History

The Biology of Cognition Laboratory of the Universidad de Chile (1960 -2006)

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Introduction.

The laboratory created more than 40 years ago by Dr. Humberto Maturana has been a unique place where research has been conducted in fields ranging from theoretical biology to the neuroanatomy and physiology of the vertebrate visual system. Thus the recent fire (August 5 2006) which completely destroyed the Laboratory of Cognition Biology is rather sad news as the fire interrupted a unique scientific tradition that should be continued. In order to understand the implications and impact of this scientific tradition perhaps first it is necesary to consider the history of the laboratory during its 40+ years and to focus in its creator, Dr. Humberto Maturana.

In early 1960 Humberto Maturana returned to Chile from Boston where he had been working at MIT in association with Dr. Jerome Lettvin, to accept a position at the medical school of the Universidad de Chile. Maturana, in the period 1958-1960, had been involved in (now) classical work in neurophysiology describing the visual responses of retinal ganglion cells in the frog[1]. These papers, done in close collaboration with Lettvin in the MIT laboratory headed by Warren McCulloch, one of the creators of Cybernetics, were conceptually important as they revealed that the metaphor of the visual system working as radar, or a fax machine, (a common idea in the 50s) was

not true, but rather that visual neurones acted as predetermined filters whose properties were caused by ecology/phylogeny rather than being mere implementations, in neurons, of abstract algorithms. Thus, because of the well-earned reputation of Maturana, the Universidad de Chile offered him a professorship at its prestigious School of Medicine (Facultad de Medicina) to organize a laboratory to study the anatomy and physiology of the vertebrate visual system.

There at the School of Medicine Maturana begun the creation of his laboratory called then Laboratorio de Epistemologia Experimental. Instead of using the standard preparation of cats, frogs, or monkeys Maturana decided to study the avian visual system. This choice has remainded for the last 45 years Maturana and all his students have continued this tradition. At the school of medicine, and using equipment obtaind from his US derived grants, Maturana begun to study retinal responses in the pigeon. The first research recruits were Samy Frenk, who stayed associated with the lab until 1973, and Gabriela Uribe (1964-1969). In1963, the Universidad de Chile decided to create a special Facultad (i.e. a School) devoted to scientific research. In effect up to the latter 50's most Chilean scientists were "amateurs" as they had to live a double (or sometimes triple life). During most of their days they taught at the University to students in Liberal Art careers (Engineering, Medicine, Economics) and only after 5PM were they able to do scientific research. Sometimes they taught at the University then worked at their professional offices, and after 6 PM they were able to think about science[2]. Thus in the late 50's, the University created the first backbone of real scientific research: El Instituto de Ciencias. The idea was to collect in the same place all the people involved in research in the basic areas of Mathematics, Biology, Physics and Chemistry. Also these people were to be "scientists" in the current meaning of the word: a full time job devoted to research and some University level teaching. This Instituto de Ciencias, had its first director Carlos Martinoya around 1959 and installed itself in the School of Engineering.

Creation of the Facultad de Ciencias at the Universidad de Chile As the experience of the Instituto de Ciencias grew more and more positive in 1963 the Universidad de Chile decided to transform that Instituto into a full fledgedFacultad. This is not a mere administrative point as the Universidad de Chile, for historical reasons, is in fact a federation of very independent Facultades who fight hard to get control of a common budget that is always too small. Thus an Instituto has no real finacial (or administrative) independence. Thus in 1963 the administrative steps began in order to transform the Instituto de Ciencias into aFacultad de Ciencias with four departments (Biology, Physics, Mathematics and Chemistry). As at that time the Universidad de Chile was still organized around the medieval concept of "Chairs" (instead of the more modern concept of Departments) the initial designation of the CHAIRS of the new facultad was a difficult undertaking where Maturana played a fundamental role. Because of his international prestige (at that time Maturana must have been the most cited scientist of the Universidad de Chile[3]) he was chosen as part of the "petit committee" of professors who would designate the other Chairs. The process was not easy, but by 1965 the administrative backbone of the new Facultad was in place and it was inaugurated, without a physical site!, in March 1965. During the period 1960-1970 Maturana's lab continued in the School of Medicine, and it survived the 7.6 magnitude earthquake of march 1965. Also during the 1964-1969 period Maturana went many times to an important laboratory in the US which was, at least, 20 years ahead of its time: The BCL (Biological ComputingLaboratory)[4] at Champaign-Urbana

