannot be put to question - namely, the ideas of mentality and culture. Indeed, when a particular view is more or less shared, and more or less prevails in a given population, we can talk about a certain mindset. So we can talk about, with the vagueness that the case requires, of the mentality of Mexicans, when what we want to do is to contrast with that mentality, for example, the Argentines, the French, the Poles and so on -or the mentality of Chiapas, where we want to contrast it with that of Tamaulipas, Jalisco or the capital. What that means is that the average citizen of each of those countries or communities tend to form different ideals, pursue different objectives, using different methods to achieve their respective goals, etc., than the average citizen of other parts. But it is clear that the matter does not end there, because mentality is not something that grows like a fungus, which in turn cannot enroll within a broader framework that somehow explains or sheds light on it. This general framework is what we might call culture. Thus, the concepts of individual conceptions of the world and of life, mentality and culture are intertwined notions that serve to explain each other and there is no vice in this circularity.

## Conclusions

I think we are in position to offer a concrete but nuanced answer to the question that served as our starting point, namely, 'can you live without philosophy?'. First, in a basic or spontaneous but not illegitimate 'philosophy' sense, the answer is clearly "no". Beings endowed with language and therefore thinking beings cannot live with a minimum dose of philosophy. This, of course, is not to argue that everyone has to study philosophy, do philosophy professionally, or devote their lives to philosophy. To say that would be absurd.. Now, between philosophy, say, "natural" and professional philosophy is

a gradation imperceptibly leads from the first to the second . In this speculative incorporating sliding van technicalities , theses, theories, etc. . , So that what at first was a more or less crude conception of the world gradually becomes a complex theory of reality. And this brings us to a second meaning of the question : can we live without philosophy in the sense of whether it is worth living with a thick conception settle for a crude view of life , not an idea developed for human beings and more generally of living beings and the universe as a whole? I think not and I think there are arguments implicit in what we have said that would support my position , but in any case this other discussion is something that we will leave for a later occasion.

# The word and drawing: an experience with children of the jungle

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## Abstract

This work is aimed at trying to explain the shift from oral to written in the Chiapas jungle communities . First we must not forget that each group is different : the background of the children, the expectations of parents, the communities culture-as well as have respect for the language spoken in the place. Another important objective is to understand the process of literacy acquisition with a group of children belonging to an preliterate community in the Lacandon Jungle, and how they managed to use the drawing as a tool to take the first steps towards writing, as well as a form of motivation to read and reading comprehension. In Chiapas there is a long tradition of drawing as a means to communicate and as a means of expression. It is a common practice everywhere, with ritual relevance, as art, or as a transmission of collective memory. Drawing is the starting point with which children can express their emotions , fantasies and realities to the outside world by using signs as words.

*Keywords: Drawing, reading, writing , Lacandon Jungle , kids*

## Introduction

All children naturally learn the language of their parents, but reading and writing are skills which need instruction, practice and motivation. The transmission of technical literacy in Chiapas has been aimed at Spanish-speaking children in urban cultures and there has not found a better way to transmit it to children who speak other languages or who live "in the field" , ie , immersed in other socio-cultural conditions .

The illiterate children of some forest communities , face the problem of literacy acquisition from their preliterate communities , without the presence of letters. The distance from urban centers and the lack of schools does not create a suitable environment for the access to the written word.

We believe that , to start the transition from oral to written , each community is different which is why you have to take into account the prior knowledge of the children and the community culture with their traditions and customs . Among the activities to initiate and motivate children to literacy , drawings have been taken as an introductory step towards facilitating and mastering writing, accompanied by an enjoyment of the process.

## Orality and literacy

The two most common ways to convey a message are orally and written, which are part of two different worlds but related by the aim that they evoke: communication. All human groups base their social relations basically through speaking. Today there are many rural communities with no or very little contact with writing. In farming communities they do not feel the need for written signs to perform socialization and to survive. An example of this is that only 78 of the 3,000 living languages have a system of writing and literature.

Human communication is to share codes with the individual and the group. In order to make it possible to understand the message the signals need to be recognized by the sender and the recipient. The common form is verbal communication.

The reason for the existence of a written language is to transmit remote communication in time and space, as well as to retain an experience, tell stories or share important documents. Factors that influenced the possibility of the development of writing were the socioeconomic conditions of the societies, the capacity for abstraction, and finally the knowledge of the spoken language. The socio-cultural needs of each group affect the use or non-use of writing.

We have created two basic writing systems: ideographic and phonemic. Ideographic scripts are characterized as representational systems to differentiate the meanings of concepts.

In alphabetic systems, coding systems convert sound units in graphic units, based on auditory discrimination achieved visual discrimination, alphabetic scripts are systems of representation of significant ideas. There does not exist perfect calligraphic systems where there corresponds a graphic sign and sound, since visual resources are limiting.

If writing is conceived as a code of transcription, learning is considered the acquisition of art. If writing is conceived as a system of representation, learning becomes the ownership of a new object of knowledge, a conceptual learning (Ferreiro, 2002: 17).

Emilia Ferreiro conducted studies that recognize a variety of modes of representation that precede the alphabetical representation of language. Urban children draw two types of figures, sticks and balls, which translate as numbers and letters. That is, corresponding to the

sound pattern of a release and syllabic script . This means that children have the ability to invent original constructions with their own logic for organizing created signs ( Ferreiro , 2002 : 18) .

The distinction between figurative and non-figurative drawing, between drawing and writing , is of fundamental importance . When the child draws they are located in the space of the iconic : the forms of graphics do not reproduce the form of the objects, no do the special ordering reproduce the shape of the objects. ( Ferreiro , 2002 : 19) .

The appropriation of the written tradition generates a possibility of the liberation from speaking to expand the horizon, to enrich the world and give dimension and meaning on the ephemeral nature of the spoken word in order to give continuity to the memory .

The existence of a tradition of writing in a group allows the acquisition of reading and writing which is, in a way, more natural for children. You have to understand written language as an object for social use: in other words in the urban environment where scriptures are everywhere - propaganda, television ... - reading is second nature- but not in the farm communities because the use of reading is practically nil. A child growing up in a community that does not attach importance to the signs of writing will have more difficulty learning to read and write than children who are surrounded by written words.

Knowledge acquisition starts from childbirth. The child begins to perceive the world around her and pay attention to record in her memory her immediate surroundings through perception.

The world of early childhood experiences such as taste, see , hear, touch , and smell develops and is interpreted by children before they are expressed in symbols such as words. Language acquisition begins early in the family. The conception of the meaning of a word as a unit does not exist in isolation but as an idea that is embedded in a social setting.

In order to achieve the best results in the development of children's literacy in rural communities, it is necessary to rethink education within the processes of thought and communication of an oral culture. The concepts of children from their perspective must be

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<sup>2</sup>“¿Qué me quieres?” (Traducción de Carmen de la Mora).

included in order to intervene in the process of teaching-learning. It is important to consider that the practices that have been implemented are by literate adults who can not shake the idea of writing, therefore they are not always suitable .

In preliterate communities the level of literacy required to survive is limited primarily by poor access to reading, comprising only small written messages such as the labels of medicines and industrial products that arrive to their community. Writing, on the other hand , is used primarily to fill out forms and applications . The question is how to introduce literacy in rural environments not only as transcription but rather as the appropriation of a social object, how to explain that sticks and balls have meaning for letters or numbers in a way that children achieve a complete appropriation of writing and they internalize it .

## Drawing

Drawing is a natural human means of expression. It is considered an activity that can express and represent experiences, emotions and experiences. Drawing can be performed with only artistic intentions or for the purposes of communicating information. All cultural traditions have taken this activity for various functions: rituals , arts , entertainment and education.

Drawing lines is one of the most spontaneous activities of man , a means by which one's own reality is externalized , an interpretation of the inner or outer world in which we live. Since prehistoric times , when man began to draw on surfaces where its traces remained , there were created invaluable testimonies of their environment and activities that we would not have evidence otherwise.

Drawing is the task of organizing lines. Their continuity and distribution show the variation of shapes that represent understanding of spatial relationships ; the elements of language: line , shape , color and volume, together with their combinations or outside of a surface.

Drawing is a graphical language by which the child manages to convey how they feel and perceive the surrounding reality with elements that get their attention. The acquisition of this technique provides the ability to manually handle the tools of writing: using the pen on a paper surface relaxes the hand and arm to draw lines and

circles. In its own way, it also promotes activities that allow the child to develop his own imagination and sensitivity.

Barthes (quoted by De Alba, 2010 : 43 ) believes that drawing is a coded message that has connotations according to the time and space of the artist . The act of drawing is a codification because the drawing separates the importance from the meaning; the drawing does not reproduce all of the object and , contrary to the reality of a photograph, can change the interior of the object . Drawing requires learning- it is more connotation than denotation. It is a projection of the subject.

Communicative drawing is a still image ; a different registry of the oral discourse ; a graphic expression that communicates a message that goes beyond what can be described with words and may represent a part of a reality impregnated with intentions or emotions in a personal way to see the world.

## Communicative drawing in indigenous communities.

Among the indigenous communities of Chiapas there are groups that use pictures to convey a communicative or informative ritual idea, and also to record a memory. There are some publications on the importance of drawing among contemporary groups such as the Lacandon , the Tzotzil of San Andrés , the Tzeltales of Cancuc and craftswomen of the Chiapas highlands.

In 1905 in the Lacandon Jungle, Tozzer (1982 : 85 ) found ritual ceramics with representative figures on the vessels intended to make offerings of pozol (a cornmeal beverage), pumpkins and the drink baltsé. These kinds of containers were decorated by incisions. The well identified signs are related to the figure of the man showing bones and spine . Another recurring theme is the figure of a star. The Lacandon at that time did not remember or did not want to explain the meaning of the drawings. Years before, Theobert Maler (1901-1903) had described and sketched the petroglyphs found in the rocks of the cliff Petha : a snake with two heads, hands and human characters . These drawings are attributed to the god who lived there . The clothing of the Lacandon that Tozzer met had dots and broken circles painted over a white fabric , which meant rain and sky. The dome of

the heavens and the black of the black rain clouds were offerings to “Mensabak” The Rain Maker. They also painted goats on their clothes, and painted their body for ritual ceremonies.

Among the Lacandon ritual objects there were incense burners, consisting of a ceramic sculpture with a face on the mouth of the censer with painted sides marked with the names of the gods U’kābah which indicate the sex of those who are dedicating the copal incense : male , red and black vertical stripes , female, cross hatched , as seen in weavings. Tozzer did not give them some hieroglyph meaning , and the Lacandons told him that the first ancient drawing was painted by a god.

Years later, in 1964 , Robert Bruce watched the Lacandon use something similar to glyphs to write the names of their gods for their ceremonial vessels. In Najá graphic representations were found in the censers- designs which corresponded as already noted by Tozzer , to the names of the gods that they were dedicated to. (Bruce, 1964: 137). Two different glyphs representing the sex of the gods : the male gods appear with alternating stripes of red and black ; the female goddesses are presented with cross stripes forming fabric .

Even up until 2012 the censers retain the same characteristics. Even though most of the Lacandon have converted to Protestantism and abandoned their old ritual life , they continue to manufacture the censers with vertical or crossed stripes with their respective colors. Some of the Lacandon drawings, on the other hand, represent lyrics of their songs that refer to their jungle world : animals, men, women, vegetation and homes.

In Los Altos de Chiapas, Piero Gorza conducted a study with Tzotzil children from San Andrés Larráinzar in order to interpret drawing as a source of information which indicate changes in the processes of perception and visual communication within cultures transiting between orality and writing. Drawing represent the mirror of identity and interprets the spaces of tradition. Readings about the drawings of the children in San Andrés were made at two different times , which identified that the first drawings in 1985 represented the town in way that they saw themselves and as they would like San Andrés to be like. Ten years later Gorza returned in 1995 . The graphic description of the children showed differences and similarities in the first representation of the community. The drawings described the area and the presence of animals and people. In the version of the area from 1985 writing was included, in a large part due to the influence of the school. ( Gorza , 1998).

Indigenous women in Chiapas and Guatemala share codes through their textiles. Each drawing represents a word : seed, bird, red , star , walker , Santa Cruz , crown , clown , butterfly , Earth, dogleg, snake, flower, monkey, scorpion, fish , bow, spine , pumpkin, saint, tree, etc. These drawings are not just ornaments - each embroidery means a request for rain, or good bodings for life and health among others.

In indigenous textiles the image of the universe is woven with clarity , line by line , with the weavers own vision. The group is constituted by a variety of designs that identify the weavers community . All indigenous women retain a strong tradition of using the drawing through their weavings and clothing; there is a symbolism that can be understood , in other words read between communities which is represented as a textile language in order to communicate between groups through clothing of both men and women. For example , the Cosmo vision is embroidered as a diamond; the drawing that identifies the community of Magdalenas is a vulture. (Morris, 2009).

Marta Turok mentions the importance that women give the words embroidered on their huipils: “ When I die , woman, bury me with my party huipil; this way I shall take the words , our word , through the daughters of the real men ” ( Turok , 1987: 32). “ Like the Virgin taught our women how to make designs, how to write on cloth , they take the word, our word, to the children of Batzvinik , the real men ” ( Turok , 1987: 18).

On the other hand, in Cancuc Pedro Pitarc noted the importance of writing in relation to disease and death. For contemporary “Cancuqueros”, what produces death is allotted to the religious texts of the Protestants. These texts have been introduced orally to a body in order to make it sick. The disease is therefore a result of these words , the purpose of healing is to delete the words. Prayers serve to remove the disease. One of the most powerful therapeutic songs is of the jaguar, because on the skin of the jaguar it is written and drawn *stz’ibalchoj* , which means “ your Tiger writing” the disease is the power of the written word that is on the jaguar skin . According to Pitarch (2005 : 528 ) The powerful spirits can write, paint over bones. The *nahuales* of the House of Lightening are characterized as writing great books ( see Figure No. 1).



Figure 1. Drawing of snail.

## From drawing to writing

Any sign, if its intention is to communicate to others, becomes prewriting. The marks are conventionally understood elements that can be identified culturally. When these signs are organized, they are converted to graphics systems to record, and in some cases to represent, spoken language. Reading is the interpretation of this event. Writing is the same as representing sounds or ideas with traced symbols in various designs and paintings.

The word in the Zoque language to write is the same as to draw: *hoypa*. In many of the Mayan languages it means the same write as to draw. To mention some examples in Mayan languages, in Chol, to write: *ts'ijban*; writing: *ts'ijb*; drawing *ts'ijbal*; in Tzeltal from Copanagustla: *Zibal*, writing; *tsibabil* painted.

The existence of graffiti in ancient settlements is another evidence of the writing that was done by the Mayans even though they were uninitiated in writing (Coe and Kerr, 1998).

It is well known how the Maya wrote in glyphs on stone and paper, recording their history, rituals, religion and genealogies. Many of these documents disappeared at the hands of time and many others were destroyed in the Spanish conquest. However, some of these graphics survived to the present in monuments of stone, jade, bone, ceramic, and bark paper which is why we know a good part of the religion, astronomy and cosmology of the ancients.



In Chiapas the codices did not survive because, as Dolores Aramoni (1993 ) said , virtually all codices were written in Chiapas were destroyed during the colonial period. Bishop Núñez de la Vega was responsible for the disappearance of the vestiges of pre-Hispanic tradition of writing in the seventeenth century. Before colonization there was a close relationship between religion, the power of writing, and the teaching and learning that occurred among the upper classes as part of their control of knowledge . The privileged classes wrote and could read the codices. They were the sages of the nations that had managed to preserve the wisdom of the ancients through writing -booklets written in their own language ; codes and calendars made with painted figures ; explained with abbreviated characters and enigmatic figures; and drawings of names of places, animals and stars ( Aramoni , 1993).

There exists two letters written by Bishop Núñez de la Vega which talk about books or codices found in Chiapas that contained paintings with figures of animals, the indigenous language in which they were written , references to the information contained on sacred sites like caves and mountains, and ritual calendar dates cited by Carmen Leon and Mario Ruz in Diocesan Constitutions :

Books of divination , Letter to the Marquis of Vélez :

I've taken and collected over 30 books where the superstition of the Indians was exposed through art. It was deduced by the main teachers that I surrender these books with other papers that were written in their language invocations that call the Devil..... by one way or the other it was taught and communicated to those who understood and who were able to learn this art ...there is also even a notebook where they are painted figures of some animals: monkeys, toads and snakes which are assumed to be *naguales* for the children ... (León and Ruz, 1988 , 210 ) .

Letter Nunez de la Vega to Fray Juan de Malpartida :

"The instruments written in the indian language indicate that the Indians keep with great stealth four books of Tepanaguaste ( Copanaguastla ) and in some of them in a language that only the devil can understand and the Indians that lean and with some clauses in Hebrew - so that by singing they explain and gave news about places and sites of caves, mountains , hills etc., and so were going to practice their superstitions ... and have a booklet where, as in the calendar of the Church , are written their names and their effigies which they have recorded in different stones and enclosed in large vats made and placed in a cave where I removed them and burned them in Huehuetlán in public and general faith... (León and Ruz, 1988: 237)."

The last of the Mayan scribes were killed in the battle of Tayasal. These itzaes wrote hieroglyphics until 1697 when the city was conquered (Coe and Kerr, 1998 : 220). The Master singers of Yucatán, guardians of tradition , still wrote in 1782 the Chilam Balam, which included calendric glyphs of different classes.

## Indigenous communities and access to the written word

Excellent papers have been written on the history of literacy in indigenous Chiapas , however we will refer only to some of the ordinances on education of the colonial period, as well as a Chiapanecan pedagogical proposal from the nineteenth century and some comments on educational experiences in the twentieth century.

When the first religious arrived with the Spanish they tried to teach indigenous groups Latin letters with the intention of converting them to Christianity. Also there were several royal orders to establish schools, introduce teachers and promote the Spanish language in indigenous communities.

In order to teach the natives in the Captaincy General of Guatemala, several orders were given. They were mainly developed by the visitor Lara Mongrovejo in 1647 , who In this manner they would avoid interpreters who would trick them-above all with the Christian doctrine.

Ordinances that made the lawyer Antonio de Lara Mogrovejo, judge of the Audiencia of Guatemala , for the government of the provinces of Zapotitlan , Soconusco and Verapaz , 1647 .... that they learn the Christian doctrine in Spanish ..... and because it is highly desirable that the Indians know the Spanish language as mandated in many Royal groups also by the conveniences that it follows in the spiritual and temporal in order to forgive them the damages that they not seem to understand and ignore the great miseries and humiliations that they can ponder. (Carrasco, 1982: 191).

Some missionaries disagreed with teaching of Indians because they feared that the acquisition of the written word would lead back to idolatry. Religious understood how important it was reading the calendric books on learning the divinatory art and therefore in its

perpetuation, which they considered the danger inherent to literacy“ can have serious disadvantage that the Indians learn to read and write, usually in public schools, if not precisely those which are necessary for singers of the Church ...” (Carrasco, 1982: 196).

Regardless of the considerations against the danger of literacy , the Spanish government promoted the idea of founding schools so that both indigenous boys and girls could learn Castilian. Parish priests were instructed in the task and were granted payment as teachers for their services in the community where they taught .

In the village of San Francisco Panathel in November of 1643 these ordinances are true: giving faith , Gaspar de Armas :

Giving arguments as to why one should speak Castilian :  
because they have advantages in stores and treaties, because being the common language grows the results of their wealth and haciendas and also inconveniences are avoided in the administration of justice , by the ignorance of the language and avoid paying interpreters and the following producing laudable effects of friendship and kindness ... For the lack of understanding they are free the wrong and are punished the innocent as there has been malicious interpreters and that for a lack of understanding the language are not aware of the laws in their favor and the Spaniards treat them worse than slaves ... (Carrasco, 1982: 270) .

Since the nineteenth century the concern of independent governments was the assimilation of Indians into the national culture within the incorporative policy. Among the few who in the nineteenth century took into account the education of the Indians , is the Chiapas monk Victor Maria Flores who in 1841 wrote his “ Domestic Method for teaching and learning securely to read and write in 66 lessons with experienced with ignorant natives even in the Spanish language .”

In the early twentieth century, in 1902 , the government proposed the creation of regional indigenous schools . The construction of the first of the schools started in the county seat of Chamula. In 1912 it was again proposed to open more schools in rural communities, and donations were requested to build them and for illiterate adults .

