

banquete

nodes and networks

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banquete_nodes and networks is a work in progress designed to explore and stimulate interactions across art, science, technology and society. Conceived and developed by Karin Ohlenschläger and Luis Rico, the project enjoin us to explore the borderlands of Spain's emerging digital art in a dialogue with science and society that will, in its turn, open up avenues of cultural and technological transfer to and from Spain.

banquete_nodes and networks considers the network as an organising pattern that traverses all domains of our reality. From neuronal tissue to the dynamics of contemporary social flux, from the interplay of bacteria to digital information highways: these are but different strata in a single *network society*, a realm of constant technological, scientific, social and cultural change that touches on us all. From the perspective of this new form of shared patterning, the project opens up a forum for dialogue and reflection on the global society.

The ceaseless technological convergence in which we are all engaged requires that institutions devoted to culture and the arts join forces to produce fresh ideas. The search for innovative strategies and lines of approach urges us to scrutinize and process the interconnected complexity of contemporary societies. We need to cut new, cross-disciplinary paths that lead to a synergy of art, science, technology and society, and so lend shape to new forms of work, creativity and research, training and communication.

The institutions behind *banquete_nodes and networks* — SEACEX (State Corporation for Spanish Cultural Action Abroad), LABoral Centro de Arte y Creación Cultural, ZKM | Center for Art and Media Karlsruhe, and the Fundación Telefónica — seek to build networks and practices of cultural production and communication that articulate the output of the arts, technology and science in one and the same process of creation, thus fostering a vigorous culture of research, development and innovation.

It is a great satisfaction for all of us to unveil this project, which brings together and inter-relates the work of thirty artists and creative teams and of a similarly broad range of scientists, technologists, philosophers, thinkers and producers of knowledge, so as to embrace a wide diversity of creative practices. Their work invites us to make an intriguing journey across the landscape of Spain's digital culture today

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Mercedes Álvarez, Regional Minister of Culture and Tourism of the Principality of Asturias

Peter Weibel, ZKM Chairman and CEO

Charo Otegui, President of State Corporation for Spanish Cultural Action Abroad, SEACEX





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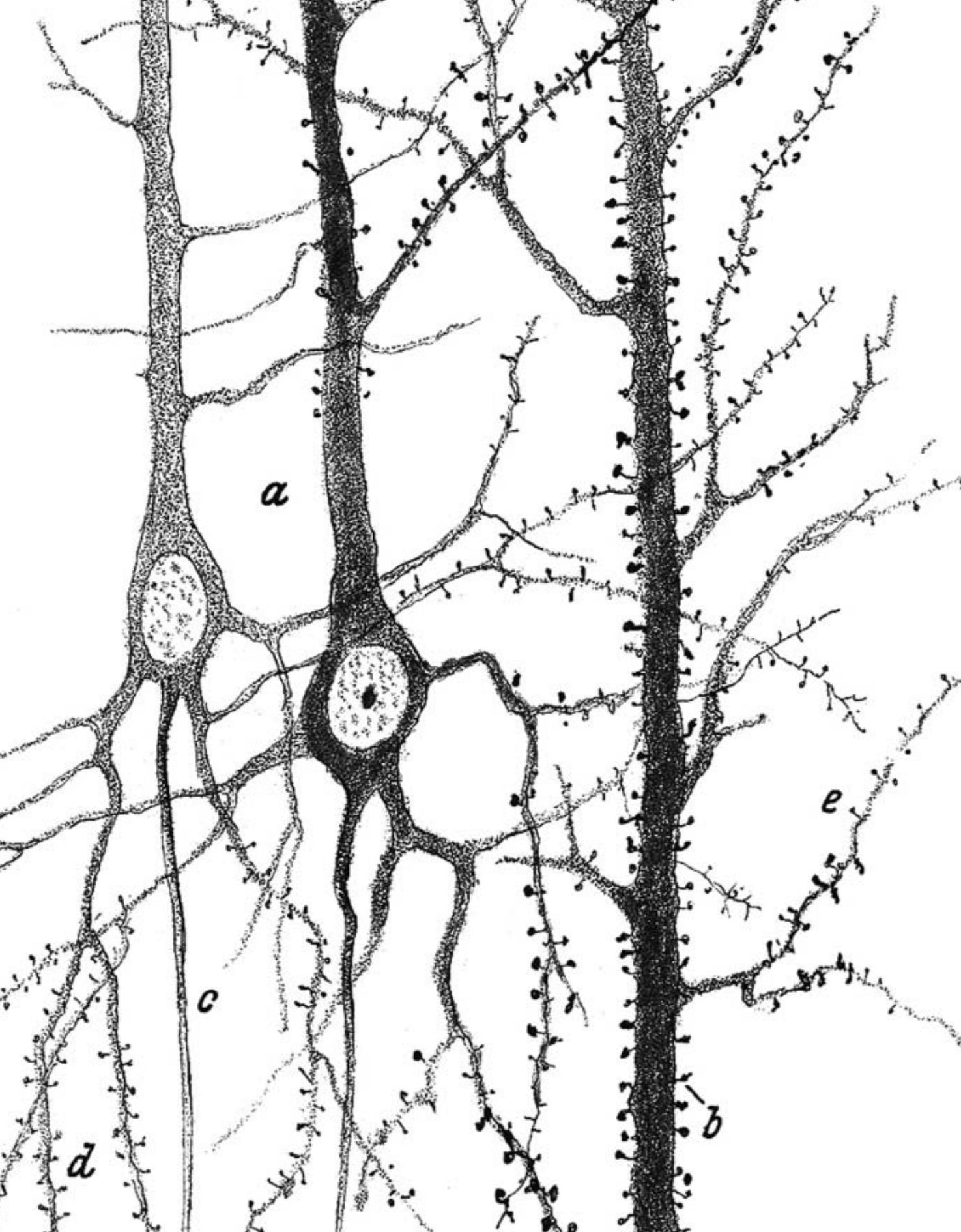
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From the neuron to network society