(Illinois) under the direction of an icon of Cybernetics: Heintz von Foerster. These visits to BCL, where people like Ross Ashby and Gordon Pask were working full time, seemed to have been very important in shaping the future research of Maturana. The interactions between Maturana and BCL people seemed to have been mutually beneficial. In fact around 1965 Maturana performed a series of experiments in human color vision[5]. In these experiments Maturana reached the conclusion that the nervous system does not operate as a detector of wavelengths to define color, but that any given "color" is a certain relationship of internal neural activities. Thus in 1968, during a sabbatical year at BCL, Maturana put forward the idea that is a the basis of his subsequenet research: that the nervous system can not distinguish illusion from perception (BCL internal report number 9[6]).

The creation of the Facultad de Ciencias had many consequences, one of them was to convince a young medical student to switch paths and to abandon the financial safety net associated to Medicine for the more variable but vastly more interesting field of biological research. Thus in 1965 a young student approached Maturana, and asked to be accepted in his lab: his name Francisco Varela[7]. In 1968 Varela went to Harvard, where he did his Ph.D. thesis in record time, he returned to Chile in 1970. The collaboration between Maturana and Varela in 1970-1973 and 1980-1985 would prove to be very fruitfull.

Finally, in 1967, the freshly created Facultad de Ciencias did get a site to operate: a large plot of land in Ñuñoa was bought by the Universidad the Chile. Its primary purpose was to house a small cyclotron donated by the University of California. A real building (with bricks and concrete!) was constructed to house the small research accelerator and some wooden structures were hastily built in order to accomodate the 40+ professors of the new Facultad. The Physics and Mathematics departments were given the most elaborate (wooden) structures but biologists and chemists were crammed into prefabricated modules that ressembled cows stables thus their affectionate nicknames: "lecherias"[8]. In theory these modules were only to last 2 years as the University had planned to build real buildings soon after 1970 on the campus[9]. So, in 1970, after returning from BCL Maturana begun moving his lab from Medical School to the "Lecherias" site located in Ñuñoa, but the increased effervescence of the Chilean University system[10] dragged the final move to 1971.

Work at Las Palmeras Campus 1970-1973

During the period 1967-1973 Maturana's lab was centered on cybernetic theory rather than neurophysiology or neuroanatomy. In this period, Maturana and Varela working together on the ideas presented by Maturana in the BCL Number 9 technical report (1970), wrote an inmensely influential book: De Maquinas y Seres Vivos (1973)[11], especially when it was translated to English in 1980[12]. In this book they presented the idea of Autopoietic Systems. They also published a paper introducing the notion of a computer program mimiking the behavior of an autopoietic system. This program would serve, two decades later, to start the field of computational autopoiesis[13].

During this period, which corresponds to the period when Salvador Allende was president before being overthrown by a coup d'etat led by Augusto Pinochet (September 11, 1973), the laboratory was visited, among others, by Heinz vonFoerster (June-August 1973) and Stafford Beer (1971-1973) a

renowned Cyberneticist from England. During this period the small laboratory space inside one of the “Lecherias” was an epicenter of systems thinking. In fact one of Allende’s ministers (Fernando Flores), by exploting his talks with Stanffor Beer and Maturana, did try to build a centralized control system (using Telex technology and computer mainframes!!) of the Chilean economy. At this time the laboratory was an unique place in fostering theoretical thinking about cognition and living systems.