It would be too numerous to mention the various attempts by federal and state governments to establish schools in rural areas in Chiapas after the revolution, which of these left their mark on

the indigenous population. In this space we refer to the presence of the government through the National Indigenous Institute and institutions such as the Summer Institute of Linguistics .

Among literacy experiences is the National Indigenous Institute, through the cultural promoters of the Tzeltal - Tzotzil Coordinator Center (1951 ) . Regarding the teachers and bilingual education advocates, there has been several notable works written and their influence continues in indigenous literacy programs.

A predominant situation that continues until today is the learning difficulties of the Tzeltal and Tzotzil groups that learn to read without understanding the reading. The Summer Institute of Linguistics wrote a report on the state of literacy in 1973.. The study consisted of investigating the levels of literacy using the parameters for the understanding of dialectal forms . They worked with Tzeltal variants from Oxchuc Chanal , Tenejapa , Ocosingo , Chilon , Bachajón, and Altamirano and in all of the cases the Spanish language. Among the results, it was indicated as to how many respondents had books in Spanish or in Tzeltal . Most of those who read in Spanish did not understand the content . Probably some of the Tzeltales had a Bible translated into Tzeltal . Since the 1940's Presbyterians assured that the indigenous learned to read in Sunday school with access to the Bible.

Aguirre Beltrán (quoted by De la Fuente, 1964 ) states that , in the intercultural situation where indigenous communities transit, formal education must be innovative -adapting to the culture of the community, knowing the reality that each space so that there is no discontinuity between formal education learned at home with formal education , so that school means a cultural renewal for the indigenous child ; children are required to learn two cultures , rhythms of work, work schedule , and work distribution .

Bruce highlights three points on indigenous literacy that are common to all groups : the first is the difficulty in understanding the concept of phonemic writing, the second the lack of motivation, lack of third books written in his way of speaking Spanish or lack of knowledge of the standard Spanish .

The Lacandons found it easier to understand the ideographic writing, and almost none of them considered writing was of some use. Some began to understand the importance of writing and reading, such as Bor Lacandon who was interested in reading the contents of medicines or to be able write a list in order to buy goods.

Also, Young Chan Kin wanted to forever remember the songs of his father. Little by little they were gradually being forgotten and this motivated him to learn to write. Antonio, Lacandon of Naha, had a notebook from the SIL that a missionary had given him some time back with which he learned to draw his name in Lacandon as well as a few more words, but never caught on to the principals of the relationship with calligraphic writing (Bruce, 1976 : 10-12).

Bruce began by teaching them to read and write in Spanish used by the Lacandon, a remote dialect of the standard found in books. These Lacandon showed trouble understanding the concept of writing related to sounds and in the process that the writer could memorize, recognize and reproduce some letters and short words. But they could not make the relationship between the written symbol and sounds that they represented- this does not could be overcome, the separation of the words seemed impossible.

The teacher Joseph Weber, throughout his life as a teacher on the coast and in the highlands of Chiapas in 1970, recognized the difficulties that the indigenous have being literate and adapted his famous bridge method and applied it in indigenous languages in his Memorandum on indigenous adult literacy. The bridge method raises the need to build on the sounds of language.

Weber proposed as an initial phase of learning the interpretation of drawings and followed by the learning of symbols. He also wrote a book entitled *Reading Drawings*. This method of teaching reading and writing was done using different types of associations: acoustic, visual, tactile and intellectual basis of sensory experience by drawing on the sounds. The basis of his theory of drawing consists in orientation, distribution, helps in fantasy, calculates, sets, teaches, explains, symbolizes, orders, illustrates, encourages, suggests, plans, simplifies, and takes apart the whole.

The basic features of the bridge method are the following steps: 1.Sensitize children in their language phonetically, analyze children's oral language and not their writing which is an arbitrary product; 2.Take apart the sentences into their individual elements: words-phonemes, and discard the simultaneity in the introduction of letters; 3.Transform auditory elements into visual elements such as reminders, provide natural bridges between phonemes and letters; 4.Simplify reminders, get the child involved in an organic way with the letters; 5.Put together the letters; 6.Mecanize reading and literacy. One advantage, says Weber, is that this method " contributes greatly

to ease tensions between indigenous and *Ladinos* by automatically directing a greater understanding between Spanish speaking and monolingual people" (Weber, 1972: 7).

The first phase is to ensure that the illiterate interpret drawings and understand symbols, " their minds, after many years of inertia , will be prepared step by step to be more receptive , more awake and restless regarding learning" (Weber, 1972: 6) .

Images and suggestive drawings helps to discover the natural wonders of the environment and relate them with the corresponding voices – the auditory representations.

The bridge method invented graphic shapes that resemble or suggest in some way that phonic elements contact the phoneme and the letter : for example , viper , " ssss " ; owl, " uuuu " , and the image of the animal's bodies suggest the sign ( Nivón , 1994 : 345 ) .

## Tzeltal communities in the Lacandon Jungle

The Chum Cerro La Laguna community is located on the edge of the Montes Azules Biosphere Reserve, populated by groups from the highlands for nearly 35 years.

The importance of the Montes Azules Biosphere Reserve lies in it being one of the few regions of Mexico where the tropical rainforest with the greatest floristic diversity in the country is preserved. It consists of various high evergreen forest ecosystems , Medium evergreen forest , pine-oak lowland and aquatic vegetation . It was declared a reserve in 1978 , which means that existing human settlements were declared irregular , with frequent evictions of communities.

In the high forest species like *mahogany* , *ramon* , *tight sapote* , *jobo* and *cochimbo* are found, among many other varieties of trees. As for the animals that exist in the region there are jaguars , pumas , tapirs , bats , parrots , crocodiles , monkeys, among many other species.

The reserve is divided into three zones with different levels of protection and human use. No one is allowed into the core of the reserve.

In the area of restrictive use research and ecotourism are allowed. Here dwells the Lacandon ethnic group, which live on subsistence

agriculture without destroying the environment , as well as most recently ecotourism. Tzeltal and Chol communities are located within the area of sustainable use.

This region is Laguna Miramar , considered the purest water reserves across the country . It is also has a hydraulic network of major rivers like the Lacantún the Jataté and Lacanjá .

## Migration and colonization

The Chum Cerro Tzeltal Indians migrated to the forest in the late 60s due to the poor quality of their land in the highlands of Chiapas, and especially for the lack of water . The intense colonization of the forest began in 1954 , and by 1990 there were over 200 human settlements.

In a pastoral visit to the region of Miramar, Pablo Iribarren mentioned the organization of various communities and the problems faced by some of them. For example, the 18 families of Chum Cerro in 1988.

The first inhabitants of Cerro Chum asked the government to be established in the Santa Isabel ranch, which was owned by Jaime Bulnes, near the Rio Azul. The Agricultural Secretary relented because the owner had not paid taxes for 25 years . Some of these early families could not support the amount of flies and left the area .

In 1970 the Agricultural Secretary provisionally ceded the land to seven families from Ocosingo, Sitalá and Sabanilla During this time they had a temporary permit on the lands that they requested from the government in order to settle. However the resolution of the biosphere reserve was made with other 26 villages without legal ownership . Their main need was to have a radio in order to call a small plane when someone was sick ( Iribarren , 1988 : 3).

The inhabitants of Chum Cerro La Laguna are constantly threatened with eviction , as has been done with other forest communities, since they have failed to achieve recognition of their land. The villages have been persuaded by different means into leaving the area of the reserve. Government delegates once arrived and gathered in the church to ask them to leave the place. During this meeting a strong lightning bolt hit close by that made the government representative jump, and the people started clapping & shouting “ Long live the Holy Ray , another shot , another shot!” ( see figure no. 2 . ) .



Figure 2. irls playing

## Rural activities

The Montes Azules Biosphere Reserve imposes a number of conditions in order to plant crops and looks for ways that do not harm the environment.

In the zone of tolerance where communities are based, agriculture and livestock is allowed under certain rules . The National Commission of Natural Protected Areas ( CONANP) forces them to reduce their space for livestock and planting, and plant crops that do not harm the conservation of the forest. The land is divided by color : black and brown for the cultivation of corn and the red for livestock and timber.

The inhabitants of Cerro Chum are farmers , living by growing corn and beans. They have also planted sugar cane, coffee, cocoa and citrus. The land is equally good for rice and pineapple. They work collectively in terms of animal husbandry , agriculture on a family scale.

Since 1988 the family plots became collective . It became necessary to cut down more forest to pant cornfields and in order to feed the armed struggle. In 1994, coffee prices rose and they began to plant coffee trees. This coincided with the decline in sugar, so they abandoned the cultivation of sugarcane. They are now cultivating vanilla.

There is great honey production but they cannot easily market it due to a lack of roads, and are forced to sell to middlemen who collect



on the site but then do not pay them on time or nor at the established price . As for the breeding animals, they have horses, cows, and chickens. They also resort to collecting , hunting and fishing.

## Roadways

In this part of the jungle near Montes Azules , there are no roads , only footpaths for transportation. The situation of living in the boundaries of the reservation prevents the construction of highways that would connect the communities with the rest of the State. The nearest town is Comitán. The Tzeltales from Chum Cerro have to walk along a path , then take a bus in Nueva Esperanza on a dirt road with a combined time of 10 hours on the road during the dry season. To reach Ocosingo they walk two hours to Miramar lake then travel by boat to San Quentin or Zapata. From there they take a bus to Ocosingo, with a journey time of 12 hours. In order to market their goods, they have to go to intermediaries to avoid the long road to Comitán or Ocosingo.

For some time they benefited from a runway that allowed them to get the seriously ill evacuated by plane. However , now there are no flights since the last plane crashed in April of 2010 and no other pilots are encouraged to fly there since then . This airstrip was also used by the bishop during visits and for the program Opportunities . In order to give a local perspective on the value of money , we can look to an example from 2011 when a messenger on horseback charged 20 pesos to move 6 km on an unpaved road.

In 2011, the Federal Electricity Commission convinced the Chum Cerro and Benito Juárez communities to make a dirt road in order to bring in electricity. Every adult went to work on the road ,except for the Zapatistas. Vehicles were able to travel for a period of time, but in the rainy season the road became impassable again.

## Community organization

Community decisions are agreed at meetings where women also participate . The a'teletic is the main group consisting of presidents, catechists , aides, nurses and the commissary . They also have tunnel authorities ( deacons) . The a'teletic "are not the rulers but are ordered by the community."

The first major organization was supported by the Church in 1975, the *Quiptic ta cubesel* was shared by several communities of the jungle. Later in 1976 came the Peasant Struggle, and between these two groups formed the Union of Unions in 1980. Tensions began in the eighties in several communities in the forest because a non Catholic religious group was established called "of the Brother Galván," also called "the institutional," because they were allies of the government. For this reason the Quiptic organization lost some members" (ribarren, 1988: 5).

Through these organizations the Tzeltals of the jungle were seeking legalization of their land, which the government refused claiming that they were in the Biosphere Reserve, which to date has indefinite boundaries. This resulted that in 1984 they joined the EZLN movement that promoted their recruitment. Since 1988 they have received military training.

In 2003, two thirds of the community stopped fighting claiming they did not like the practice, but also feeling the prohibition of the Zapatistas of migrating to the United States. Since 2003 half of the Chum Cerro families stopped being Zapatistas, while the other half continues.

The families that continue as Zapatistas do not receive government support, such as Opportunities or from the Conservation Program for Sustainable Development. The non-Zapatista mothers receive money from Opportunities for each child that goes to school.

Most Chum Cerro children born between 1994 and 2003, do not have birth certificates. The censuses of 2000 and 2010 could not be carried out by the Zapatistas opposition group.

For community places they have ample space for the church with its images of St. Thomas, the Virgin of Guadalupe and Christ. The houses are made of wood with thatched roofs or sheetmetal. Some are painted, some others also have drawings. There are stoves for cooking with firewood. They sleep on mats or in hammocks.

All of the residents of Chum Cerro are Catholic, and they mainly celebrate the holidays of All Saints Day, Santa Cruz, Guadalupe Day. The deacons preside over the ceremonies in Tzeltal. The religious festivals to pray for rain and weddings are very happy events. Everyone participates, and the events being with pilgrimages that include flags, music and fireworks from one side of the community to another

. Outside the church small dances are held where participants include children to the elderly .

Even when women participate in the meetings, tradition remains. Very little Spanish is spoken. They wear traditional clothes and only leave the community for health reasons.

In terms of services, they have electricity through solar panels. They also have a potable water system and latrines which were installed by a foreign foundation. Sometimes you can hear broadcasts from Guatemala . They also watch movies through videos.

## Education

In the last census of 1990 , Chum Cerro La Laguna had a total population of 113 people : 54 men , 59 women , of whom 51 were literate , and 41 illiterate ( over 5 years ) .

Chum Cerro children live in a completely oral community: public practices , decisions and agreements are made in assemblies. Private commercial practices, the transmission of knowledge to survive, are also all oral . In the jungle they resort to writing only for governmental issues. Adults still find it difficult to fill out a questionnaire. Under the circumstances of these isolated communities there are no public spaces where they can see letters, brochures or Bibles. The priests are the only ones who read and who retain community roles to apply for recognition of communal property . Currently , there is no school in Chum Cerro .

Before 1994 there was a government school . Following their integration into to the neo-Zapatista movement , they expelled the teachers. For this reason there is a generation of people between 1994 and 2003 who have not learned to read or write. Although some Zapatista villages began their own education system ,this was not the case in Chum Cerro .

Some of the parents of the children went to school and are literate . However, very few practice their literacy skills as they are mainly farmers and gatherers. Mothers are monolingual. According to the last census that was held in Chum Cerro in 1990 , there were 22 children aged 6-14 attending school and 6 who did not attend ; 29 people were monolingual and 59 bilingual ( over 5 years old ). The

ejidos population had 38 people , 6 of them with incomplete primary school, 2 fully educated (primary and secondary) , and 6 more with secondary education .

In Chum Cerro in 2011 there were 22 children aged 8 to 18 who could not read or write. Moreover, half of the children and some parents do not have birth certificates in order to get CONAFE- INEA involved in the formal education of the community.

The Chum Cerro neozapaitstas families have a teacher who occupies a portion of his time teaching because of his many activities . Only one parent sent two of their children to the New Sabanilla school , A Chol speaking town that is an hour walk from the community ( See Figure No. 3).



Figure 3. Drawing a jaguar.

## Literacy workshops

22 Chum Cerro children , (2010-2012 ) between 8 and 15 years old were started on literacy instruction . These children speak very little Spanish , and are accustomed to outdoor life , doing small tasks for the community, taking care of their siblings , and gathering wood. Almost none of them has left Chum Cerro . The girls wear their traditional dress , except one whose parents are interested in having their children learn more and sent two men of the family to study in New Sabanilla . Parents of the Zapatista families did not allow their children to come to take the literacy

workshop. The children, Zapatistas or not, are often friends and play together.

The most interested in the education of the children in the community is a volunteer, Alfonso Pinto, who studied until the second year of high school. He gave a space for conducting the workshops. He also agreed to be the instructor and since February 2010 brought the children every day. There are advantages of having an instructor in the community that your group knows and likes, and is not required to submit progress reports before the SEP, and can also be free to teach in their own way.

For the realization of the workshops, Alfonso Pinto had several volunteers who helped with the animation by giving drawing lessons, games, reading stories, looking at clippings, modeling, teaching letters and numbers, and so on.

In Chum Cerro children had never had paper or pencils, so literacy workshops were a privilege by practicing drawing, which was initiated by an expert in painting and sculpture. They were allowed to do free drawings, anything that was copied from reality, as are required in schools. Children showed surprising creativity in their abstract paintings.

One of the volunteers taught them to cut pictures from magazines and tell stories about what they saw to get them used to seeing images on paper. Children drew freely while writing some words related to their drawings. They drew their homes, environment, flowers, animals...they also drew people, particularly women with their very colorful traditional dresses. Many colors were used and unlike other children they did not use the entire length of the sheet of paper.

With help from the instructor they were asked to first narrate and then try to write stories to show how much they understood in writing. At the same time they read stories in Tzeltal and Spanish, and were asked to draw what they were listening to see if they understood the stories. From each of these illustrated works booklets were published for distribution among children.

When they could tell and write some stories, they talked about their daily lives, the sowing of maize, the importance of eating, animals in the house: cats, chickens, ducks, dogs, sheep, cows, hunting, fishing, caves, trees, river, mountain, wild animals such as

rabbits who were always hungry and ready to invade the corn , the tiger and his power, deer, agouti , dove, buzzard , sparrow hawk , coyote, wild boar, and badgers, among others . Many of these tales are an interpretation by the children of magical realism .

Besides reading practices there were several volunteers who taught them how to add and subtract . One biology student taught them to make games from local materials: stones, seeds and even modeling in clay figures . In the summer of 2012 we had the support of two academics from the Universidad Complutense de Madrid , who spent a month in the community and made an assessment of the group.

From the beginning a small library was organized with: books in Spanish for different ages, with some written in Tzeltal , dictionaries in Spanish and Tzeltal , materials on nature and the environment , history, geography , readings about the Maya and others, all of the books were well illustrated b . (See Figure No. 4).

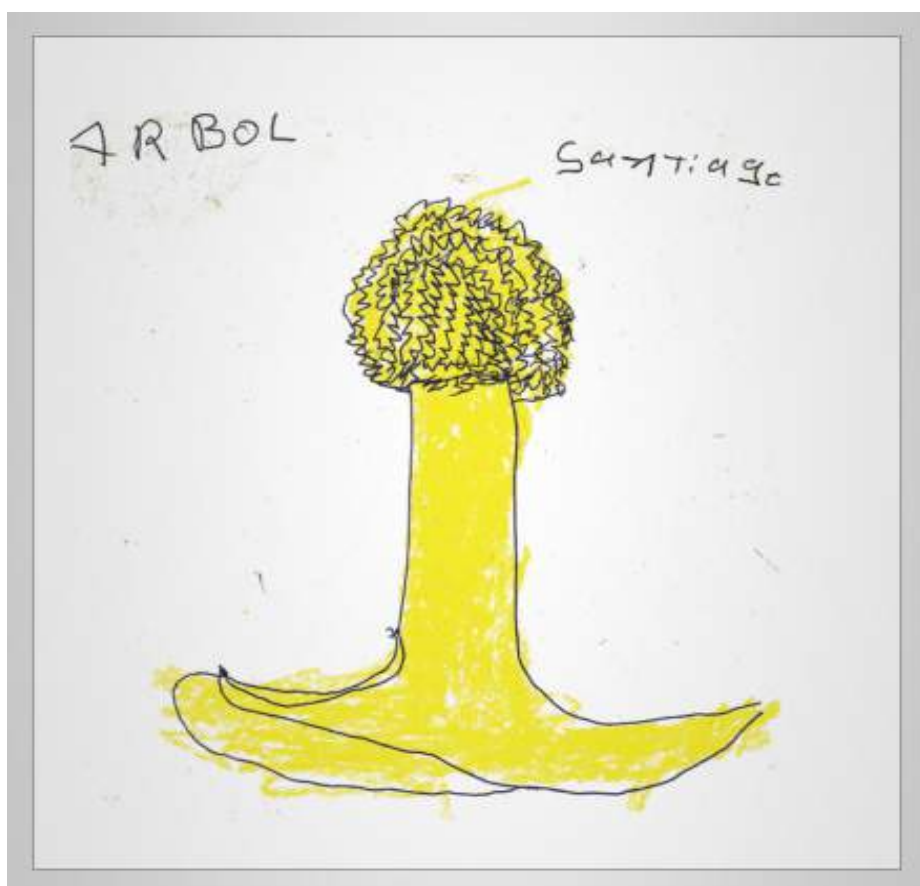


Figure 4. Drawing of a tree.

## Conclusions

The acquiring literacy skills for children in oral cultures , on order to be effective , need to take into account the knowledge of the group and the particularities of each community. We believe that in rural areas where children and teachers belong to different cultures , the process of transmission of literacy is more complex.

Among the obstacles that arise in learning to read and write and to encourage reading in oral communities are the lack of adequate space , lack of teaching materials and lack of motivation of families who belong to an oral culture where writing is not a basic element for survival.

Before the Chum Cerro Children could appropriate writing they had to start to learn how to view an image, to make drawings and encounter the difficulty of identifying the sounds of the language through the strokes of the letters, and later on seeing the letters together in order to form a word. What is most important is that Tzeltal children are required to learn to read and write primarily in Spanish , as there are very few texts in their native language and few teachers and techniques to convey writing Tzeltal .