In 1971 Maturana and Varela were put in charge of teaching the first elementary biology course (called Biologia Celular) to the freshmans that entered theFacultad de Ciencias to study biology. At that time the number of students was very small, between 15 and 20 each year, and the course instead of following the typical Bio-101 backbone (i.e an immense collection of chapters surveying, without any critical thinking the expanse of biology) wasbased on a different principle. Instead of teaching “all of biology” in one semester they focussed on the general principles of metabolism underlying the fact that metabolism is a curious entity as it is “closed” (i.e. it produces itself). The course was rich in structural details and in intelectual discussions. All the students who took that course remember it with clarity and appreciation.

But after 9/11 (1973) the world changed abruptly. Varela had to exit Chile in a hurry and Maturana had to spend time, among other things, visiting his friendFernando Flores in jail (ministers and important people of the Allende goverment were sent to prison by the new junta). Of course the string of very illustrious visitors stopped inmediately as no one wished to visit the Chile of Pinochet. Also some collaborators of the lab (Carlos Martinoya, Susana Bloch, Ricardo Uribe[14], ...) went into voluntary exile into the US (Ricardo Uribe, Frenk), Europe (Martinoya, Bloch) or Venezuela (Gabriela Uribe).

A difficult period 1974-1979

The years of the dictatorship were hard on the University of Chile. The office of University President (rector) became of the destination for generals of the Chilean Army ... thus it was announced with the others destinations for Chilean generals.. without a doubt a unique characteristic for a fairly prestigious university. The Facultad de Ciencias was especially hitted as many of its professors had the label of “lefty”[15] or had gone away. In this period, when it could have been more than possible for Maturana to emmigrate to a prestigious US or European University ... he decided to stay in Chile[16]. This single fact is instrumental in understanding the path the lab was going to follow in the period of 1974-2006. Had Maturana chosen self-exile his lab would have been destroyed at that time.

Beginning in 1974, Maturana and Osvaldo Alvarez taught the Biologia Celular course and again it was an unique experience. Thus for all of the students entering the Facultad de Ciencias to study biology in those years (1974-1981) their first biology class was impossible to forget because of the magnetic personality of HMR, and the surgical precision of Alvarez, and the intellectual discussions concerning the notion of Autopoiesis. For all these future biologists to be exposed to the theoretcial ideas of Autopoiesis from their very first day at the university, by Maturana himself was an

enormous gift. This direct interaction of students with Maturana did have lasting consequences as a susbtantial group of students begun to have, from very early in their career an interest in understanding living systems as totalities and not as unrelated collections of facts and properties. It is important to emphazise that nothing similar could have existed in the US (or Europe?) since the normal biology curricula, in US Universities, is intrinsically reductionist and centered in facts not relations. This group of students little by little formed a critical mass that desired to work in the lab of Humberto Maturana. But that lab, in the period 1974-1979 was still in small quarters in the original lecherias. Neverthelesse in that lab, and under difficult financial conditions Maturana continued to do experimenst in neurophysiology (with Gloria Guillof and Monica Quiroz and with students Nicolas Piwonka, Gonzalo Marin and Alfredo Kirkwood) and in Synthesis of artificial metabolisms (Gloria Guillof with her Molecular Protobio project[17]). Maturana also continued theoretical work with Anita Lizana, a Licenciatura student, by coding a second generation digital protobio but now in an IBM 3700. Also, starting in 1977, Maturana begun to teach directly a course called Biologia del Conocimiento (Biology of Cognition) to students in the last years of theLicenciatura degree. Little by little this course transformed itself in a very popular one and was the backbone of the book The Tree of Knowledge.