Drawing with children Chum Cerro was the most appropriate tool to take the step from oral communication to writing. Through image came better communication with Tzeltal children, even with books written in Spanish . Through the drawing of lines there was the abstraction of calligraphic signs. The children of Chum Cerro achieved primarily the ability to communicate with drawings, without the intervention of the community language or nor the language of school instruction . Children freely expressed themselves about their world: their concerns and their likes. These 22 children of different ages and different levels of knowledge were able to learn the rudiments of reading and writing while they are waiting for some time in the near future to have a school and a classroom teacher .

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# Aquaculture and its effects on the environment

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## Abstract

The document argues that aquaculture production systems in the world are part of the economic and social development of fishing communities involved in the exploitation of this resource, indicating a secure major source of food production in the coming years, resulting in a direct generation of employment and a reduction in poverty. However, beyond these contributions their negative environmental impacts should be studied to identify and establish mitigation proposals that meet environmental laws and regulations in order to ensure sustainability, in this context there is a demand for institutional participation and by various interest groups, but above all there is an obligation of fish farmers to assume responsibly to these commitments and include environmental management in production processes.

*Key words: sustainable aquaculture, management, environment.*

## Introduction

Worldwide, aquaculture has increased in the past three decades , which has meant economic and social growth for the sectors involved in this activity which has contributed significantly to the generation of employment and the production of rich, high quality protein food for human consumption. Globally, aquaculture plays an important role in focusing the efforts in eradicating hunger , providing food and generally improving peoples health and quality of life.

In this regard and in order to promote sustainable fisheries and aquaculture in the long term , the 1995 conference of the United Nations Food and Agriculture Organization ( FAO ) adopted the Code of Conduct for Responsible Fisheries and Aquaculture , establishing the foundation for the principles and standards of behavior for responsible practices to ensure the conservation, management and effective development of living aquatic resources with respect for the ecosystem and biodiversity ,and recognizing their nutritional, economic , social , environmental and cultural importance.

This article aims to describe the enormous potential for economic and social development of aquaculture practices , the main effects and impacts that occur in the environment as a result of the implementation of this activity, and how environmental management

systems address these problems by proposing alternatives to minimize their impact through decision making and actions aimed at achieving sustainable development for these production systems with the dilemma of knowing the environmental effects that are generated and how environmental management systems pose this problem in an effort to resolve them. In this paper the contributions made by various researchers on the subject are reviewed in order to present an overview of the action methods.

## The aquaculture in the world

World aquaculture production continues to grow in the new millennium and has acquired unimaginable dimensions, evolving in the field of technological innovation and development and has adapted excellently to meet the food needs required by the population. In 2011 it reached a record level high of 63.6 million tonnes (Fig. 1). Another very important element to mention is the documented record of some 600 aquatic species grown worldwide with various systems and installations, with different levels of input use and technological complexity using fresh, brackish and seawater, contributing significantly to the capture fisheries production established through crop systems, particularly in inland waters (FAO, 2012).

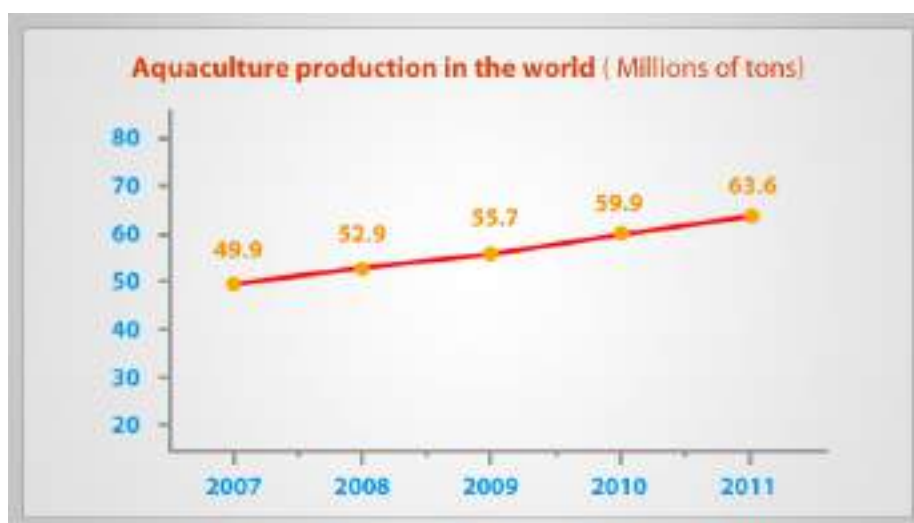


Figure 1: Aquaculture production in the world (FAO 2012)

The variation of the global aquaculture production between the years 2007 to 2011 is set in the order of 13.7 million tonnes of fish

products , which is an equivalent to a continuous increase of 27.5 % for this period.

While in America aquaculture has been growing in recent years with 600.942 tonnes reported in 2004 , by 2010 the records indicate the production of 543.428 tons. The difference in absolute numbers -57.514 tons, represents a decrease from 2004 of -9.6 %. (FAO, 2012)

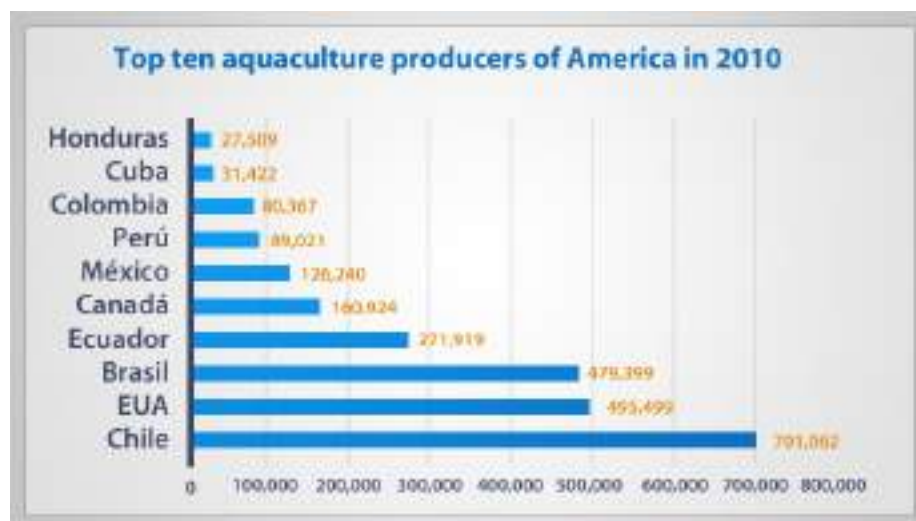


Figure 2: Top ten aquaculture producers of America in 2010 (FAO 2012)

Chile , with its long coastline and excellent sanitary, environmental and labor conditions successfully entered relatively early during the flowering of modern aquaculture. The spectacular growth of salmon was definitely responsible for the growth rate in the sector shown until the late twentieth century , ranking within the top 10 countries with increased aquaculture production in the world ( Parada, 2010 , p. 144 ) and first in the Americas (Fig. 2 )with aquaculture production for 2010 of 701.062 tons- this is equivalent to 27.2 % of all fish products produced in America. Mexico is in sixth position according to the records with 126.240 tonnes at 4.9 % of the total aquaculture production in America , with shrimp being the most exploited resource as a farming system product.

## Panorama of aquaculture in Mexico

In Mexico commercial aquaculture production has increased which has made this practice an activity with great potential for development ,

providing social and economic benefits and translate into alternatives for the production of food sources. This is done by application of skills and knowledge focused on the cultivation of various species of aquatic animals and plants.

The potential for fisheries and aquaculture is huge. Mexico has 11,592 km of coastline, of which 73 % corresponds to the coastline of the Pacific Ocean and 27 % to the Gulf of Mexico , Caribbean Sea and Islands. Mexico has 12,500 km<sup>2</sup> of coastal lagoons and estuaries and 6,500 km<sup>2</sup> of inland waters such as lakes , ponds, and rivers (SAGARPA, 2011) , which makes it a region of great importance for furthering and promoting its development. Competitive advantages are the right climate in much of its territory for growing many commercial species , proximity to the world's largest seafood market (the U.S. ) and native species with excellent characteristics for aquaculture including white and blue shrimp ( Martinez et al. , 2009).

Species	Aquaculture Production ( tons )				
	2007	2008	2009	2010	2011
Shrimp	111,707	150,201	133,282	104,612	108,815
Tuna	2,882	2,923	2,762	2,008	3,689
Tilapia	73,580	71,018	73,373	76,986	71,125
Oyster	46,491	42,148	38,974	47,611	43,757
Carp	21,798	24,157	22,620	24,231	18,528
Trout	4,345	4,917	6,055	6,914	8,480
Catfish	3,801	3,041	3,145	3,388	2,929
Sardine	1,403	2,338	1,876	1,806	1,226
Shrimp	46	24	23	26	18
Black Bass	1,234	1,221	1,379	1,154	1,044

Table 1: Participation of aquaculture in Mexico , tons of live weight by species ( Figure prepared from data taken from " Statistical Yearbook of aquaculture and fisheries "). SAGARPA, 2007-2011. Mexico

The most predominant cultivated species is shrimp , its position in the international market for its economic value is relevant. For years it has been one of fishery products with high commercial value , followed by the production of cichlids belonging to the family cichlidae . However, the behavior of aquaculture production between 2007 and 2011 has been asymmetrical , with the maximum values of marine and inland aquaculture reported in 2009 as 285.019 tons ,with a decrease 262.853 tons occurring in 2011.

## Shrimp farming in Mexico

In Mexico , the exploitation of blue shrimp began in the thirties, when significant populations were found in the protected waters of the Pacific. From then until the fifties it was an extractive activity dominated mainly by private and foreign initiative. In the Gulf of Mexico it was not until 1947 when the fisheries were initiated in Ciudad del Carmen , Campeche , twenty years after the research program for shrimp culture sponsored by various organizations and public and private institutions emerged. Its first achievement was the intensive cultivation of blue shrimp at the Center for Scientific and Technological Research in Puerto Peñasco Sonora ( Bortolini and Garcia , 2004).

Due to the economic feasibility that shrimp farming represented in the southernmost states of Mexico, such as Oaxaca's " closed estuary" and Chiapas' " The Capulines ", shrimp cultivation can trace its beginnings back to 1980 with the construction of pilot stations of stocked ponds using with postlarvae from the wild. These projects were promoted by the Ministry of Federal Fisheries, which provided a range of information and knowledge that were subsequently applied to the crop first semi intensively in shrimp cages and later by intensive aquaculture through the construction of shrimp farms operating under controlled conditions using high planting densities .

## Growing freshwater aquaculture species

Regarding production volumes , today the most important fish species for freshwater aquaculture are represented by the " mojarra " tilapia and carp. Cicliculture in Mexico began with the introduction of an African cichlid genus *Tilapia* with three species: *Sarotherodon aureus*, *Sarotherodon mossambicus* and *Tilapia zilli* , which were imported on July 10, 1964 from Auburn , Alabama in the United States and placed in ponds at the Ciclicola Temazcal Station , Oaxaca, Mexico . The development of Cirpiniculture began with the introduction of the carp *Cyprinus carpio communis* escamuda in 1872 , after the goldfish *Carassius auratus* was introduced. The popularity of carp began with the Israel carp, *Cyprinus carpio specularis*, through a national distribution program conducted by the National Ejido Credit Bank in 1956 known as Rural Fish Farming program (Rosas , 1982).

Although these two species of fish ( mojarra tilapia and carp) were introduced, they are now present in almost all bodies of water are considered unique because of their easy handling and adaptation , toleration of wide temperature ranges and low oxygen, readily acceptance of a balanced food supply , have a high feed conversion , and have short product cycles. Today these are the two species that support major fisheries of inland waters ( Table 1).

In this context the development of aquaculture has a broad perspective, but significant progress is necessary to establish a parallel with the technical work : training of farmers on breeding and planting , the arts of capture , monitoring and management systems , monitoring quality , etc. . , which would allow them to breed , plant , maintain and properly use resources that occur in inland and coastal waters ( Cifuentes et al. , 1999). From this point of view aquaculture establishes itself as an alternative to food production, but it is clear that the activity also brings in more or less direct impacts on ecosystems affecting large areas near crops and natural populations living in that region .Due to these effects there are multiple ecological problems ( Rivero et al. , 2003) : poor management of a resource due to its uncontrolled and irrational exploitation , overexploitation , the existence of unfavorable conditions in the type of development and even the lack of an environmental culture .

## Environmental problems

In the 1970s firms has not yet considered the environmental variable in the production process ( FUNIBER , 2010) .Damages to the environment were not taken into account, therefore it was clear that development was confined to economic and social growth for years , but not reflected in the environmental area. This disregard of companies of the environmental impact that their activities were having was evidence of the degree of the consumption of natural resources at such an extent that the pollution levels have produced environmental impacts have caused an impact on the planet that we still see today. However, these practices have been changing. For more than a decade society has been organizing and creating awareness about the care of the environment in such a way that the governments of the countries of the world continue to pursue efforts to establish legal initiatives that permit aquaculture and fisheries management.

In various ways of interactions that occur between businesses and the environment are found production processes , distribution



and marketing. These processes require raw materials , energy and water - the latter considered a scarce limited natural resource. It is during these production processes when a number of pollutants are generated , creating this dependent link between production systems and the generation of wastes. In this context development must strike a balance to address interrelated objectives , such as how to change the pauses between production and consumption, reduce poverty and monitor economic growth and productivity , according to the available natural resources and their regenerative and replacement capacity ( Nicholas, 2010).

The different modes in aquaculture practices have diversified over time. Technical and production strategies as well as the variety of cultured organisms are growing, some operating at a small scale aimed mainly consumption, to building huge ponds with intensive production systems in the modes of inland and maritime trade all of which are common practices with processes that have caused negative environmental impacts.

The United Nations Organization for Food and Agriculture ( FAO, 2011 ) document “Development of aquaculture, aquaculture ecosystem approach ” states that the ecosystem approach to aquaculture as a strategy should be the means to achieve or reach a higher level of policies that reflect the objectives and relevant development agreements at national , regional and international levels directed towards sustainability , equity, and resilience of interlinked social-ecological systems .

Actions undertaken for sustainable aquaculture development are based on lines of action that go beyond food production , economic development for poverty alleviation and food security . Application protocols for best management practice have been consolidated so that the environment, society and economy have been defined as the basis for sustainable development of this activity. Within this vision work many producers in the industry, coupled with the demands of interest groups, consumer and environmental organizations. Through this perspective it is as if the codes of conduct and best practices in aquaculture can address a number of issues and concerns (IUCN, 2010) which tend to focus on reducing environmental impact , productivity, product quality , health and animal welfare , food safety , economic aspects and more recently its position on sustainability in general.

## Environmental degradation by aquaculture practices

The exponential growth of aquaculture has caused serious concerns among governments, environmental groups and society itself for any damage that it is generating. It needs to be considered as an activity where one must be cautious in the process of expansion. How and where it is done can affect water quality and adversely affect ecosystems, both in rivers and in the sea ( Bordehore , 2005) which are strongly affected by farm waste.

Aquaculture activities threaten the conservation of biodiversity which is a global concern because its loss dramatically decreases humanity's quality of life. Man has caused the decline of biodiversity in marine and freshwater organisms particularly for causes related to aquaculture. The possibility of improving fish grown by hybridization has been considered by some farmers as a solution to the problems of low yield. However, it has not always given satisfactory results. If these hybrids reach the natural environment they could exchange genes with the parental species and cause unpredictable consequences . (Pérez , 1996)

Regarding the introduction of exotic species, almost all modern aquaculture is based on a relatively small number of species that have spread throughout the world : including carp ( *Cyprinus carpio* ) , rainbow trout ( *Oncorhynchus mykiss* ) , some species of tilapia , *Oreochromis niloticus* especially , and *O. aureus* molluscs , the Japanese oyster, *Crassostrea gigas* and the American oyster, *C. virginica* and crustaceans *Macrobrachium rosenbergi* and several species of marine shrimps of the genus *Penaeus* (Pérez , 1994)

The activity has a negative impact on the receiving bodies of water , particularly where production is greater than 10 tons per year ( Velasco et al. , 2012) In this sense, ways are sought to reduce the impact through the enactment of environmental laws and regulations that regulate the activity through sustainable management and in a voluntarily manner through the application of basic environmental management tools and best aquaculture and environmental practices.

It is true that from the point of view of the economy of the producers and the technological tools available in the market , it is difficult to reduce the discharges of wastewater enriched with organic

matter with high concentrations of nitrogen and phosphorus- a product of the undigested food and feces. This leads to nutrient enrichment, and may affect large areas near crops and biodiversity inhabiting the receiving water bodies ( lakes, rivers, estuaries and marshes ). It is clear that the environmental impact depends largely on the species, culture method, stocking density, feed type and watershed conditions ( Borja, 2002).

Eutrophication problems start when man pollutes lakes and rivers with excess nutrients that generate the acceleration of the process and causes the algae growth, the death of fish and other aquatic flora and fauna, and the creation of anaerobic conditions. This process is the result of the use of phosphates and nitrates as fertilizer on agricultural crops, organic matter in garbage, detergents made from phosphates, which are dragged or thrown into rivers and lakes ( Oceanographers Without Borders ).

The trophic status of lakes is a fundamental concept in their management, which means the relationship between the nutrient status of a lake and the growth of the organic matter. The process of changing from one trophic state to a higher level is through the addition of nutrients. Agriculture is one of the main factors of eutrophication of surface waters ( Ongley, 1997 ). Notwithstanding the latter, in ponds for growing fish and crustaceans the use of a rich chemical fertilizer of P, C, N and K was widespread in recent decades, with the goal of increasing the natural productivity of the waters of these aquaculture systems through phytoplankton production, which is considered as the first link in the food chain in an aquatic environment ( live food for the organisms that are being grown ) This resulted in obvious wastewater discharges to receiving bodies with nutrient enriched water that may be the source of eutrophication in rivers, lakes, coastal lagoons and marshes.

Another of the impacts from aquaculture that may be cited are chemical compounds used to treat some viral and bacterial type diseases are also difficult to predict. Experiences indicate what may occur when compounds entering the food chain ( Espinoza and Almada, 2012 ), with a potential for bioaccumulation in links above or maybe cause long-term damage due to its cumulative impact.

Regarding the use of herbicides with glyphosate as the active ingredient, these compounds are potentially causing toxicological and environmental damage in aquatic systems and can cause delayed growth of organisms like algae and fish, histopathological changes,

alterations of enzymatic parameters , decreased sexual activity and biochemical changes . In the human body they can cause toxicity in the liver and placental cells , act as an endocrine interrupter device , generate respiratory, gastrointestinal , dermatological and neurological conditions, as well as fragmentation of the genetic material. (Salazar and Aldana, 2011).

It also warns that as a result of overexploitation of resources and changes in land use , there may be changes to the habitats in areas where farmers remove mangroves to establish pools for breeding species of economic importance (Uribe et al . , 2009 ) , particularly in cases of grow-out shrimp in coastal areas and in similar conditions during construction of aquaculture farms located in inland waters.

The factors affecting the quality of the cultivated product and the sustainability of the activity are good water quality, avoiding contaminated sites and good water renewal. The current in the area should be sufficient to prevent the accumulation of waste products ( feces and food waste ) which generate low oxygen levels( Borja , 2002).

Finally, most of these potential impacts on the environment can be managed and minimized by knowledge of the different processes and through the responsible management and proper location of fish farms (IUCN, 2007).

## Environmental Management

From the perspective of sustainability , environmental management in aquaculture has implications that go beyond making commitments to continual improvement, compliance with environmental laws and regulations, planning , the adoption of strategies to maximize the reduction in consumption of resources with the decrease in production costs and replanted through the definition of environmental policy implementation takes on an enormous importance of an organized and systematic way that all of these actions are measured and evaluated by the degree of compliance of the management system. In the best cases the resources are adjusted to improve results. These environmental policies establish the principles for prevention and minimization of negative impacts.

In order to accomplish this ideal form of organization, among the sectors involved in environmental management are: general government,

public and private productive sectors, associations of various kinds, universities and research centers and the general population , which results in a shared responsibility with community participation at different times, forms and levels ( Barn and Ferrando, 2007).

From this point of view it is desirable to implement environmental management systems as tools for the prevention and reduction of pollution . It is also important that in all productive processes natural resources and energy are used and these in turn are transformed into products. Waste must be managed properly through minimization practices , assessment and deposition , thus the existence of guidelines for sustainable management are essential tools for political and technical managers and administrations , aquaculture producers, and other users. (IUCN, 2007). From these considerations the environmental management systems are being implemented in many sectors of the industry in order to help organizations comply with legal requirements to minimize impacts on the environment , reduce waste and gain an advantage in the market ( Gavine et al. , 2007 ) .

In addition to these requirements , another way to get a company to be environmentally friendly is the awareness of its members that there is responsibility for the protection and the conservation of the environment, which entails the use of clean technology that allow a minimal use of natural resources ,a reduction in waste production ,an allocation of economic costs representing environmental protection and the implementation of environmental management systems and audits.

## Sustainable aquaculture

The concept of sustainability since its introduction as a subject of analysis has undergone various interpretations with a common denominator, all contextualized within the framework of development. The main condition is to ensure resources for future generations, and that they are always available despite the means that man takes to get from them the means to survive and grow in development. This involves the use of technological tools and education as ways of acting in a conscious and orderly manner.

It is from the conception of the term sustainable development that a series of scientific interpretations arise , basing these principles

on ecological , social , political and economic sustainability, but with established limits and minimum requirements that imply that sustainable development at no time should endanger the natural systems that maintain all forms of life on Earth. The care and exploitation of water resources , soil, atmosphere and living organisms are elemental parts of our environment, so it is urgent that in the short term technological development is an essential part of our needs as individuals , trying to avoid the disruption of these natural resources due to exploitation and development, decreases the carrying capacity of planet earth. Given these paradigms , aquaculture is determined by a set of regulations from environmental law . In this sense, this economic activity will apply both general environmental legislation and specific legislation developed in pursuit of sustainable aquaculture . ( Bermúdez , 2007)

With this approach , sustainability can be divided into three process-related dimensions : an ecological system as the foundation of life on the planet , the economic system , which considers the production of goods and services, and the social system, that allows active participation of society and institutions. By establishing these strategies for achieving sustainable development, a comprehensive plan of action and legal support through the signing of agreements and regional and international treaties can be developed. Based on the environmental management mechanisms and policies of the exploitation of natural resources , an approach of sustainable aquaculture is the approach towards an equilibrium of the three components of sustainable development : there can be no social and economic development if we do not responsibly use our resources.

Figure 3 shows how the three strategic dimensions of development interact to form sustainable aquaculture.

An important aspect to consider is the risk that sustainable development becomes a simple element of marketing and image (García et al. , 2011) , being necessary to work together in order that the development philosophy does not remain as a fashion and can be actually implemented in a proper and effective manner.

In the context of development, social planning turns out to be as an aspiration reconciling the principles and ecological systems. It is a necessary symbiosis of anthropogenic natural ecosystems , associated with the various political, economic , social and cultural systems on individual principles. While the original idea was to apply the concepts and resources of clean technologies , zero emissions



Figure 3: Elements of sustainable aquaculture. ( White , et al. , 2004 ) . Retrieved from *At a Crossroads : Will Aquaculture Fulfill the Promise of the Blue Revolution: a Sea Web Aquaculture Clearinghouse.*

and environmental impact studies, and encourage scientific research in a concrete way ( Pardo et al. , 2006),it is also the study and research aimed at identifying and defining aquaculture management tools - structured tools based on the use of sustainability indicators. In this sense, knowledge and adoption of these indicators by the agents of the aquaculture sector will advance , not only in the greater sustainability of productive activity , but also in improving the awareness of the managers of the activity and of society about the need to encourage a more sustainable every day management of our seas and rivers and the resources that they provide (García et al., 2011). To achieve sustainable development we must consider all variables and environmental, social and economic dimensions while identifying strategies and tools to facilitate effective integration and reactive involving the whole of society ( FOESA , 2012).

The importance of sustainability of the aquaculture sector is crucial if the industry does not take the right path , so it is essential to continue to seek ways to make practices more sustainable , efficient and profitable for improving aquaculture production-for example human capacity , the use of resources and environmental management ( SustainAqua , 2009).

## Conclusion

Today, aquaculture is considered as a very important source of food production, compared only with agriculture and livestock source. However, the construction of large aquaculture parks that demand for its operation in the production phase the use of huge amounts of water can have real implications and impact receiving bodies (rivers, lakes, reservoirs, coastal lagoons and marshes) and affect the organisms that live there for the high loads of discharged pollutants rich in phosphorus, potassium and nitrogen which results in a process of eutrophication.

In a globalized world the expansion of aquaculture demands the optimization of production processes. It is necessary to improve these systems through the use of techniques that properly manage the natural resources that are used. However, in order for aquaculture to be sustainable ecological, economic and social dimensions must be assigned an equivalent importance value and interdependent forms of action must be permitted without departing from their related objectives, which represent balance and a trend towards strong sustainability indicators.

From this point of view, the implementation of environmental management systems by these productive sectors should be common practice, since they are regarded as true instruments to prevent and reduce pollution. These systems are an implicit application of the principles of prevention against the urgent need for sustainable aquaculture, which could be achieved by incorporating environmental variables in management policies, making it possible to identify legal and regulatory requirements, and allowing decision-making. Above all there is one especially important element: full consciousness for the care and respect for the environment of all of the parties involved.





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# Tsotsil Rock : stereotypes on another way to make music

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## Abstract

Tsotsil rock has been present for more than a decade in the music scene in Chiapas . Groups : such as Saktzevul , Vayijel , Lumaltok , Among Others , talk about their realities in diverse situations in their native language . However , there hasn't been a lack of adjectives from various fields describing this genere, such as "indigenous rock", "ethnic rock" , and " etnorock " as a way to grade and stereotype from a western vision regarding the forms of creativity done from a particular culture which had empowered its identity, language, and cosmo vision through this genre of music.

*Keyword : Rock, ethnic identity , cultural industries, autonomy*

## The rock tsotsil : Stereotypes about another way of making music

*"Here the temptation of narcissism is all the more fascinating to the extent that it seems to express the common law : do as others in order to be yourself."*

Marc Augé ( Non-places )

The delimitation of objects of study is not without the romantic unilateral construction of the new, of the extraordinary, which goes beyond the everyday. In short, the exotic. In this methodological framework the observer , even without linking the structure of the symbolic territory, life histories and collective identities , draws a series of arbitrary lines that generate that the observed or subjects being observed appear to those who read academic papers as "interesting", " unique ", " special " characters- with qualities constructed from another age that provides a series of surprises for the Western world .

It is as if the act of thinking of themselves could apply equally in the act of thinking in others, as if it were providing real experience - that even goes unnoticed before seeking such exquisiteness - a

mystical halo in which he or the subjects being observed reveal themselves as entities that star in unexpected spectacular acts and , as it were , “ curious ” about the methodological rigor of the investigator.

The rock made in Zinacantán<sup>1</sup> does not escape this continued development of the construction of the “extraordinary ” and has been defined , as if the object of social research, as “ ethnic rock ” , “indigenous rock” or “ folk rock ” as if they were suggesting that Rock is the exclusive patrimony of the Western world and that these youth are installed in a musical Integrationism flying the ethnic flag both to share their identity through the songs as to transform it to the influence of cultural industries . If in this direction we are going, then let scholars and experts in the subject matter...why not define Pink Floyd as “ ethnic English progressive rock ” and El Trias “ Chilango classic rock ” or the Tex Tex as magnificent examples of “postmodernist otomie ethnorock ” .

“ For starters, I do not agree to call it native rock, since all cultural events either in terms of music , painting and dance , no way should be labeled because they are expressions and manifestations of people who take the meaning of what they generate , “said Omar López Espinosa , an anthropologist who heads the Multidisciplinary Unit of the Intercultural University of Chiapas, in the town of Oxchuc .

In this sense , the problem of the definition of indigenous rock is cultural boundaries and scientific otherness in an effort to describe and explain the object of study under tons of theoretical premises and methodological arbitrariness , coupled with a particular perception of Rock as part of the Western heritage , who overlook a different way of making music with its own style, own music composition , own tuning (where traditional instruments are used ) and even its own public and spaces.

Far from these perceptions , there is the methodological approach to the analysis of rock groups from the municipalities of

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<sup>1</sup>Located in the Tsotsil-Tzeltal highlands region, bordered to the East by San Cristobal de las Casas, to the northeast and north by San Juan Chamula, to the West with Ixtapa, to the Southeast by Chiapa de Corzo and to the South with Acala and San Lucas. The name of the municipality in its own language is “Sots’leb”, Place of the Bats.



Zinacantán and Chamula, a marked cultural frontier that fosters the axis of analysis depart from the views that Westerners have rock and the main label to analyze it and later make it a stereotype. That is not the purpose but the result of such approaches , whether indigenous , where it becomes a “ prodigious “ act when a young tsotsil takes an electric guitar and share their songs in their native language. “ If he is playing Aerosmith or Van Halen, then it is rock. If the person playing is from Zinacantan then it is Indigenous Rock. These labels are completely racist , “affirmed Omar López Espinosa.

In this agrarian society we are surprised and it calls attention when there is a group of Tzotzil which are organized and fought to defend and disseminate a musical style which they call - phonic rock , which is a composition of mostly traditional music that comes from indigenous music mixed with rock and classical music , with no alteration in the lyric and traditional rhythms ; the traditional appropriates new instruments and denotes a contemporary composition with tints and foreign influences,from which results a new traditional music , as he says Damián Martínez : “ the spirit of the zinacanteca land shared by three musical metaphors highlighting two different emotions as the allegorical and the gloomy, without losing the sense of spiritual origin.”<sup>4</sup>

The fact that it is “ surprising “ and “ attention-grabbing “is that these young people playing rock with a foreign influence reflects the desire to rebuild them as protagonists of a new way of being that does not fit with what researchers normally expect from them . Is it as exotic in the eyes of those who investigate a young native of Zinacantán making a riff using a distortion bar ? If the youth in question was from Mexico City , Tuxtla Gutierrez or San Cristobal de Las Casas, the fact would not make it worthy of being studied, but as it does seem a Zinacanteco that gives you the “ folk “ touch to make it known to the academic community as something unique and unrepeatabe , since the hands that are making a riff a Tzotzil .

It seems that the person or persons who analyze these startling facts are assumed as spokespeople of an academic community that is surprised to not own acts of conception of those who venture into symbolic territories designated as themselves. If a mestizo or a foreigner , however , experiment with music they call arbitrarily as

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<sup>3</sup>[http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area\\_tematica\\_12/ponencias/0052-F.pdf](http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area_tematica_12/ponencias/0052-F.pdf)

indigenous , maybe that would not be an object of study but an act of self- experimentation of the musical evolution of the interpreter. Why not just call it rock and that's it? By some chance do labels guarantee indexed publications?

"It seems that we have become a guinea pig for playing music in our native language," said Julián Hernández , guitarist of the group Lumaltok which was interviewed in the radio room at the Intercultural University of Chiapas. He said he is loaded with a stereotype that a lot of people generate who go to see them out of curiosity and not for the musical concept they have. " By singing in tsotsil anyone who hears it says wow! What language is that ?" And it is his point of view that they are biased because ethnicity is valued more than the interpretation .

According Ulises Fierro , 30 years ago it would have been unthinkable the existence of an indigenous rock band singing in their own language . What's more, although he played with electric instruments, there wasn't a break with his community because youth had already identified with them.<sup>4</sup>

"Rock is culture and it has always stuck everywhere, even in the indigenous world with what we are doing which of course cannot be called or labeled as indigenous rock since it is a universal genre, but thanks to that label many are coming closer to that genre and this allows us to learn more ,"said Moises Perez Perez, drummer Lumaltok group.

In social research , the subject observes in theory should not ignore the context and in the case of the analysis that is made of rock produced in Zinacantán and to a lesser extent in the town of Chamula, it focuses largely on integrative approaches , where the term that prevails is fusion . It seems as if the other stereotype, such as exotic, is defined based on an musical analytic ethnocentrism of rock and marks a cultural border where there is a perception that these young people were "exploring " outside symbolic territories.

Although the members of the group had the opportunity to join the Western world , the spirit of ancient culture has remained in them. In this sense, the rockers become re -creators of cultural practices to encode and decode the an ancestral message of sounds and meanings

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<sup>4</sup><http://www.jornada.unam.mx/2008/01/06/index.php?section=espectaculos&article=a07n1esp>

in rituals and myths that support the configuration and transmission of knowledge to new generations . We can say that in the musical art its cultural history is summarized , and in turn , nourishes their learning process . Those who arrive denote a different way to stimulate the interest of children and young people following the logic of their own culture that can be applied to other aspects of education .<sup>5</sup>

Clearly the perception that there is a different world - "modern" - to which these young people have had the "opportunity" (the term is very clear in the above quote ) to " join the Western world." This western / indigenous dichotomy is quoted, reproduced , legitimized and accepted as such ,and promotes the incursion of these young people in rock is like a fairy tale in which they live in a magical bubble where ancestors take a guitar , bass and drums and sing the whole world about their culture to the surprised look of social researchers or journalists who also claim to have candle in this ethnocentric burial and incidentally put a rebellious touch, but I do not mean RBD but the association that is made with the Zapatista National Liberation Army.

"In this manner, Bill Haley, John Lennon , Ozzy Osbourne, Billy Joel , among others , already have talented indigenous rivals that have generated a new variant of this rhythm : The Indigenous Rock. A native of this area that still feels the influence of the Zapatista Army of National Liberation ( EZLN) " ,Damián Martínez ,A musician at heart who has promoted along with other groups, Indigenous Rock . This was evident last month in Zinacantán, where for a moment the indigenous forgot their ideological disputes and for the possession of the water."<sup>6</sup>

It is evident in this type of analysis of life stories that the motivations of the individual - or group - playing rock, breaks generational motivations. The events are in a way ( including stereotyping from research and academia ) the presence of their worldview at the time of writing , the influence of the media and cultural industries , the influence of other rockers groups from diverse backgrounds ,the presence that that make concrete elsewhere in the country, building their sense autonomy , their sense of resistance, taking their position at various institutions such as the family, schools , churches

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<sup>5</sup>[http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area\\_tematica\\_12/ponencias/0052-F.pdf](http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area_tematica_12/ponencias/0052-F.pdf)

<sup>6</sup><http://chiapas.turista.com.mx/article188.html>

and traditional authorities , participation in social movements , their perception about the uses and customs, etc. . Even the same groups perceive these two worlds in their areas of expression .

The native rock is a fusion of “folk rock”, as a merger between the rhythms of both traditional rhythm and contemporary music adaptations <sup>7</sup>

Research and the academia have place their gain of sand for these young people who assume their role as representatives of indigenous rock ( label which at the end of the day that has been repeated for ten years ) and as a result of a merger and experimentation with different rhythms and sounds , attracting as well the “intercultural” a touch to their analysis. Thus, the possible world from the observer’s analysis focuses on the musical integration , and from the point of view of these youth who are involved in the ongoing reconstruction and revitalization of their culture , this seems to go unnoticed .

Members of YibelJ’metik Banamil (Roots of Mother Earth ) have the idea of fusion . Valeriano Garcia, vocalist and guitarist, said : “We see the possibility of making new music , as long as the root of our culture is that which gives it meaning . We explore what the traditional music can offer for a new sound. Music brings joy to the soul, the spirit , because every note penetrates the heart , even in the toughest people. It makes us reflect on life , which must be enjoyed through love , and death . If one love is shared with others, it is like water and land. <sup>8</sup>

It seems that this civilization in denial insists that Bonfil Batalla ( 1987) tries to explain from the construction of an essentialism that chronicles the relationship between a musical Integrationism describing the appropriation of what are considered Western instruments to speak from the “ native ” culture with processes cultural transformation .

The native rock it self is derived from several musical fusions between western music and other genres such as blues and reggae. The emergence of this mode of musical expression which takes traditional instruments and cultural ideas as a spoken language . Indigenous rock is like a mixture of Western music with the traditional. It is a fusion that we express , or as we say in our own culture as is Zinacantán and

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<sup>7</sup>[http://leietnorockchis.blogspot.mx/2011\\_11\\_01\\_archive.html](http://leietnorockchis.blogspot.mx/2011_11_01_archive.html)

<sup>8</sup><http://www.jornada.unam.mx/2010/05/05/espectaculos/a09n1esp>

San Juan Chamula and converting music such as a Western rock, we have influences of Western rock, Nirvana or something ( ... ),” Alfredo de la Torre, guitarist Yi’belJme’tik Banamil said. As , Eduardo Gómez Gómez , professor of Bilingual Intercultural University of Chiapas ( UNICH ) , states “Without a doubt , the language of music is universal , mixing sounds and instruments carry a message of resistance and expression as gender, and a cultural rescue . Indigenous rock is a current and part of the resistance to keep , to preserve indigenous languages and cultures [ ... ] of course with its changes that have occurred and at the same time expressions that they mention in the lyrics of their songs .<sup>9</sup>

These processes are not only described ,they are arbitrary categories that seek explanations from the re- discovery of the “ethnic” in the rock, where it is stressed to the marrow that these musicians “ adapt” songs and rhythms that are not theirs and present them live for indigenous use.

SakTzevul creates their lyrics , adapts them and translates them to Tzotzil . At concerts the members present themselves with the typical zinacanteca clothes ( straw hat with colored ribbons , shirt and pants, blanket, a kind of multicolor cloak and Aztec style sandals). They also set the stage with the representation of a Mayan ritual using whistles, drums , rattles and conch.<sup>10</sup>

The analysis present subjects divided between modernity and cultural encapsulation, between the rock identity and ethnicity , between empowerment and subordination , between the human condition and as a fantasy called “ ethnic rock essence .” Bonfil Batalla ( 1987:11 ) argues that the peoples of Mexico continually deeply create and recreate their culture, adjust to changing pressures which strengthen their own private areas and make foreign cultural elements to put to thier service , cyclically reiterate collective acts that are a way to express and renew their identity.

“There’s nothing different, playing rock does take away the tsotsil , it does not remove the original thing you are and what you bring this tattooed on the heart, you cannot take it away ,” said Juan Javier Pérez Pérez , drummer YibelJ’metik Banamil . For him, his music is a way to

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<sup>9</sup><http://kuxaelan.blogspot.mx/2011/05/vivencias-y-experiencias-en-el-rock.html>

<sup>10</sup>[http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area\\_tematica\\_12/ponencias/0052-F.pdf](http://www.comie.org.mx/congreso/memoriaelectronica/v10/pdf/area_tematica_12/ponencias/0052-F.pdf)

reclaim their culture and not a cliché imposed from other contexts. “Modernity will crush you if you do not react and our music is a way of saying we are here and what we cling to is our language and cultural elements,” he said.

Indeed , a good part of this band’s songs are composed in whole or in part in this language along with Spanish . In addition to these languages others have been included in compositions and lyrics such as Tzeltal or Tojolabal . SakTzevul was precisely born as a project to bring the field of rock music to the native languages that did not have access until now to this type of musical expression . In this sense, SakTzevul is a pioneer in recognizing the value of the native languages of Mexico not only as a vehicle as a modern wing of artistic expression. SakTzevul was created in 1996 by Enrique Martinez, Otto Anzures and Damian Martinez, the latter is the composer of most of the songs that, they play. Since its founding SakTzevul has been growing increasingly well known in the musical world inside and outside of the State.<sup>11</sup>

For Sergio Omar Perez, bassist of Lumaltok , playing music represents another stage in the history of Chiapas rock ,and gives new meaning to play in both the tsotsil language , at the institutions that promote such events , and with other groups playing in Castilian that have another way of making music and the public attending their concerts. “We’re musicians that share knowledge about our culture, not Indians who pretend to be rockers .Our root is our own culture.,”he said .

Music and rock music are cultural expressions where we can see different social realities. They have been discourse in the last two decades in general, and in Chiapas in San Cristobal de Las Casas in particular where there has been building positions about criticisms which are intended to make conscious asymmetries and social injustice or environmental irresponsibility. From there , from the makers of music, from those who create and interpret , there is a discourse that seeks to gauge the exclusion of the indigenous world , the “destruction of mother earth “ or verbalize the “ ecocide” . It emphasizes in favor of pacifism and against the militarization processes . Thus we have a kind of ethnic revival from rock, a genre that , although locally redefined , is one of the great landmarks of mass culture , the culture industry and globalization of much of the twentieth century and new millennium. Talking about the indigenous is not a matter of fashion, there is more background , look : although there are several cultural identities in Mexico that have merged with the West, there continues to be many

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<sup>11</sup><http://macuala.blogspot.mx/2009/10/sak-tzevul-xchulel-balamil.html>

traditions that we carry and express daily and have an ancestral origin, the mode to be Mexican that comes to us from our first root, which is indigenous.<sup>12</sup>

This historical connection in the way to make rock is not recognized. How did Zinacanteco rock begin? What are its roots?, its history , its tensions , contradictions, complexities , transformations , settings , its continuities and even the charges of selling traditional musicians on their culture ? Not enough to say , “adapt “ to Western rock music , dress in costumes, put incense on the stage, and things like that. What is said of its involvement in the promotion of a sense of resistance and , conversely , why does it insists on its de-Indianization by simply touching a genre that is not native to your town ?