A new change of location and the return of Varela 1980-1985

In 1980 the Universidad de Chile decided to re-hire Varela[18] and offered him a position in the Biology department of the Facultad de Ciencias. Because the positive synergistic interaction between Maturana and Varela, was known the Dean of the Facultad (Francisco Santamaria[19]) offered them a new, much bigger space … but again in a prefabricated “transient” Lecheria. So, at the begining of 1980 Maturana moved his lab (essentially himself and Gloria Guillof) to the new quarters, the southernmost Lecheria on the las Palmeras campus) which were almost triple the space of its old lab and Varela arrived with new interesting gadgets …. essentially a new 8 bit computer based on the Z80 CPU (a North Star machime) with 56K of (very) expensive RAM. The change in location, the extra space, the new viewpoints brought by Varela (like the use of mathematics in Neuroscience) and new institutional support made the lab very attractive for Licenciatura students looking for thesis projects. In less than one year the laboratory a lot of student begun to do their Licenciatura theses under the aegis of Maturana and Varela in a variety of topics related to neurobiology.

An incomplete list of these students should include: Nicolas Piwonka (recording in avian GLv), Gonzalo Marin (recording in avian retina), Juan-Carlos Letelier(recording in avian Tectum), Vivian Budnik (color vision in pigeons), JorgeMpodzis (anatomy of the avian retina), John Ewer (human psychophysics), JorgeGollowasch (cortical physiology related to learning in cats), Alfredo Kirkwoodand Francisco Aboitiz (physiological role of the extracellular matrix in muscle fibers a tesis inspired and co-directed with Sammy Frenk), Ximena Rojas(development of the avian visual system), Michel Gho and Luis Montecinos(Synchronization of the alfa wave in EEG), Frank Samson (Human auditory physiology), Pedro Maldonado (Avian psychophysics), Patricio Huerta(interaction between visual nuclei). Also Gloria Gullof was finishing her Ph.D. thesis on the ultrastructure of the avian visual system. This generation of students had

extremely rewarding academic careers as they were able to acheive and fill important positions. Also, because of small grant from the OEA new equiement (oscilloscopes, amplifiers) were bought for the fisrt time since the mid sixties. But still a large portion of the equipment was built and developed in-house by the students and HMR and Varela during that period. The great ingenuity and self-reliance that this situation developed in the students served them well when they began their Ph.D. programs.

Also, as part of the deal to obtain the OAS money, HMR and Varela organized something that was unique: a course to introduce the basic fact of the Biology of Cognition to people not related with sciences. Thus during 1981 they dictated a course in the MIDEPLAN ministry directed towards managers, engineers and even foreign diplomats!. Initally this course was seen as very odd, and perhaps "crazy" activity[20]. This course could explain why the notions of Autopoiesis and Biology of Cognitions became to be appreciaeed by a wider audience in Chile and elsewhere. Also the laboratory was a center of theoretical thinking especially about evolution [21] or the cooperative action of neuronal assemblies. In fact, it was during this period (1982-1983), that Varela began his involvement with the mathematical analysis of neuronal populations.

Also beginning in 1980 Maturana and Varela, began to write a popular version of AUTOPOIESIS AND COGNITION. This new book, was called The Tree ofKnowldge (El Arbol del Conocimiento), was translated in most than 20 languages and it can be considered a popularized version of Autopoiesis and Cognition. Many of the people who had become interested in Autopoiesis had their first encounter with the theory through this book.

During the period 1980-1985 the work in the Laboratory had many aspects. Firstly the two professors in charge were directing a lot (a lot!) of diverse projects and writing a very influential books and trying to get money and resources to get more modern equipment[22]. They even managed to organize an international symposium in Vertebrate Vision (Nov 1982) attended by Jack Pettigrew, Wolf Singer, Vicente Montero, Gerhardt Roth and others. This was a great coup as, at that time, it was difficult to convince people to come to Chile. Next to them a group of students trying to finish their basic "licenciatura" degree (with theses that in other part of the world would have gotten them a Master's degree directly) or a Doctorate (the case of Gloria Guillof), plus an endless stream of visitors who came because of their love of biology and their desire to understand an unusual theory of the brain. These visitors ranged from Raul Berrios, who went in 1982 to do graduate studies on population biology in the US, to Rolf Bencke who was interested in the political applications of the notions derived from the Biology of Cognition, or Maria Eugenia Moneta (interested in the study of brain plasticity), Carmen Cordero (interested in emotions) and many others.