For members of YibelJme'tik Banamil , rock and traditional indigenous music is not only a complement as to what is musical but it can be integrated as a contemporary cultural expression of indigenous youth . In this course , something is changing in the cultures of these native peoples, and what is outstanding is these young people who are leading these changes and to the others that are emerging and forming more groups , reaffirming the taste for the música.<sup>13</sup>

On these transformations , the writer Javier Molina , said in La Jornada:

“The youth of San Juan Chamula opened the concert. They interpreted traditional music, or “another type of rock ,” as they call themselves. “Starting from this the make their own creations , using the same instruments. What changes is the rythm , time , shape ,everything changes “ The old seed is now renewed, according to the present times.”<sup>14</sup>

Another type of rock is a afirmation that fully describes the musical preferences of these young men who compete in both the quality and content of their interpretations ,with other Chiapan and national groups . And about making an extra point , the rock groups from Zinacantán and Chamula, not play covers and most of the bands of Tuxtla Gutiérrez do.

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<sup>12</sup><http://www.proceso.com.mx/?p=273579>

<sup>13</sup><http://kuxaelan.blogspot.mx/2011/06/rock-tsotsil.html>

<sup>14</sup><http://www.jornada.unam.mx/2010/05/05/espectaculos/a09n1esp>

Rock music and cultural expressions are where we look at the different social realities. They are a speech in the last two decades in general and in Chiapas in San Cristobal de Las Casas in particular - has been building positions that reviews are intended to make conscious asymmetries and social injustice or environmental irresponsibility. From there , from the makers of music, from those who create and interpret , there is a discourse that seeks to gauge the exclusion of the indigenous world , the “destruction of mother earth” or verbalize the “ecocide” . It emphasizes pacifism in favor of and against militarization processes . Thus we have a kind of ethnic revival from the rock, a genre that , though redefined locally , is one of the great landmarks of mass culture , the culture industry and the globalization of much of the twentieth century and the new millennium ( Ascensio and López, 2012:70)

“I think it should be seen as a new form of musical expression without any labels. To talk in Tzotzil and Tzeltal does not mean that things have to carry that label . They are musicians who are responding to interest created through music and recreate their everyday world. They obviously have different musical influences but you are giving a twist ,”said Omar López Espinosa.

The importance of freedom of expression and cultural manifestation of indigenous and non-indigenous people in a globalized society is to promote and contribute in the preservation and dissemination of traditional values , either : language , prayers, tales, myths , and legends expressed through the language of music. Such as the proposal of Yi’belJme’tik Banamil does.<sup>15</sup>

This way of making rock is revitalizing the tostsil rock culture and is strengthening the original language , promoting a sense of autonomy , has a rebellious sense , disseminating ecological thinking , strengthening its spaces of expression due to its link with alternative communication, telling different stories of life, promotes the interest of other young people to pursue music , and many more aspects that make the labels fall short .

Despite the social importance of rock music as music for the masses in Mexico, it is still a topic that has yet to be discussed and analyzed considering the cultural environment in which it operates

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<sup>15</sup><http://kuxaelan.blogspot.mx/2011/05/vivencias-y-experiencias-en-el-rock.html>



. In general , there is no real interest in making visible the most important music of the youth of the world , so you should always find opportunities to encourage open discussion ( Zebadúa , 2011:13 ) .

## Final Thoughts

The treatment that is given in certain analysis of rock that is done in Zinacantán marks cultural boundaries between the researcher and the subject of study ; there is a lack of humanistic sense in the methodological approach to the subject and a need to set aside the stereotypes that have been brewing since the emergence of this peculiar way to rock .

These stereotypes foster the idea that these young people are perceived as “guinea pigs” who are giving a “surprise” to the academic world by playing rock, forgetting to cultivate their fields , tend their gardens or nurseries : the have become endo culturalized people who do things that are not specific to their culture.

If rock has a universal character , why the stereotype ? Adjectives abound and their use explains virtually nothing. The important thing from my academic and musical point of view, is that they talk about their things related to their own culture and develop their peculiar style . Cheers for the rock made by the Tzotzil for anyone who wants to listen without prejudice.

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# Fiber optic sensors and their environmental applications

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## Abstract

This investigation is an analysis of fiber optic sensors and their application in the environment, taking into account the quality of water, soil and air which are areas of interest because they are part of the environment in which life develops. A body of water, air or soil with high levels of contaminants are not apt for the life and development of a species. When it comes to measuring one or more physical parameters of the water or air, or to detect and quantify a substance, you need to use some kind of sensor to provide reliable data in order to implement solutions that mitigate the existing risks. The most commonly used sensors for these purposes are mechanical, electrochemical, and, for some parameters already in place, optical sensors. In the society in which we live, it is becoming increasingly necessary to develop small analytical devices that are inexpensive, portable, reliable, selective, easy to use and require only a few microliters of sample to determine a particular parameter.

*Keywords : environment, physical, optical sensors.*

## Introduction

Pollution is defined by Henry and Heinke (1999 : 235-237 ) as “a biological undesirable change in the physical or chemical characteristics of the air, water or land which may adversely affect the health, survival or activities of humans or other living organisms”, and is a result of the improper use of resources in the production of goods and services and the consumerist way of life and our villous cultures (Bustos and Chacon ., 2009 , 164-181 ).

Some of the main air pollutants that are known are: Nitrogen Oxides ( NOX ), Sulfur Dioxide (SO<sub>2</sub> ), carbon monoxide (CO ), Carbon Dioxide or Carbon Dioxide (CO<sub>2</sub> ), ozone , Lead (Pb ) , Mercury (Hg ) and hydrocarbons ( HC ) . These contaminants can be primary or secondary. The primary contaminates originate directly from secondary sources and are formed in the atmosphere by combining the primary contaminates with normal atmospheric constituents (García and Martínez : 1978, 70-75 ). There are various water pollutants , and in most cases they directly affect the health of human beings and their consequences can be severe :

## Pathogens

They are those that cause disease . In general they are bacteria, viruses , protozoa and worms that enter the water from domestic sewage and animal wastes . In most developing countries, they are the main cause of diseases and deaths , including those of many children under five . An indicator of water quality for drinking or swimming is the number of coliform bacteria in a sample of 100 milliliters of water. The World Health Organization (WHO) recommends a count of 0 colonies of these bacteria per 100 milliliters of water. For drinking and swimming there is a maximum of 200 colonies per 100 milliliters of water. The sources of these agents may be excrement, both human and animal ( Tyler : 1994, 27-39 ) .

## Wastes that require oxygen

These are the wastes that can be decomposed by the presence of aerobic bacteria , which in turn use oxygen to biodegrade waste. Very large populations of bacteria carried by these wastes can deplete the oxygen gas that is dissolved in water. Without this oxygen, fish and other life forms are killed . Pollution sources can be sewage, agricultural runoff, animal processing and papermaking ( Tyler : 1994) .

## Soluble inorganic chemicals in water

Such substances refer to acids, salts and compounds of toxic metals (such as mercury and lead) . High levels of these dissolved solids can turn water non-potable, harming fish and other aquatic life, and even affect agricultural life and accelerate corrosion of equipment that uses water. The main sources are from industries.

## Inorganic plant nutrients

These nutrients are nitrates and phosphates that are soluble in water, which may lead to the overgrowth of algae and other aquatic plants

which die and decompose, resulting in the depletion of oxygen found in water, fish kills and the death of other living things that depend on it . Excessive levels of nitrates in drinking water can reduce the oxygen carrying capacity of the blood and cause the death of babies, especially those under three months of age ( Tyler : 1994 ) .

## Organic chemicals

Organic chemicals that can pollute water are oil, gasoline , plastics, pesticides , solvents and detergents, among many other water-soluble and water-insoluble chemicals that threaten human health and damage aquatic life ( Tyler : 1994 ) .

## Sediment or suspended matter

These refer to insoluble particles in the soil and other solid materials , both organic and inorganic that are suspended in water. This material clouds the water , reduces the ability of some organisms to find food , reduces photosynthesis by aquatic plants , alters aquatic food webs and is a carrier of pesticides , bacteria and other harmful substances. The bottom sediment destroys the land or feed regions for fish, and clogs and fills lakes, ponds , bays and water channels. The primary source is terrestrial erosion ( Tyler : 1994 ) .

## Radioactive substances

Radioactive isotopes are water soluble substances capable of being amplified biologically in higher concentrations as they pass through the food chain . This radiation can cause birth defects and cancer, among other diseases. The main sources of these substances are mining, power plants and weapons production plants ( Tyler : 1994 ) .

It is considered that 58.4 % of surface water is contaminated, with few areas of the country that have good water quality ( Alcocer : 1998, 127-129 ) . It is also estimated that between 75 and 90 % of hazardous waste ( toxic, reactive , explosives , flammable or infectious waste ) is

handled without adequate systems of environmental control , creating serious pollution processes in agricultural, industrial and urban areas ( Diaz, et al : 1998, 104-115 ) . In this scenario it is important to consider that reaching a kind of feasible development in both economic and ecological terms does not only depend on the implementation of new technology and regulation measures on the use of resources.

Sustainability implies in itself the generation of new forms of social life , ie , new norms, values and virtues that enable building a different social - environmental relationship. It becomes indispensable , then, to know how and under what circumstances environmental values are taught within a society (Durand : 2004, 511-530 ) . The importance of environmental quality is an unquestionable fact in today 's society, especially in the social-environmental relationship , and thus a quick measurement of contamination is necessary to maintain control of the environment. This is where biosensors play a role . The term biosensor is applied to a analytical system engaging a sensitive biological element associated with a transduction system , which can detect and measure quickly , proportionally , accurately and sensitively a signal produced by the interaction of the biological element and the substance of interest (Castro- Ortiz, et al : 2007, 35-45 ) .

Environmental biosensors , according to the type of technique used, can be classified in bioassays and biosensors . Bioassays were the first biological tool to be applied to the environmental field. Basically they are methods employing various living materials to estimate the potential toxicity of a substance or a contaminated matrix. A bioassay is generally defined as an experiment aimed at investigating the role of a substance in a biological , ecological or evolutionary context , using organisms or living systems ( Mozaz , et al : 2005, 291-297 ) . The term biosensor is applied to an analytical system engaging a sensitive element associated with a biological transduction system which can detect and measure rapidly , proportionally , accurately a sensitive signal produced by the interaction of the biological element and substance of interest (Castro- Ortiz, et al : 2007 ) .

In the past 10 years biosensors have been integrated with pollution control programs , implementing them in environmental security systems in two ways:

1. Monitoring methods capable of predicting the possible danger of biological effects such as toxicity, allowing the measurement of a lot of pollutants in short periods of time.



2. Methods of screening used to detect the presence of a contaminating compound.

The sensors are alternatives to conventional analysis tools. The arrangement of a fiber optic sensor based on the sol-gel method has two important characteristics:

1. On site, real time analysis. This translates into a result of increased reliability, since we avoid that the substance loses its original characteristics due to its transfer. Early detection allows us to take measures for prevention and mitigation.
2. The sol-gel is an inert material-in other words it presents resistance to very hostile environments that many polymer based sensors don't have ( Valcárcel and Luque de Castro, 1994, 32-55 ).

## Definition of fiber optic

An optical fiber is a dielectric medium that carries physical information in the form of light, that is, guided electromagnetic waves parallel to the fiber axis. It consists of a core which permits the propagation of light, an optical cover or coating that allows for the propagating mechanism, and one or more coatings of mechanical protection (Fig. 1) ( Vázquez : 2011, 163 - 188 ).

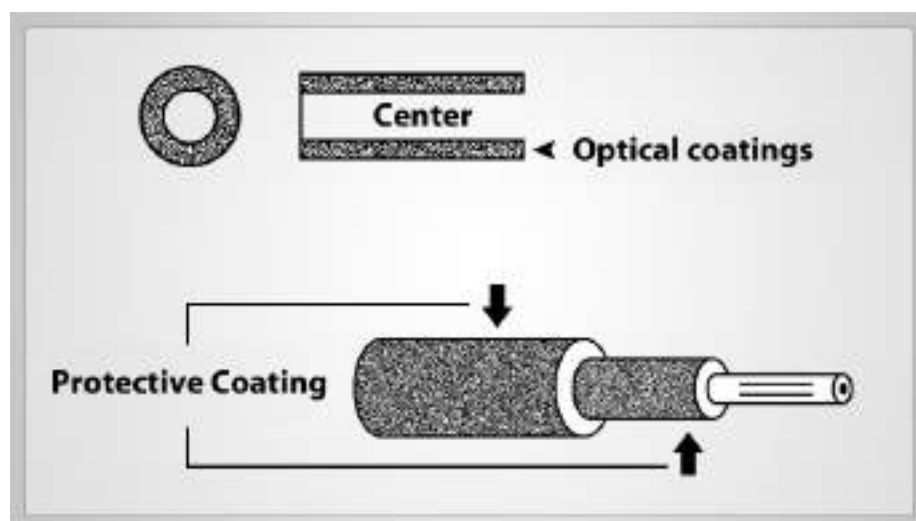


Figure 1 . Representation of an optical fiber ( Vázquez , 2011 )

The fibers are made from glass, consisting of silicon or a silicate ( $\text{SiO}_2$ ). The center must have an index of refraction greater than the coating, so that there is total internal reflection. Doped oxides such as  $\text{GeO}_2$ ,  $\text{B}_2\text{O}_3$  and  $\text{P}_2\text{O}_5$  are added to silicon to obtain the difference between the refractive indices (Vazquez : 2011)

Fiber optic sensors are known in the scientific community as optodes, first mentioned by German researchers Opitz and Lübber, referring to an optical system for measuring  $\text{CO}_2$  (Wolfbeis and Bernhard : 2006, 95-111). Some characteristic properties of the optodes (Marazuela : 1997, 103-109) in the environment are :

- They do not require a reference signal. Unlike potentiometric and amperometric electrodes that measure the absolute potential difference, optodes do not need a reference signal.
- The possibility to build remote sensing. The use of low loss optical fibers as light guides enables measurement over long distances, providing access to sensor measurement locations. Great depths in lakes or media exposed to ionizing radiation or electromagnetic interference, unlike conventional electrical sensors, is not a problem for these systems since the distance between the terminal and the sensitive transducer can be adapted to the measurement conditions without entailing loss of information.
- Multi parameter measurement. Due to the large bandwidth of optical fibers, it is possible to transmit more information than electrical cables. That is, the optical signals that are caused by the presence of different data in the sample may differ from each other in wavelength, phase, polarization or intensity modulation; therefore a multi parameter sensor can have a multiplex of these signals.
- Sensitive terminals are easily interchangeable. The multi parameter analysis can also be performed by exchanging

specific sensitive terminals whose indicators are based on the same measuring principle which allow the use of a single instrumental device. This advantage of fiber optic chemical sensors are particularly useful in clinical chemistry , because it facilitates the sterilization of the terminals and enables the use of disposable sensors ( Bustamante , 2001 , 55-59) .

## Propagation

Light waves are referred by their wavelength , which is related to the frequency by the expression  $\lambda = c / f$  where  $\lambda$  is the wavelength , c is the speed of light and f is frequency.

Since light is a form of an electromagnetic wave, its properties must be described from the Maxwell equations. The rigorous method of calculating the intensity and phase of a light wave implies the use these equations . However, because the wavelength of the electromagnetic waves ( infrared and visible ) that are propagated is small , the study of the propagation inside the fiber can be performed with the simplified model of light rays and laws of geometrical optics ( López- Higuera : 2002, 89-98 ) .

Thus, the study of the arrival of the wave or light to the interface between two media with different refractive indices beam can be performed in two ways:

- A. As an optical wave, which should be resolved with the wave equation , which imposes the boundary conditions .
- B. As a light beam using Snell's law and total reflection ( Wolfbeis and Bernhard , 2006).

## General aspects of optical fiber

With the development of fiber optics in the late '60s, practical optical communication systems were obtained. Quickly these technologies developed for optical communications , were joined to optical detection technologies ,and allowed the introduction of elements of

optical fibers as waveguides for optical sensors . Since then they have shown steady progress and have greatly developed ( López- Higuera , 2002). The application of optical fibers to carry the signal so it operates as an active element of the sensor ( transducer ) makes it possible to miniaturize the optical system ( making them suitable for compact, portable field use ) , increasing its sensitivity and making the use of more powerful sources of radiation appropriate . The low cost technology available is crucial for the success of optical sensor systems that can take advantage of fiber technology and manufacturing methods produced for telecommunications devices ( Alois : 2001, 203-209 ) .

The main effort of researchers has been made to produce a set of techniques based on optical fiber that can be used for a wide variety of purposes , providing a good basis for a technology that can effectively complement conventional methods. This is the key to success of optical fiber sensors : taking measurements in difficult situations for specific environments where the use of conventional sensors is not possible.

## Advantages and disadvantages of fiber optics

The main advantages of fiber optic technology makes available to researchers for use in sensors include:

- Cheap telecommunication fibers .
- Infrared sources available: LED 's, laser diodes. Possibility of using laser fibers.
- Wide range of lasers which can be coupled to reasonably effectively fibers .
- Wide range of detectors: pin devices, avalanche photodiodes , etc. .
- Availability of new integrated optical or optical systems ( Grattan : 1997, 109-119 ) .

However , a number of technological problems exist that make the ideal situation is not so easily applicable:

- Telecommunication fibers are sometimes inappropriate for use as sensors: they need larger diameters / numerical

apertures , the exotic fibers are expensive for small production runs , large diameter fibers are expensive and inflexible .

- Losses due to the bends in fiber -based sensors affect intensity measurements .
- Laser sources are often difficult to couple with optical fibers : many laser diodes or LEDs have wide angles of emission and provide a limited laser power in a useful wavelength .
- Many laser sources in the visible or the infrared means are large, expensive and unsuitable for the use and coupling of fibers.
- Telecommunications fibers have a limited temperature range : typically the upper limit is at 100-150 ° C while many applications require temperatures greater than 200 ° C.
- The methods of mechanical coupling of extrinsic sensors can be complex or unreliable , especially with environmental changes .
- Doped fibers are expensive and limited in available dopants, which are governed by the telecommunications needs (Er , Nd ) .
- Laser fibers, promising as sources, are expensive and are primarily infrared or red , or require complex frequency doubling equipment.
- There is a need for hand assembly of the sensors : a high cost is associated with many of them.
- Training for staff is necessary in order to become familiar with new techniques ( : Grattan 1997 ) is necessary .

As a result of all this, when developing the sensors it is necessary to achieve a number of practical commitments in the specifications, materials , response, sensor size and robustness, etc. . This can be determined in order to define what an ideal sensor fiber must be. The ideal specifications will only be practical for certain applications. However it is worthwhile for the particular case of fiber optic sensors

designed to explore the environment, while trying to get these ideals even though only some can be used ( Grattan : 1997) . Therefore, to take full advantage of the benefits by minimizing the drawbacks a sensor should:

- Operate in the infrared or red to take advantage of the simplicity and low cost of sources and detectors.
- Intrinsically operate to prevent couplers and not base on intensity measures to avoid losses for coupling or curvature .
- Do not show problems with power levels : sufficient photon for a detection with low noise.
- Use telecom fiber and minimize the need for the number of couplers .
- Operate in a temperature range  $T < 150^{\circ} \text{C}$ .
- Be insensitive to any other parameter as much as possible .
- Be cheap and easy to produce automatically .

The potential of fiber optic sensors is significant. It has been found that as the cost of key components decreases and the number of cheaper components is extended , the potential for further market and quality of components increased ( Herrera : 2005, 141-153 ) .

## Fiber types

Depending on the light signal propagating within the fiber , they are classified into the following groups :

1. multimode
2. single mode

In a single mode fiber , light can have a unique path through the core , measuring about 10 microns in diameter . Multimode fibers have cores between 50 and 1000 microns. Mono mode fibers are more effective for long distances , but the small diameter of the core requires a high

degree of precision in its manufacture , splicing and fiber termination ( Krohn : 1988 , 53-77 ) .