The unavoidable diaspora.

But the intense ambiance of 1980-1984 could not be maintained forever. First many students, after finishing their basic degree wanted to go to the US or Europe to do a Ph.D[23]. Also the political climate of produced by the dictatoship was more than upsetting for many people inside the

Universidad de Chile. Furthermore, in 1984 Varela decided to accept an offer and spend one year as a Humbold fellow in the lab of Wolf Singer in Hamburg. He did not return to Chile since, in 1985, he accepted on offer to became of member of the CNRS in France. Thus begining in 1983 most students left the lab and many did not return to Chile and stayed in the US or Europe: Letelier, Marin and Rojas (to CCNY, there they worked in the laboratory of Josh Wallman also studying the avian visual system),Ewer, Gollowasch, Kirkwood, Huerta (Brandeis University), Gho (University of Paris), Aboitiz (Harvard and then UCLA), Samson (Kansas University),Montesinos (became an electrical engineeer and a CEO of an Avionic company (!!), Gloria Guillof went to Utah to work with Helga Kolb, Maldonado (University of Pennsylvania). Off all these students the following have returned to Chile: Aboitiz (1990, to the UdeChile), Letelier and Marin (to the laboratory), Rojas and Maldonado (to UdeChile, medical school), Ewer (2006 to U de Valparaiso).

1985-1990 a very difficult period.

After 1985 the situation became more complex on many levels than it had been in the previous 4 years. First, only one professor remained directing the laboratory (HMR), and his interests were changing in order to explore the ethical consequences of Biology of Cognition[24]. Also the new laws concerning Chilean University[25] were showing their many negative aspects (for example in the initial years the money for scientifc research was rather small), also no new students came to replace the one already left[26]. During this period the responsability of running the lab, on a daily basis, felt upon the shoulders of Jorge Mpodozis who stayed in Chile to do his Ph.D. in the laboratory with Maturana as tutor, studying the responses of avian ganglion cells. Next to him, two students finishing their master thesis (Cecilia Babul and Elisa Sentis) and the technician of the lab (Solano Enriquez). Also for a while Rafael Panteon (a master student) begun to work in the lab helping Mpodozis with its recordings. Panteon, will later go to Hunter College of New York to begin a Ph.D. program (1990). Jorge Gibbonsworked on the behavior of wales. This small group did an amazing dance in the late 80s as they manage to keep the lab open and productive in face of a complex financial and institutional situation. It must be underlined that most of the equipment present in the lab, until the later 80s, was mostly the equipment bought by Maturana during 1960-1970.... thus the equipment was, without a doubt, obsolete.

More impresive is that during this period Mpodozis and Maturana were able to find time to write two important papers[27]. One, in 1987, was about how “objects” are not independent entities, but rather are continously configured by the actions performed by living systems. The other paper is about how to use the notion of structural coupling (an essential item in the theory of Autopoietic Systems) in order to generate a new interpretation of evolution based on drift rather than selection[28]. These two articles demonstated that the lab was surviving a very complex period as well as advancing the notions of Biology of Cognition. in new directions. Also during that period Mpodozis spearheaded the collaboration with the laboratory of Harvey Karten, a leading neuro-anatomist at UCSD. This collaboration was going to be very important since, one decade later, the laboratory was going to become a center of excelency in vertebrate neuro-anatomy with ever increasing importance in the community of neuroscientists.

The 90s and beyond.

In the 90s some of the people who had left the laboratory one decade earlier began to come back. Letelier was accepted as a post-doc in 1993 and offered a definite postion in 1994 at the Facultad de Ciencias. Fortunately the partnership between Mpodozis and Letelier was a very positive one and slowly by combining their positive aspects and using each other's strenghts for compensating their negaive sides they began little by little to obtain research grants, vastly improving the hardware in the laboratory (in anatomy and physiology), and to publish more in the mainstream literature. Also they created new ways of finacing the lab by doing external projects.

Some of these projects consist in year-long courses (Seven versions have been done since 1994) to introduce the ideas of biology of cognition to people outside academia, or the participation in projects in the area of technology like participating in the design and test of a underground autonomous robot for mining (Fondef). Other projects have consisted in biomedical devices to test and train aircraft pilots or to study human posture. All of these projects, in the period 1994-2005, have transformed the lab into a small, but respected center, in bioinstrumnetation in hardware as in software. A little known fact[29] is that beside being a center of thought in theoretical biology and neuroscience the lab is also a well developed center in signal analysis and bioinstrumentation. In practice these projects have had two effects; they served to finance the lab as well they have projected the work of the lab to a wider community, beyond the normal boundary of academia[30].
During the 90s the laboratory and under the guidance of Mpodozis, Letelier and Marin, slowly begun a deep transformation. New, expensive (but really necessary) equipment was bought (like fluorescent microscopes, multi-channels systems for neural recordings, dissecting stereomicroscope, ...) and fundamental problems concerning the anatomy and physiology of the avian visual system were attacked. This effort has been very rewarding as important papers have been published in the most demanding scientific journals (like the Journal of Compartive Neurology and The Journal of Neuroscience). At the time of the fire 4 important lines of research were in full throttle in these fields. In a sense these lines of research (and the students associated whith them) are the main victims of the fire. Also, using our expertise in instrumentation we have continoulsy published in the Journal of Neuroscience Methods.

Following its own tradition the laboratory has been involved in theoretical research as well; ranging from biomathematics (like the use of wavelet analysis for spike sorting), the study of (M,R) systems[31] and its relation with Autopoiesis to a critique of the concept of species. In this respect our theoretical activities have generated a lot of attention. For example Jorge Mpodozis travels regularly to Brazil to lecture about Evolution and Autopoiesis, Letelier has been named visiting professor at the University of Tokyo to teach about Autopoiesis and for the first time papers about Autopoiesis have been accepted in the Journal of Theoretical Biology.

Finally the laboratory has also expanded its teaching activities. Since the mid 80s Mpodozis has been coordinating the mandatory course Evolution for biology students. In this course the students are exposed to topics from biogeography, geology or molecular evolution and also are exposed to recent critiques of the selectionism approach to darwinism. In fact this course, which is so popular

that students from other universities regularly take that course[32]. Beside the teaching of this mandatory course the laboratory participates in teaching various courses at a more specialized level: some of these courses are:

- Comparative Neuroanatomy
- Neuroethology,
- Mathematical Methods in Neuroscience
- Theoretical Biology
- Bio-instrumentation
- Computer Programming.

Always these courses attract a solid audience of undergraduate and graduate students. Since the late 90's this teaching has been a pleasant experience and it has never been considered a "load", but rather as an opportunity to grow, as concepts are always made clearer by explaining them to inquisitive students. Fortunately (perhaps as a reward for all the efforts invested) this activity (teaching, experimental and theoretical) has attracted a new cohort of bright students which, in a sense is repeating, but with important changes, the history of the group who studied in 1980-1985. The most important change is that students are staying in Chile, after their basic Licenciatura degree, and deciding to stay in Chile to do a Ph.D. This (crucial) change reflects the change in funding and administration of Chilean science as a whole[33].

The relevance of the Laboratory.

The scientific work done at the Laboratory in these 45+ years, has been massive, interdisciplinary and exceptionally relevant. The inner life of the Lab has had cycles which have paralleled the up and downs of recent Chilean history and the enormous changes that the University of Chile (positive and negative) has undergone in this half a century. In its whole life, especially in the last 20 years the Laboratory has followed a continous path of productivity, impact, recognition (at the national and international levels) and attracting people to work in it (Figure 1).

Figure 1: Time-line for the production of the main documents produced by the Laboratory.

At the time of the fire the Lab was a community of 25 people conducting a variety of projects in neuroanatomy, neurophysiology, comparative biology, theoretical biology, neuroscience methods and bioinstrumentation. The total scientifc output of the lab (measured by papers published in peer-reviewed journals, conferences attended, students formed, courses taught and visitors received) has been particularly strong in the last five years averaging 4 papers/year plus many presentations at conferences.