The optical fiber is also classified according to the refractive index, classified as two types:

- a. Step index
- b . Gradual Index

In the graded index fibers , the refractive index is lower in the vicinity of the coating than on the fiber axis . The waves propagate slightly slower in the vicinity of the core shaft near the coating .

Considering the fiber material , they can be classified as:

- a. Fiberglass
- b. Plastic fibers

These latter are used for communication over very short distances. Often used to interconnect equipment in the same building , connecting digital audio equipment and small sized computer networks.

Within the first two general classifications (type of propagation and refractive index ) , we have three basic types of fiber :

- a. Multimode step-index fiber
- b . Graded index multimode fiber
- c . Single mode fiber

Multimode fibers are typically used in the first and second windows, and single mode in the second and third windows ( Krohn : 1988) .

## Multimode step-index fiber

Guiding the light signal is caused by the total reflection at the interface between the core and cladding . The refractive index has a defined profile by the following expression :

$n = n ( 1 + \Delta )$  (where  $\Delta$  increase the refractive index between the core and cladding )

In this type of fiber the numerical aperture , NA , can be approximated by the expression :  $NA = \Delta$  . NA typical values are between 0.2 and 0.5 .

The incidental signals with an angle whose sine is less than the numerical aperture cause the appearance of many modes ( or said in a more intuitively manner, a multitude of rays and angles of reflection ) propagating through the interior of the fiber ( Figures 2 and 3 ) . This is why we use the term multimode to describe the type of fiber .

The core of these fibers have a diameter between 50 to 1000 microns . This large nucleus involves several propagating modes . The different paths give a place for the modal dispersion , in other words the temporal spread of light as it travels through the fiber. Dispersion is a mechanism that limits the bandwidth or the amount of information that the fiber is capable of transporting .

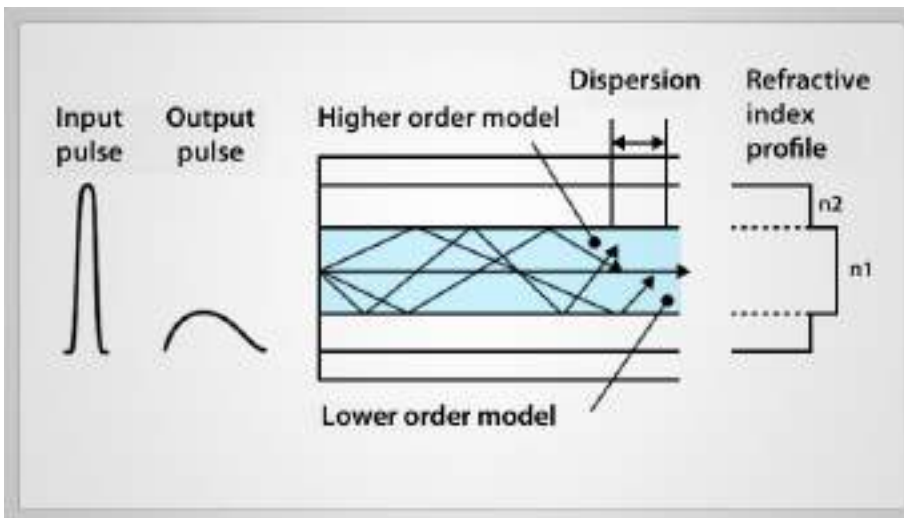


Figure 2 . Multimode fiber ( Krohn : 1988 ) .

These fibers can be further classified according to their composition :

1. Glass / Glass: glass shell and core .
2. Plastic / Glass: plastic casing and glass core .
3. Plastics / Plastic: plastic shell and core .

Such fibers are the links used in short distances up to 1 km. and its most important application is in local networks.



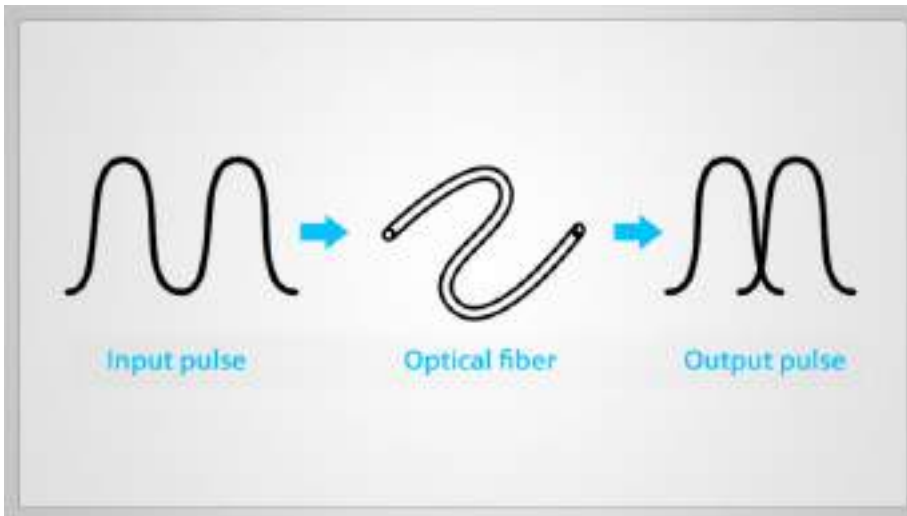


Figure 3 . Dispersion ( Krohn : 1988)

## Graded index multimode fiber

In this case the change of refractive index in the interior of fiber is gradual , resulting in a wave propagation of the light beam (Figure 4) . The graded index fibers engage in the coupling efficiency for greater bandwidth. It does this by giving the core a non-uniform refractive index throughout its profile.

The variation of the refractive index profile of the fiber results in that the light propagates according to a curved path rather than in straight sections as in step-index fibers . The greater distance of the beam is offset by the higher velocity of propagation ( $V = c / n$ ) in the outer region of the core .

In these fibers the acceptance angle depends on the distance to the core axis , maximum at the center and zero at the border with the coating . However, the numerical aperture ( NA ) of the graded index fibers is defined in the same way as in step-index :

$$NA = ( 2 n_1^2 - n_2^2 )^{1/2}$$

The NA has a typical value of 0.2 for these fibers.

Most graded index fibers have a core diameter of 50 microns and a cladding diameter of 125 microns .

These fibers cause fewer modes of propagation than step index , reducing the dispersion , thereby increasing bandwidth . These fibers are used up to distances of 10 km.

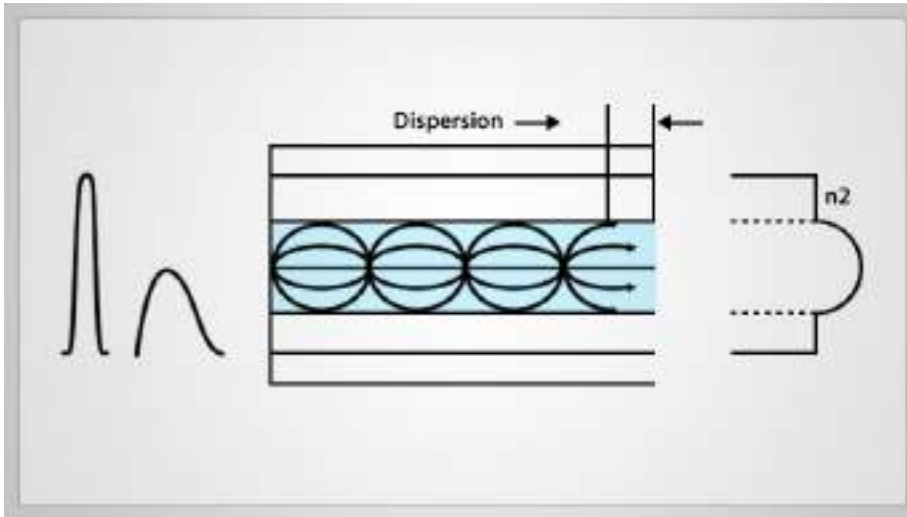


Figure 4 . Graded index multimode fiber ( Krohn : 1988) .

## Single mode fibers

When very large band widths are required single mode fibers are used . These fibers , in its simplest construction , are equal to the multimode step index , except that the core diameter is very small (5-12 microns ) , being able to propagate a single mode.

The modal dispersion is very low, only about tens of pi - cosegundos ( 10-12 seconds ) per kilometer , which bandwidths are exceptional and low loss , being suitable for long-distance or high-speed communications ( Krohn : 1988) .

It is the simplest conceptual case , as it is a step-index fiber but with a core diameter so small 15 16

( less than 10 microns ) that it only allows the propagation of one mode, the basic mode(Figure 5) .

This type of fiber is what allows better performance and is used in long-distance links . These fibers have ,however, some disadvantages such as increased difficulty injecting the optical signal to the fiber

( typical numerical aperture of 0.1 @ angle of incidence of  $12^\circ$  ) , increased sensitivity to mechanical error , abuse, bad splices , etc . The difficulty of signal injection is resolved used laser light sources ( Krohn : 1988) .

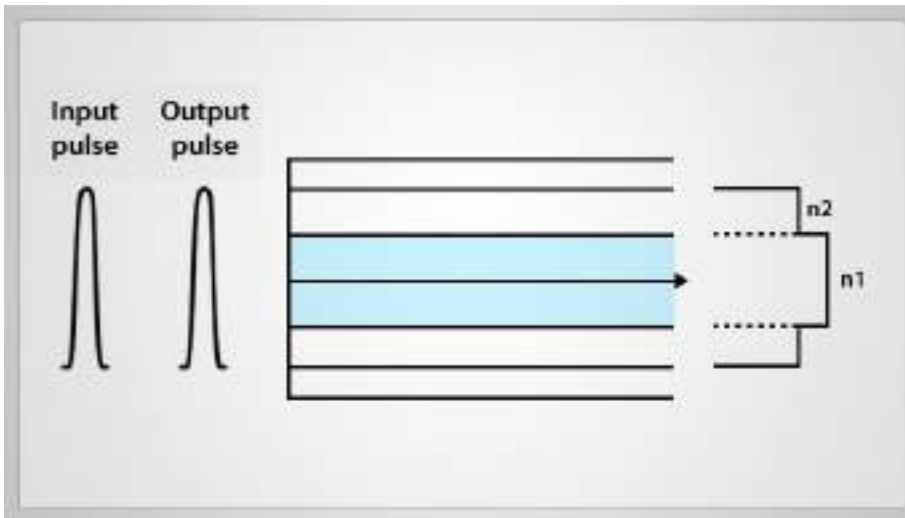


Figure 5 . Singlemode fiber ( Krohn : 1988) .

## Fiber optic sensors for monitoring environmental parameters

Applications of fiber optic sensors corresponds to the tasks of environmental monitoring, industrial process control , and biomedicine . They have successfully developed optical sensors for monitoring of molecular oxygen , carbon dioxide , pH , iron , hydrogen sulfide , alcohols , humidity, temperature , detergents , oils , pesticides, glucose, acetyl choline, and cholesterol , in addition to the union of the optical sensors with biological molecules (enzymes , antibodies, DNA) biosensors , which are used in different areas such as medical diagnostics, biological applications (detection of bacteria) , and the monitoring of water and air ( Espinoza et are built to : 2007, 797-859) .

A clear demand exists for screening methods that operate in-situ and which have the potential as environmental applications of sensors in general and fiber optic sensors. They are :

- Environmental analysis such as media points

- Continual target monitoring.
- Early warning systems .
- Environmental control systems .
- Environmental protection systems .

You can sort environmental sensing applications according to the area to be monitored: home sensors , industrial monitoring inside of buildings, outdoor sensors and in space , marine sensors or for water purity ( López- Higuera , 2002).

The appropriate strategy for environmental monitoring is strongly dependent on the analytic to be detected, the medium containing the substance of interest , the accessibility of the area to be analyzed, the danger of the surrounding environment , the desired quality of the information obtained , and the current legislation. Every step from identifying a problem, to cleaning up pollution and the potential for subsequent monitoring require different analysis techniques that highlight potential areas of application of sensors in environmental monitoring .

When a contaminated area is identified, an extensive characterization of the location is essential which includes the nature and level of contamination . They are necessary analysis techniques and diagnostic tools to identify unknown contaminants and expected. The analysis of the obtained data will give us the contaminants specifications ( Herrera : 2005 ) .

These measures typically require making many discrete samples to be analyzed in batches for the presence or absence of contaminants.

Demand for exploring the countryside and having portable devices emphasizes the use of miniaturized laboratory methods applicable in the field, as well as sensors capable of providing in- situ analysis. This latter feature is a valuable advantage when considering the determination of volatile organic compounds , especially as the in-situ analysis without sampling procedures there are errors due the evaporation of the analytic or changes in the medium can be minimized.

A constant monitoring of pollutants is critical in order to continuously adapt such a process to reduce costs by minimizing

remediation efforts if desired cleanliness level (Herrera , 2005) is reached.

Depending on the legislative means, treatment or further monitoring may be required. In that case, in- situ sensors that act as thresholds alarm devices would be highly effective in time and cost compared with the classical laboratory analysis. The robustness , reliability and being inert to electromagnetic influences makes the fiber optic sensors ideal candidates for such tasks. Another area of interest for analyzing systems which operate continuously is the long-term monitoring of environmental parameters such as water pollution caused by large quantities of agricultural fertilizers , herbicide and pesticide input or industrial wastewater ( Herrera , 2005).

Sensors are claimed to determine parameters such as oxygen, pH , carbon dioxide , ammonia , nitrates, PAH , etc. . Monitoring devices facilitates quality control of water and adjustment of the thresholds of environmental alert in case of accident . The points of application for such systems are continuous monitoring stations in rivers, estuaries and shallow coastal waters . Due to the versatility and flexibility of fiber optic sensors, they represent an attractive alternative to the electro chemical measures (Herrera , 2005).

## Optodes applied to water analysis

Between 1984 and 1986 , the EPA (Environmental Protection Agency) published a series of reports in which the assessment and improvement of water quality in order to protect public health and the ecosystem are included . The highlights of these reports were tightening measures adopted by each State on the quality of water and the creation of an organization to ensure strict compliance with the standards established by the EPA (Bustamante : 2001) .

In 1994 , within the Fourth Framework Programme for R & D of the European Union /Sub-Program for Environment, two priority objectives were established: ( a) identify and assess the effects of human activity on the ecosystem and ( b) contribute to the need for observation, environmental monitoring and research technology development, including the methodologies and technologies for monitoring , prevention and management of natural hazards . On this last point , EU places particular emphasis on the development of sensors for all applications where conventional systems are

limited by sensitivity, selectivity, accuracy, reliability and / or cost, as well as in industrial processes that include cleaner production. At present, and until 2002, the V Framework Programme (1999) is in effect which re-emphasizes the need to control the pollution of water resources through water and analytical systems at monitoring points or for accidental pollution sources (Bustamante : 2001).

Traditionally, control of water quality was carried out by the essential samplers and their subsequent transfer to laboratories, where thanks to current analytical techniques, such as atomic absorption spectroscopy (AAS), gas chromatography (GC), liquid chromatography (HPLC) and mass spectrometry (MS), all kinds of pollutants are detected and quantified.

The main analytics for monitoring in water are: pH, O<sub>2</sub>, CO<sub>2</sub>, organic pollutants, heavy metals and radioactive particles.

The remote monitoring of contaminants in groundwater is a field where the use of fiber optics offers great advantages, as is the ability to run fiber to the point of interest even at great depths. The first luminescent pH sensor was developed by Saari et al. (1982), the reactive phase sensor fluoresceinamide trapped in an acrylamide polymer, covalently immobilized on the end of an optical fiber. The main advantages of this optode are short response time by not having a membrane and wide working range (pH 2-9) by having two constants of successive acidity indicator. Its main drawback is its poor accuracy (Perez 2001, 130-140).

Whenever the concentration of a substance in water is legislated, the optimization of a measuring method is necessary, which usually appears along with the allowable limits of concentration of this type. Generally, laboratory methods allow the measurement of a large number of analytics with a lower cost than would use fiber optic sensors, which are usually developed for the measurement of a single parameter.

In order for a fiber optic sensor to replace the traditional methods of measurement, it is necessary to introduce improvements in optodes for various analytical parameters such as sensitivity, selectivity, accuracy and response time. They must be competitive in terms of market costs in reference to currently implemented methods, which can be achieved when multiparameter optodes are manufactured.

## Conclusions

The study of the development of fiber optic sensors is of great importance because the use of these sensors is continuous and in situ to monitor the concentrations of different analytcs at the environmental level . Using fiber optics in conjunction with some means such as dopants, opens a new field of research in which the use of chemical methods for the analysis of some environmental physical parameters that contaminants provoke making greater reference to the analysis of water and soil .

The use of these chemicals are at times harmful aggressive to the ecosystems , hence the importance of using a fiber optic sensor to provide reliable data to apply solutions to mitigate the risks that exist .

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# **Academic Papers**



# The Development of Physics and Mathematics in Chiapas: context , challenges and prospects

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## Abstrac

It is presented an outline of the state of art on physics and mathematics as basic research fields with possible technological applications as well as a review of the socio-economic and educational scenario of Chiapas in the national context. Finally, it is showed the research developed at CEFyMAP-UNACH, and their influence of the development of Chiapas by the formation of high-level professionals.

## I. State of the art , a quick look

Both physics and mathematics have been driving most of the technological developments that we currently enjoy . The conceptual and experimental development of these sciences in the last century has resulted in unprecedented progress that is evident in great discoveries that confront us with nature and help us to understand and manage the laws that govern it. However, in order for technological development to exist, it is necessary to have a foundation, which is scientific research and its application.<sup>1</sup>

In the last century applications of pure mathematics have been found which have had a strong impact on our daily lives, such as the case of number theory and cryptography , which is essential for communications , as well as differential equations and systems dynamics which have allowed the development of financial mathematics , to give some examples. Although the motivation for the development of mathematics , like any science, is not looking for practical applications, due to its logical construction it stands as the backbone in the systematization of the laws of nature that are studied in other fields of science, such as physics. That is, any of the areas of mathematics or technology can have practical applications at some point , so all branches of science cannot neglect either of them.

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<sup>1</sup> Many times the concept of basic science and applied science is used. However we will avoid the separation since scientific development produces knowledge and this always serves for something- in first place to develop more science and applications. (See Ruy Perez Tamayo, basic science and applied science in Public Health, Mexico 2001; 43:368-372.) as well as others.

One of the mechanisms for technological development that stems from scientific research clearly occurs in physics, in which the study of nature leads to the discovery of the existence of phenomena that appear to be new because they have not been observed. So conceptual development that follows the research process predicts events to be confirmed experimentally and as a consequence, projects are proposed for the realization of these experiments which often arise in the generation of new technology that is useful for society which will be transferred to some practical applications. Similarly, the development of experiments to understand the functioning of systems have led us to find phenomena that have no theoretical explanation, encouraging the development of theoretical physics which generates new concepts, the use of new mathematical tools and even the creation of new paradigms.

For examples of recent developments in theoretical and experimental physics, we can mention String Theory which is an attempt to unify the four fundamental forces of nature. Even though it does not have predictions that have been verified experimentally, it has generated great advances in the development of theoretical physics and methods currently used to explain other phenomena in condensed matter systems. The quantum gravity loop combines quantum mechanics with general relativity theory in an attempt to quantize gravity. In this sense it is an alternative to string theory to quantify gravity. However the experiment will have the last word. In a large-scale study of the universe is Cosmology, which confronts its theoretical predictions with astronomical data and seeks explanations for observations. One of the current issues in this area is the explanation of *dark energy and material*.

As for the experimental part, we can mention the discovery in 2012 of a particle which appears to be the so-called Higgs Boson<sup>2</sup>, which was predicted in the sixties as a fundamental part in the understanding of the generation of the mass of the particles. Furthermore, in order to understand the universe there are some phenomena observed in the cosmos with poorly understood origins. This is why observatories are built to obtain data and infer answers, for example the origin of ultra-energetic cosmic rays is studied in the

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<sup>2</sup> CERN, The Higgs boson: one year on, en <http://home.web.cern.ch/about/updates/2013/07/higgs-boson-one-year>

Pierre Auger observatory in Argentina<sup>3</sup>. In order to understand the origin of gamma-ray flashes, the HAWC observatory was built on the slopes of the Sierra Negra volcano in the state of Puebla.

We have mentioned some of the main theoretical and experimental branches pertaining to the study of the very small and the very large. We cannot help to also mention that advances in physics range from the design and discovery of new materials ; the testing of new states of matter , such as the Bose- Einstein condensate conducted in a laboratory in 1995<sup>4</sup> and which now can even be done with photons<sup>5</sup>; the discovery of grapheme<sup>6</sup>; and the insulating and topological<sup>7</sup> superconductors, among many others. Of these, it is worth mentioning the fractional Quantum Hall effect experimentally discovered in 1982<sup>8</sup> whose quantization parameter is currently used to calibrate resistance, which is essential to the correct functioning any electronic device. In addition there is the substance now known as soft condensed matter. Its three basic materials are that continually being studied are colloids, polymers and amphiphilic molecules .

Likewise mathematics has developed greatly over the last century, from the research posed by David Hilbert in 1900 to its logical foundations though the demonstration of incompleteness theorems formulated by Kurt Gödel in 1931.

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<sup>2</sup> CERN, The Higgs boson: one year on, en <http://home.web.cern.ch/about/updates/2013/07/higgs-boson-one-year>

<sup>3</sup> See <http://visitantes.auger.org.ar/index.php/los-rayos-cosmicos.html>

<sup>4</sup> Keith Burnett, Mark Edwards, and Charles W. Clark, The Theory of Bose-Einstein Condensation of Dilute Gases, *Physics Today*, Volume 52, Number 12, page 37 1999

<sup>5</sup> R. Mark Wilson, reveal a Bose-Einstein condensate of photons *Physics Today*, Volume 64, Number 2, page 10, 2011 Experiments

<sup>6</sup> Mikhail I. Katsnelson (2007), Graphene: carbon in two dimensions. *Materials Today*, Volume 10, Number 12, p.20

<sup>7</sup> Moore, Joel E. (2010), The birth of topological insulators, *Nature*, Volume 10, Number 474, page 194.

<sup>8</sup> Peter Gonzalez Mozuelos, The fractional quantum Hall effect, *CINVESTAV Progress and Prospects*, Volume 18, page 29, 1999.

During the first International Congress of Mathematics in Paris in 1900, Hilbert posed 23 problems that have been a constant challenge for mathematicians. These problems raised the issue of the compatibility of the axioms of arithmetic , Poincaré's theory of functions , the theory of abstract spaces , the topology and the theory of linear spaces , the probability theory and the theory of Lebesgue integrals among others , which constitute the major advances of the past century to the present.

Within the last great advances that have been made in mathematics is the resolution of Fermat's last theorem , which was proved in 1995 after 330 years of efforts by Andrew Wiles<sup>9</sup> , which resulted in the creation of a new area of mathematics, modularity . Another major achievement was the demonstration of the Poncaré conjecture made by Grigori Perelmán in 1993<sup>10</sup>. Although it is a problem in the context of topology, it was solved by methods of differential geometry. The problem of the four colors , which was demonstrated in 1976 by Kenneth Appel and Wolfrang Haken , took 124 years to be resolved through the use of computers. Now, some additional problems such as Goldbach 's conjecture and the Riemann<sup>11</sup> hypothesis are discussed. However every day new problems that require the development of mathematics and relationships between its branches arise .

All of this sounds great, but we need some time to analyze the actual situation of our context and a brief analysis of the state of Chiapas, as well as the potential is has for the development of physics and mathematics, in order to finally describe what is being done in regards to the development of science in the state through the Center for Studies in Physics and Basic and Applied Mathematics (CEFYMAP) of the UNACH .

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<sup>9</sup> See eg Carlos Prieto, Fermat's last theorem, how do you see?, UNAM, 2-18, page 16-19, May 2000.

<sup>10</sup> See Juan Antonio Pérez, A century of the Poincaré conjecture, Science, Volume 57, Number 2, AMC, 2006.

<sup>11</sup> Carlos Prieto, Is it hard to disclose math?, Science, Volume 61, Number 1, page 80, 2010.



## II. - Socioeconomic Context

The national population according to INEGI is 112 , 336 538. For the state of Chiapas it is 4,796,580- representing approximately 4.3 % of the country. Chiapas therefore occupies 7th place of the most populous states in the country . The state population is distributed by age and gender as shown in the pyramid population graph. The average age is 22,and the proportion of men to women is 96.3 . For every 100 people of working age, there are 66 dependents. In other words, those under 15 and over 66 . The population density is 65.4 . There are 122 municipalities In the state. The most populous are: Tuxtla Gutierrez with a population of 553.374 inhabitants, Tapachula with a population of 320.451 and Ocosingo with a population of 198.877<sup>12</sup>

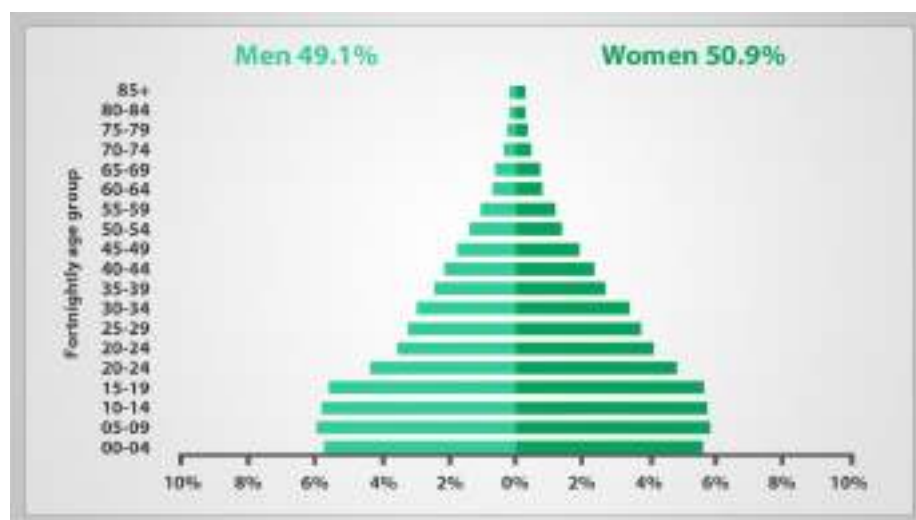


Figure 1.

The growth rate of the state in the last decade is about 2% , as the population grew from 3,920,892 to 4,796,580 . This growth puts Chiapas in 9th place in population growth. However, this growth rate is not the same for all municipalities. The following table shows the 5 municipalities with largest populations and its annual growth rate

The four municipalities with the greatest population concentrate 26.2 % of the state population, in other words more than a quarter of residents in the state.

<sup>12</sup> Sociodemographic outlook of Chiapas, INEGI, 2011.

Location	Municipality	Population growth rate
1o	Tuxtla Gutierrez	2.4
2o	Tapachula	1.6
3o	Ocosingo	1.0
4o	San Cristobal de las Casas	3.3
5o	Comitan	2.9

Table 1.

## Economic situation

In Chiapas, 51.3% of the population lives in towns of less than 2500 inhabitants, indicating that most of the population is rural. In the 2010 INEGI census, although it reports that 97.67 % of the population is economically active (PEAO), e 45.78 % are paid the minimum wage, 24.07 % receive more than one and up to 2 minimum wages, 19.04 % receive more than two and up to 5 minimum wages and only 6.06 % earn more than 5 minimum wages per month.<sup>13</sup>

In the table below we can see the comparative percentage compared to the national average.

Thus we have that with respect to the PEAO that is perceived to receive up to 1 minimum wage, Chiapas ranks first nationally, 11th place of the perceived PEAO over 1 and up to 2 minimum wages, and 32nd place of the PEAO that perceived over 2 minimum wages. This PEAO wages at the state level is distributed according to activities that are done, 42.76 % being concentrated in the primary sector, 13.51% in the secondary sector and 42.90 in the tertiary sector. Thus occupying the top of the PEAO is the primary sector and 32nd place in the PEAO that occupies the secondary and tertiary sectors.

<sup>13</sup> Analysis of the final results of the population and housing census 2010, CEIEG, Government of the State of Chiapas 2011.

PEAD	National	State
Up to 1 minimum wage	16.52%	45.78%
More than 1 and up to 2 minimum wages	22.14%	24.07%
More than 2 and up to 5 minimum wages	39.39%	19.04%
More than 5 minimum wages	14.03%	8.06%

Table 2.

Migration measured as net worth is the difference between the number of immigrants and emigrants in 2010 in Chiapas had a negative balance of 55,287.<sup>14</sup>

## Municipal context

The state capital has a population of 553,374 inhabitants. There are 91 men for every 100 women, with an average age of 26. For every 100 people of working age, ie 15 to 64 years, there are 46 in a dependent, ie under 15 and over 64<sup>15</sup>. Chiapas has a population density of 1652.4 persons per square kilometer. The municipality of Tuxtla Gutiérrez has 115 locations. The most populous are: Tuxtla Gutierrez with 537,102; Copoya with 8160 and El Jobo with 4,632.

The economically active population makes up 57% of the total, of which 74.1% are men and 41.9% are women. Also, 97.1% of the economically active population is employed, distributed according to the following chart.

<sup>14</sup> Ibid

<sup>15</sup> Socio demographic panorama of Chiapas, INEGI 2011.

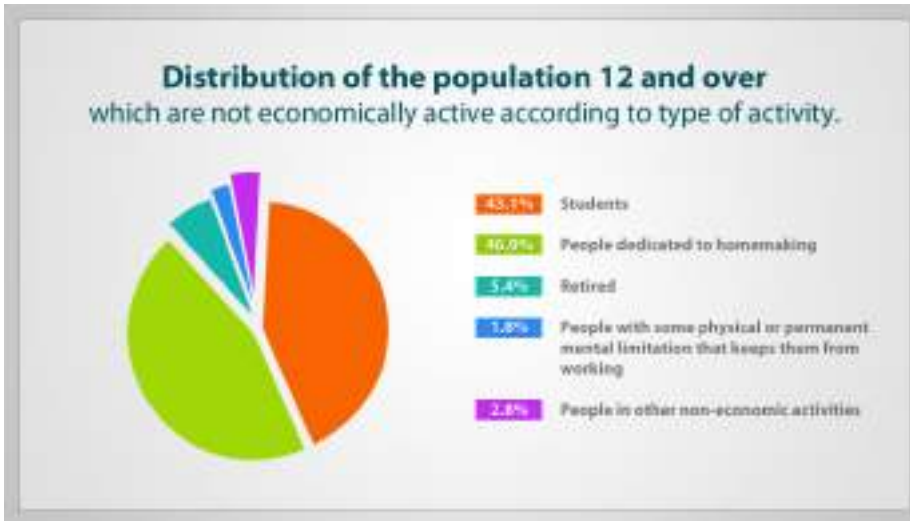


Figure 2.

The unoccupied economically active population (EAP ) form 2.9% of the population in the municipality , which is greater than the PEA unemployed in the state which corresponds to 2.3 %.

### III - Panorama. Education

In Chiapas, of 100 people 15 and over, 10 have some approved degree in higher education . However , according to the INEGI about 16.5 % of the state's population does not have any schooling. The literacy rate in the age range of 15-24 is 93.8 % and for those 25 or more it is 76 %. In order to see the context of higher education in the state in greater detail, we need do a comparative analysis of the region and the country.

In the following graph we can see a national comparison in percentage of the population with reference to higher education. Where the national average is 17.82 % , Chiapas is 10.82 % , ranking 31st , followed only by Oaxaca. This graph is referred to as higher education of the population aged 24 or more, beginning at technical-superior level.<sup>16</sup>

<sup>16</sup> Source: INEGI, Population and Housing Census 2010. [www.inegi.org.mx](http://www.inegi.org.mx)

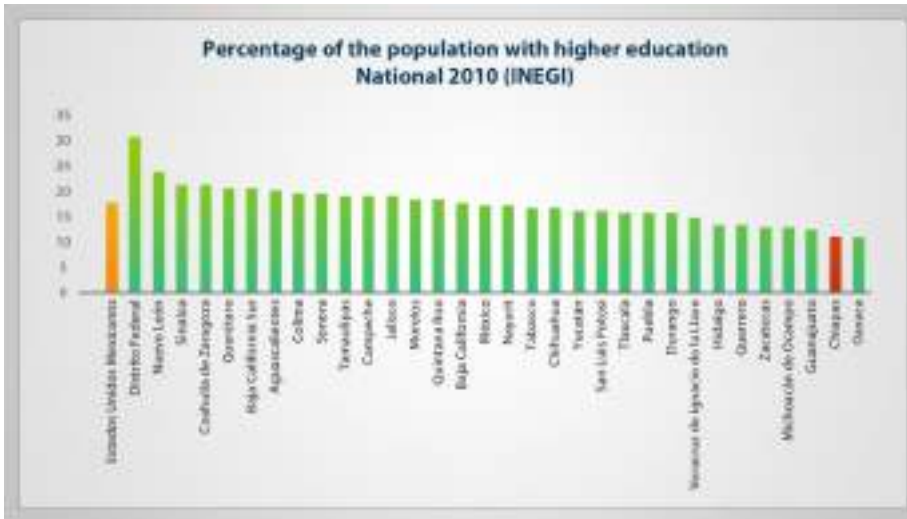


Figure 3.

Chiapas is bordered by the states of Oaxaca , Tabasco , and Veracruz, and is considered as part of the Southeast region which encompasses Oaxaca , Veracruz , Tabasco, Campeche , Yucatan, and Quintana Roo.

According to the ANUIES<sup>17</sup> statistics, national enrollment in higher education is 2,530,925 students, of which 59,684 are from the state of Chiapas, in absolute terms occupying 15th place nationally of students enrolled at this level . But we also must consider that Chiapas is the 7th most populous state in the country.

Making a comparative analysis of selected states of the Southeast region, we can compare the enrollment at the higher education level in absolute terms. In a percentage based on the total population by state, we see that Chiapas ranks last in coverage with respect to the population by state in the south- southeast of the country.

<sup>17</sup> ANUIES Statistical Yearbook 2012.

	Registration	Percentage population
National	2,530,925	2.25%
Campeche	19,767	2.4%
Chiapas	39,684	1.24%
Oaxaca	51,466	1.31%
Quintana Roo	20,678	1.55%
Tlaxiaco	37,619	2.57%
Veracruz	141,417	1.85%
Yucatán	46,893	2.39%

Table 3.

## Distribution of higher education

In the following table we can observe the distribution by area of enrollment in higher education in the country , 2% of the national enrollment is in the area of natural and exact sciences, and this pattern holds true with some regional variations. However, on the state level it has the least coverage regarding natural sciences .

Distribution of national enrollment by area						
Agricultural Science	Health Sciences	Natural and exact sciences	Social Sciences and administration	Education and Humanities	Engineering and Technology	TOTAL
64,326	266,790	31,910	1,078,505	165,952	505,441	2,530,925
2.54%	10.54%	2.05%	42.61%	6.47%	35.77%	100%
Distribution of enrollment south-southeast region by area						
12,073	37,274	8,257	144,900	32,047	102,169	397,524
3.23%	9.37%	2.07%	36.45%	8.08%	40.79%	100%
Distribution of enrollment in Chiapas by area						
5,071	3,237	917	24,201	6,102	20,138	59,684
5.14%	8.77%	1.53%	40.55%	10.22%	33.77%	100%

Table 4.

## Overview of Natural and Exact Sciences

In the chart below we can see a comparison of national enrollment at the higher education level in the area of natural sciences, where Chiapas is located at number 21. National enrollment in this area is 51,910, of which Chiapas has 917 to 2011. It is important to also include that the majors that are part of this area range from biology, marine science, to physics and mathematics.

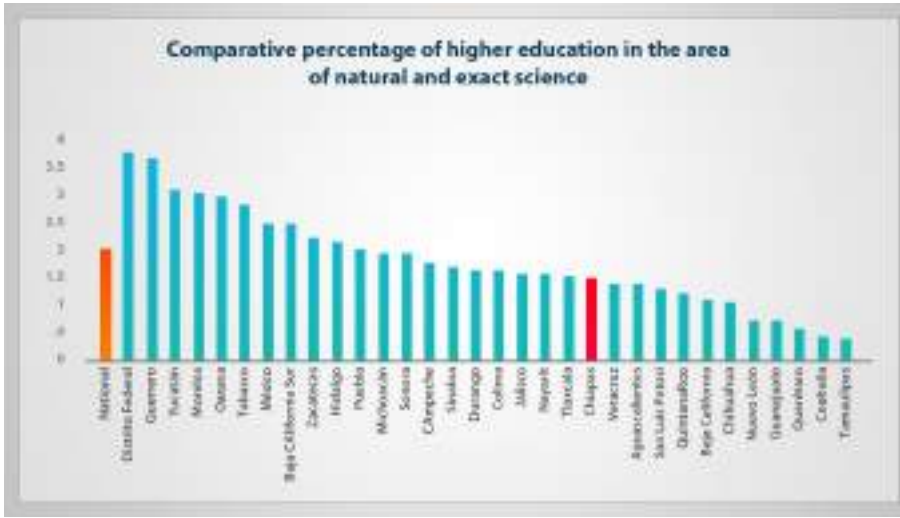


Figure 4.

Doing the same exercise at the regional level where in the south-southeast region is found the total enrollment by state, the percentage devoted to the natural sciences in Chiapas occupies 5th place, with 1.53% of the total enrollment.

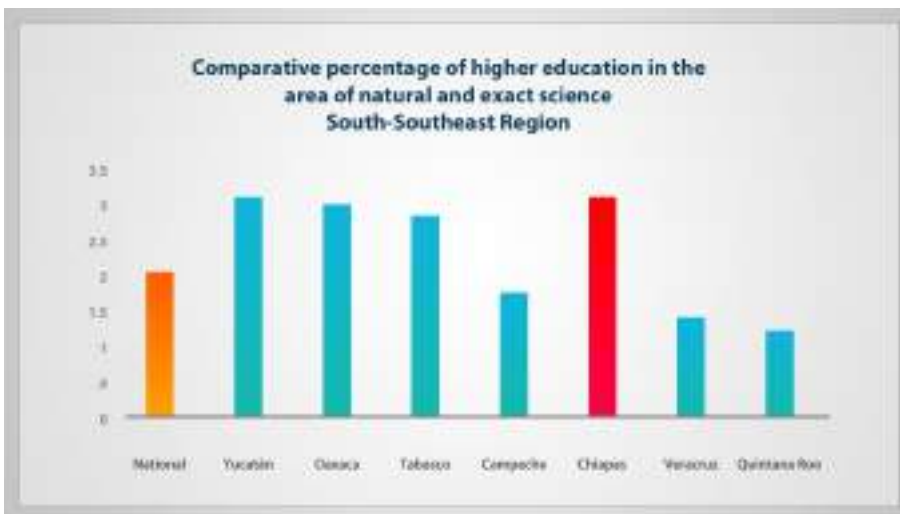


Figure 5.

Disaggregating the area of natural and exact sciences in the various disciplines that are offered at the undergraduate level in the Southeast region, we can see that the largest percentage is dedicated to biology and only 20 % of the total is enrollment in degrees directly related with physics and mathematics, as shown in the following chart.

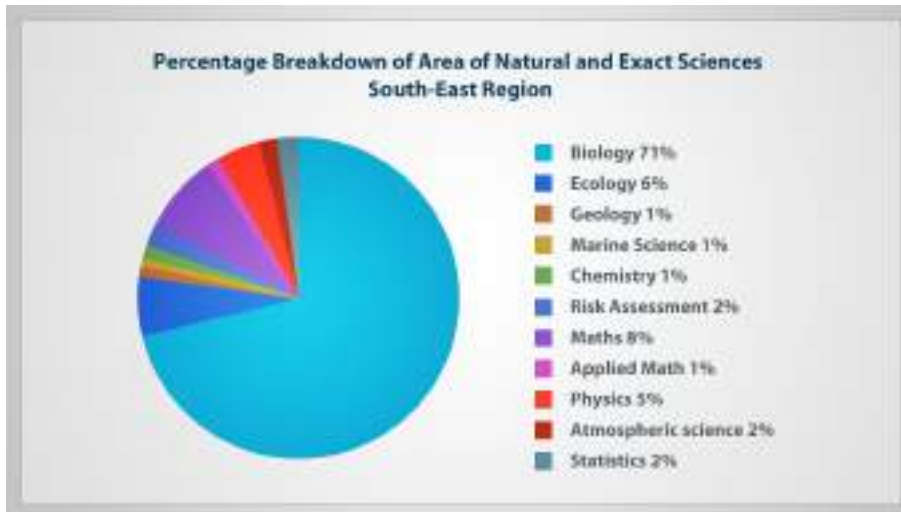


Figure 6.