This systematic work has had an obvious impact: a Google search with the keyword Autopoiesis returns ~700.000 web documents (!!!)[34], and in the more restrained enviroment of biomedical research the MEDLINE database fetch 40 references in the area of Biology while across all disciplines (biology, engineering, management, etc..) some 300 references can be discovered by the ISI database. Thus we predict that in the future, as the original ideas are better understood or decanted and new links discovered[35], they will become explainable to a wider audience The notion of Autopoiesis will be used more and more in research in a variety of fields. For example, somewhat unexpectedly, concepts or ideas from Autopoiesisand Biology of Cognition have become very popular in fields like Management and Operational Research[36](Figure 2).
Without any doubt the notion of Autopoiesis has been the scientific idea created in Chile that has had wider impact. This impact has been multifaceted, with work done in the areas of social and managment sciences, but significant effort also exists in areas of electrical engineering and biology.

Figure 2: The relation among Biology of Cognition- Autopoiesis and diverse fields.

The lab has also been a place of support and refuge for many students[37] and scientists. For example in 1993 when Carlos Martinoya decided to return to Chile from France where he went into self-imposed exile after 1973, he found in the Laboratory a place to stay and work. There he designed a kit for teaching the workings of the eye to high school students. Raul Berrios, aftter returning to Chile in the early 90s. also found a place in the lab. Lately the laboratory was going to share laboratory space with Alexander Vargas, a Pew fellow interested in the intersecting domains of Evolution and Developmental biology. But principally the laboratory was an accepting space for a large group of students interested in conceptual approaches to biology. This (initially) informal group met for many years in the seminar room of the Laboratory on Friday evenings to discuss biological ideas. Perhaps the spontaneous self-organization of this group, about 20 students who systematically (and magically) materialized themselves every Friday evening to discuss and think about Biology (with a capital "B"), is one of the most unique contributions of the Laboratory.

The lab just before the fire

Just before the fire the lab was a frenzy of activity. Mpodozis was preparing a trip to Brazil (to present a talk at the Brazilian Biological Society), Letelier a trip to Australia (to present a talk at the ASIA-PACIFIC Brain and Mind conference) and Marin was preparing his talk for a special meeting on Attentional Mechanisms at the annual Neuroscience meeting to be held in Atlanta. Active collaborations were in place with UCSD (neuroanatomy, Dr. Harvey Karten), CNRS (theoretical biology, Drs Athel Cornish-Bowden and Marilu Cardenas), Tokyo University (Informatics, Dr. Hirosho Yasuda) and Keio University (Neurophysiology, Dr. Shigeru Watanabe). Many manuscripts in the fields of Neuroanatomy, Neurophysiology and theoretical biology were in their final stages. Preparations were underway to receive Dr. Vargas and his new line of experiments in Evo-Devo. The Italian University of Bergamo wanted to sign a cooperation agreement and new experiments were planned with a university in Boston. The teaching front was also very active: one undergraduate course (Evolutioncoordinated by Mpodozis) and three graduate courses were given by people from the Lab. In addition 4Ph.D. thesis and 6 masters thesis were underway. All this activity was done in the very "transient", but very cozy, wooden structure of the Lecheria which contained, after 46 years of accumulation[38], a lot of hardware, and some of it very unique and expensive. Thus the fire destroyed about US$400,000 in equipment and the same amount in infrastructure.

Conclusion

In the last few years the "old" laboratory created 46 years ago by Maturana, initially at the Medical School at the Universidad de Chile and then at theLecherias of the Macul campus, has transformed itself for the better without losing the positive traits imposed many years ago by its original creator[39]. The Lab, now managed by a new generation of scientists who are

expanding the ideas of Maturana and Varela, has continued to attract students and scientists interested in studying a non-reductionist approach to biology. We are sure that these approaches are essential to furthering the study of Biology.