## Panorama of Physics and Mathematics in the region.

Educational programs at the undergraduate level in the areas of physics and mathematics include different degrees in the south-southeast region. In particular the state that has the most enrollment in these branches is Veracruz, with an enrollment of 595 students in 4 degrees, followed by Yucatan with an enrollment of 315 students in two degrees, Tabasco with an enrollment of 277 students, Oaxaca with an enrollment of 172 students in three degrees and finally Chiapas with an enrollment of 243<sup>18</sup> students distributed in the degrees of physics and mathematics at the UNACH.

The following graph shows enrollment by race for state Southeast region.

<sup>18</sup> Data taken from the ANUIES almanac, however it is not the right amount registered in 2011, which was approximately 150 students in total.



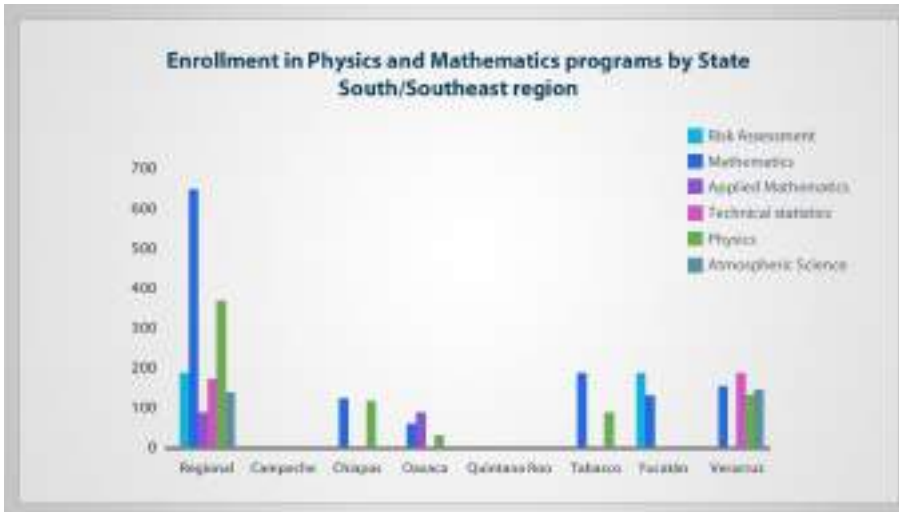


Figure 7.

## Regional programs at the graduate level

Nationally, graduate enrollment is 208.225, distributed in different areas, where about 5% belongs to the area of natural sciences. The following table shows the comparison of total domestic, regional and state enrollment and distribution.

Distribution of national graduate enrollment by area						
Agricultural Sciences	Health Sciences	Natural and exact sciences	Social Sciences and administrative	Education and humanities	Engineering and Technology	TOTAL
3,072	32,080	10,388	90,802	48,255	23,228	208,225
1.48%	15.41%	4.9%	43.65%	23.41%	11.16%	100%
Distribution of graduate enrollment south-southeast by area						
314	1,993	1,168	10,000	4,380	2,066	18,861
1.58%	10.02%	5.87%	50.27%	21.85%	10.39%	100%
Distribution of graduate enrollment by area in Chiapas						
22	91	177	1,830	1,185	243	3,358
0.65%	2.78%	5.28%	48.66%	35.17%	7.25%	100%

Table 5.

In Chiapas the postgraduate area that comprise the natural and exact sciences with their respective enrollment are:

Discipline	Programs	Registration
BIOLOGY	Masters In Biological Sciences	13
BIOCHEMISTRY	Master of Clinical Biochemistry	12
CHEMICAL SCIENCES	Master of science education in chemistry	20
	MSc in chemistry	18
ECOLOGY	Ph.D. in ecology and sustainable development	39
	Masters In sustainable development	18
	Master of natural resources and rural development	46
MATHS	Master of mathematics education	11

Table 6.

## IV - . What is being done in the CEFMAP ?

The CEFMAP is home to the Bachelor's Degree in Physics and Mathematics, and has a highly qualified faculty consists of 16 full-time professors, all with doctorates : eight in Physics and eight in Mathematics. This faculty is also engaged in research , of which 60% has the distinction of belonging to the National System of Researchers (SNI ) . This centre provides training for highly trained professionals in physics and mathematics, with a critical awareness that may influence their environment. In this manner the CEFMAP contributes to the development of scientific research in the State, which is a priority and also a social commitment for researchers studying these areas of knowledge. Currently the various lines of investigation at the CEFMAP are<sup>19</sup>:

**Theoretical Physics** : the work done in this area range from the study of quantum field theories (in flat and curved space ) in the framework of formalism " world line " , models beyond the standard model , and the role of non- commutative space-time, condensed matter phenomena such as Fermi liquid , and the quantum Hall effect , among others- to the connection between statistical mechanics and quantum field theory, and the study of relevant Brownian dynamics and fluid membranes for Biophysics .

<sup>19</sup>These descriptions were taken from the curriculum of the Master's program in Physical Science and the Master's program in Mathematical Science proposed by the CEFMAP, which were briefly offered.

**High-energy astrophysics** : investigations are done relating to the detection , analysis and physical mechanisms of the production and propagation of gamma rays coming from somewhere outside our planet. The investigators at the CEFMAP collaborate with the HAWC observatory being built on the slopes of the Sierra Negra volcano in Puebla ,whose scientific activities started in August of this year ( 2013).

**Complex systems** : investigations are done related to the structure of the systems that interactions between their internal and external elements that lead to different emerging dynamic properties ( Multi stability , self-organization , limit cycles , etc. ) in which in principle it is not possible to deduce the properties of the individual elements forming the system .

Nonlinear optical processes are studied in the propagation of signals through optical fibers with different types of doping, as well as amplifiers and lasers with optical fibers.

**Abelian Varieties: Prym varieties** . This branch of algebraic geometry deals with the analysis of topological spaces with some additional structure : they are locally similar to a real or complex space. Between these spaces , called complex varieties , there are some which have a representations as a solution of polynomial equations systems in some large space ,called Abelian varieties. Recently they found applications in the field of physics and therefore it is necessary to describe them as Prym - Tyurin varieties : varieties that live inside another and have certain good properties in this context. It is known that every abelian variety (with certain technical conditions ) is a Prym - Tyurin variety , but there is interest in a specific and optimal construction of this phenomenon , as well as examples.

**Theory of continuums and their hyperspaces** , is a branch of General Topology where the properties of metric spaces and / or compact and related Hausdorff spaces, as well as the study of hyperspace models and their properties.

**Homogeneous spaces** is part of General Topology algebra and investigates whether the homotopic groups of a homogeneous space , ie, a topological space which has a differentiable structure and is diffeomorphic to a quotient of Lie groups  $G / K$  , where  $G$  and  $K$  is a group of compact semi- simple and simply connected Lie , are sufficient to classify such spaces .

**Algebraic cycles** . Algebraic cycles are an algebraic version of the homology classes of algebraic topology . They are defined herein as a

rational , homological and algebraic equivalence. The ratios between the respective Chow subgroups are of interest in the area.

**Theory of random differential equations**, numerical and analytical methods are developed to the study of solutions of differential equations with their coefficients , their initial conditions , boundary conditions or source terms , and second-order stochastic processes are developed.

**Stochastic Processes and econometrics** , this research focuses on developing models of portfolio credit risk , factors and reductions. Similarly, there is work on applications of nonhomogeneous and continuous discrete semi- Markov processes, Bayesian models in game theory applied to political science ,economics and finance, as well as modeling and forecasting of economic indicators for co integration .

**Stochastic control theory** studies a variety of models, including Markov chains , processes jumps, stochastic differential equations ( EDE ) , and EDEs with jumps using optimality criteria ergodic averages and related costs.

## Conclusion

We can see that in the state of Chiapas through the CEFMAP, current research is being developed that represents cutting edge knowledge. This is currently being done in both degrees with an emphasis on the thesis topics of graduates, which will be extended to postgraduate level according to the development plan of the Centre. In this manner, on the one hand Chiapas is placed through the CEFMAP as a potential point to spearhead the development of physics and mathematics in the region and in the country, and on the other side responds to the clear need for the training of professionals engaged in scientific research in these areas.

## Thanks

All members of the academies of physics and mathematics CEFMAP .



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# Heraldry of the UNACH

Description and meaning of the shield and motto of the Autonomous University of Chiapas

Luis Morán Villatoro





## I. Introduction

Are we a university community with its own identity? Do we recognize our identity? What is the significance of ideology for the university? Rather than answer these almost always complex questions, I invite you to participate in reflection and analysis – unavoidable exercises prior to the passing of the first 39 years of the UNACH. In order to set a historical precedent while looking towards 2075, the centennial year for the university and the moment in the future when we look into the past through the opening of our “time capsule”, when we will say: Who were we? What did we do? The being and knowledge of the university we know today as a benchmark of tomorrow.

On the other hand, the 3,000 year history of the Mayan civilization continues to enrich us with its world class scientific and cultural legacy. Contrary to a widespread belief, the Mayan civilization never “disappeared” - At least, not entirely- as their descendants still live in the Mesoamerican region.



Picture 1. Detail of a mural about Mayan culture. SEKTA

In this regard, important archaeological remains include the stelae ( the Maya called them Tetun , or “ three stones “ ),

which describe the rulers with logographic texts describing their genealogy , military victories , and other accomplishments . [2] The latter is closely related to what thousands of years later would be called heraldry: art - science of today we will briefly discuss with no pretension to promote and strengthen the connection to the community with our coat-of-arms, our shield, our emblematic element of university identity.

## The Autonomous University of Chiapas is created

Dr. Manuel Velasco Suárez , during the celebration of the Sesquicentennial of the Mexican annexation of Chiapas , concretized the illusions of youth as governor. On September 24, 1974 , he issued decrees 97 and 98, in which the formation of the Board of Government was approved and Law at the Autonomous University of Chiapas was enacted . Both provisions were published in the Official Gazette of the State Government on 23 October 1974, which is how the UNACH was formed [1] .

This context refers us to the ideology-to the fundamental ideas of something - something that as a whole can be associated with the concept of identity which accepts the philosophy as "the parts of a thing is equal to itself". This can be represented by the use of ideograms or " images that represent an idea." We can therefore build a ideograph , or " representation of ideas "- that we collectively refer to ideology as "the study of ideas in support of human knowledge". According to Pareto, it is a " set of rules for action" . We can close a virtuous circle that goes from the origin to the activity . [3] Thus, the emblem acquires fundamental and foundational meaning , returning to the origin and referring to the work -which acquires its proper scale.

In these pages , the background on the Universities coat of arms will be discussed, such as dates , authorship and details. The reader will learn of the university heraldry , the coat-of-arms of the University and its elements are described , and their meanings are explained .

## II . An approximate description of Heraldry

It is difficult to determine exactly when Heraldry was born in the sense that the Marquis of Avilés defined in his " Ciencia Heroyca " published around 1725 :

"The Crest is the art, which in such terms , and in its own voice teaches us the intelligence taught in the Coat of Arms: the glazes , figures, and ornaments, by assigning them with rules and certain precepts , the way that all of the other Faculties and Sciences have."

In other words, there is a science that helps us to understand and properly compose coats of arms , or the code of rules that allows us to correctly represent or describe coats of arms .

Some concepts related to heraldry are:

Heraldic , ca . (From Herald ) . 1. adj. Of or pertaining to the emblems or heraldry . 2.. Art of the Crest.

Crest. 1. Art of explaining and describing the coats of arms of each lineage, city or person . 2. Each figure, sign or piece that is put on a shield.

Shield. ( Weapons ) . Field, area or spaces where crests [4 ] are painted in different manners .



Figure 2 The shield of the heraldic college.

## The Heraldic University : Spain

One of the branches in which heraldry is classified is called civic heraldry or civil heraldry. They form part of the national, provincial, municipal and other territorial heraldries, such as the Autonomous Communities in Spain, the Länder in Germany or the Swiss Canton heraldry. The corresponding authorities and public institutions that depend on the aforementioned institutions also depend on this heraldry.

From here derives the university heraldry, with Spain being an authority on the subject since the symbols or emblems that are used by institutions and universities are increasingly becoming important as objects of study for both public and private universities. Such relevance has reached the point that some universities offer modular programs to train Experts, Specialists and Masters in Heraldry and Genealogy, under a rigorous and methodical knowledge of the Spanish legal system in noble materials and the origins and historical development of nobility. Genealogy is also studied, as well as the possibilities that this offers: from the techniques for making a family tree intended to clarify the relationships and affiliations of individuals, lineages or larger human groups, to the delimitation of the social origins of people and family lines, to the internal structures of families, the mechanisms of rise and perpetuation, and the analysis of attitudes inherent in every social group, etc. . [4] .

## Background on the shield of the UNACH

In July of 1975, as the director of the then School of Civil Engineering, (today, the Faculty of Civil Engineering) Alvarado Carlos Serrato sketched the shield of the University. A competition had been organized for this purpose, which was declared void for lack of participation. Thus, taking into account the urgent need of creating a shield, Mr. Serrato Alvarado designed one[1] . See picture 3 Carlos Serrato .

Although there had been a call issued for an UNACH motto . In the XII Session of the University Council held on September 11, 1976, at Campus I, it was agreed that the theme " For the Awareness of Need " which was submitted by Fernando Orduna Calcaneus, was

the winner although it was felt that it was incomplete. Therefore the Board decided to add the words " to serve " , eventually resulting in "For the Awareness of the Need to Serve" , consisting of a dialectical form of freedom , as the author said in an interview in 1986.

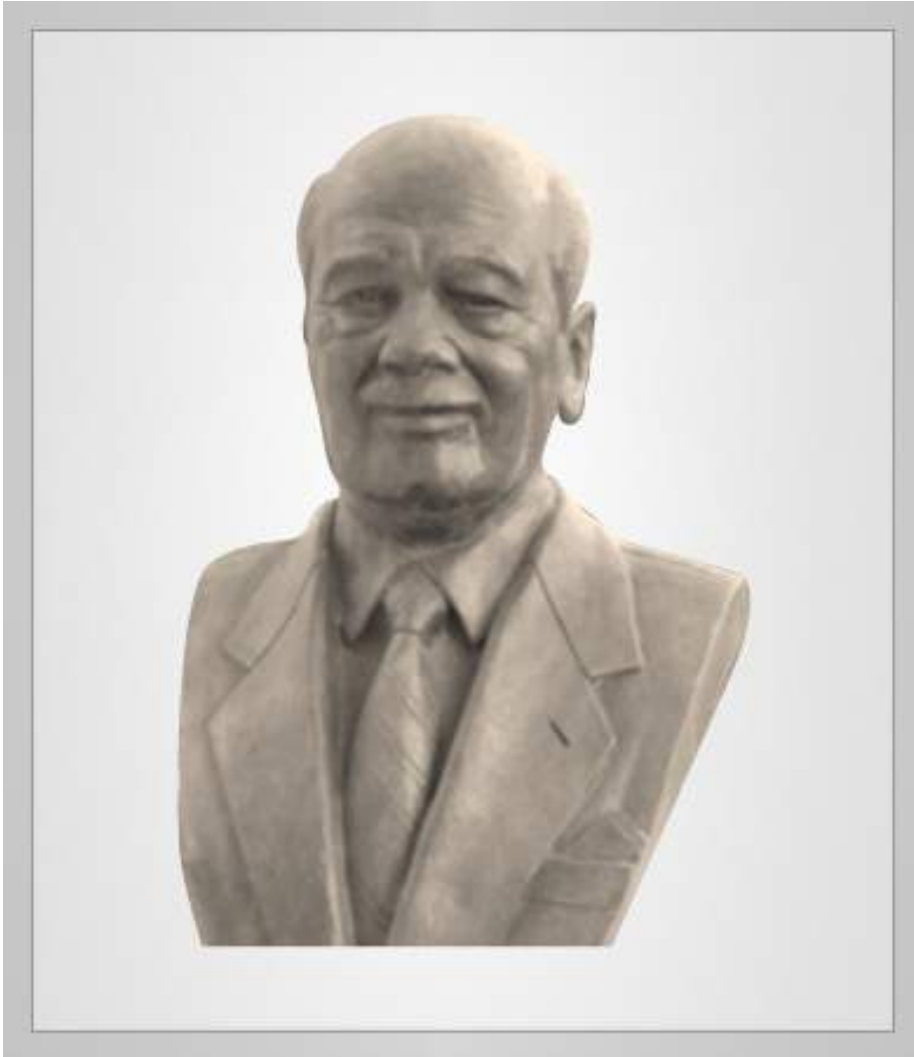


Figure 3. Bust of Carlos Serrato Alvarado.

Originally, to the initials of the Autonomous University of Chiapas was also added the letter " N " , forming the acronym - UNACH - to differentiate it from other universities .Since at that moment the universities motto did not yet exist, the space required for it was filled with the words "Science, Art and Technology", which can be seen in the original design from 1976.

See the photo of the original design for the UNACH shield.



Figure 4. The original UNACH shield, 1976.

Finally, the shield was presented to the Honorable University Council and it was approved at its regular meeting, No. 8 , which was held in Tapachula , Chiapas , on February 6, 1976 [1 ] .

## UNACH , University Heraldry

**Description and meaning of the coat of the Autonomous University of Chiapas, UNACH.**

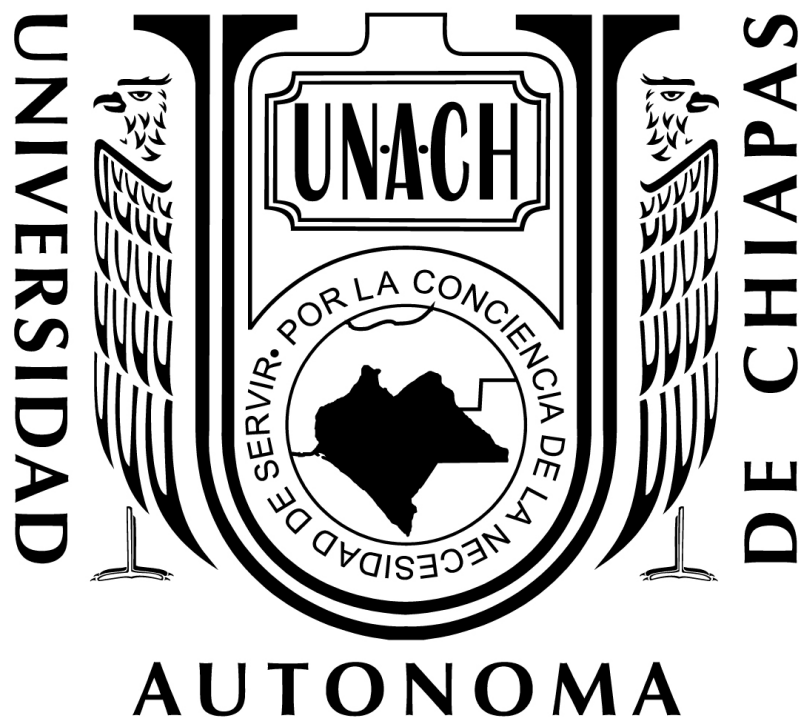


Figure 5. Shield of the UNACH

*In the place of honor* ; the letters of the “ UNACH ” can be found framed on a plate , referring to the Autonomous University of Chiapas. See the image of the actual UNACH shield.

*Shape of the shield* ; consisting of a shield rounded at its base, formed by the uppercase letter “ U ” , first letter of the word university, which composes the field of the shield .

*Enamels or colors* ; in actual practice , both the field and the figures of the UNACH shield are presented in a single color, whether sable or black , or gold which is one of the acceptable metals for the heraldry.

*Motto*; surrounding the figure of the State of Chiapas can be found the

motto "For the awareness of the need to serve", forming the language of liberty.

*External elements;* as columns, two eagles at profile hold up the shield- one on the left and one on the right with respect to the field of the shield. They represent Mexico and Chiapas. They emphasize how the people of Chiapas decided voluntarily to become part of Mexico.

*Legend ;* the shield is framed by the words " Autonomous University of Chiapas ."

## Dimensions

According to the " History of the Autonomous University of Chiapas," by Cuevas Agustín López , there has been no other shield in the history of the University other than what is that presented here , which has celebrated 37 years of its existence since its approval by the Honorable University Council . Therefore , it is appropriate to regulate the use and applications of the shield, its coexistence with other emblems and logos , as well as protect its content, proportions and colors , backed by the regulatory framework of the University.





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