Karin Ohlenschläger, Luis Rico

The present publication is the third part a trilogy by the *banquete_* project, which explores relations between biological, social, technological and cultural processes. As in the two earlier editions, it brings together outstanding artists, architects, biologists, engineers, philosophers, economist, neuroscientists and sociologist to reflect on the dynamics, patterns and processes present in tangible and intangible flows of matter, energy and information. Our goal is to foster interaction among the sciences and humanities, and to question a reigning model of anthropocentric, linear and dichotomous thought whose political, social, economic, cultural and ecological consequences call for an urgent change of sensibility, outlook and behavior. From this perspective, we propose an overview of the connections between art, science and other forms of knowledge production occurring recently in Spain. We invite you to visit the previously uncharted border regions defined by the interactions that constitute them. *banquete_* arose from a network of conversations between creators and researchers in various fields and disciplines who, since the 1990s, have been tracking the art-life binomial in light of techno-scientific advances and in relation to emerging languages linked to contemporary creation. In 2003, the first edition of *banquete_* delved into the correspondence between life forms and forms of communication, exploring analogies between metabolism and communication as processes of transformation in matter, energy or information. In 2005, the second edition emphasized the evolutionary character of both processes, and the third and most recent edition has further studied the underlying reticular structures.

Barely a century separates Santiago Ramón y Cajal's discovery of the open, evolutionary character of the structure and functioning of neuronal networks, and Manuel Castells' theory of "network society" but in that time, society has undergone one of its greatest accelerations in all orders. Our dizzying techno-scientific, social and cultural transformation has configured a new paradigm based on both the complexity of multiple realities in which we operate simultaneously, and the connections between processes and events previously considered autonomous, incompatible or simply incomprehensible.

This new scenario implies the structure of a network of networks, conceived as our most finished instrument for interpreting and understanding the diversity and complexity of contemporary experience. At the end of the 19th century the brain was able to observe itself, contemplating for the very first time its neurons and nervous system in an unprecedented exercise of reflexivity. And now, on the threshold of the 21st century, when global society is facing the need to rethink and reconstruct itself on the basis of a new paradigm, the absorbing reality of the web influences our ways of thinking and behaving. In fact, we are no longer the same since we realized that we are interconnected in all orders of human activity. Any pretense of autarchy in the areas of knowledge or creation, and any closed cultural identity grow progressively more obsolete in this new space of transit and fluidity whose very permeability constitutes a new way of

understanding and constructing reality. Through networks, identities are increasingly more open, creation is more than ever a form of communication and all of this suggests new readings of the human condition.

Just as neurons operate as nodes of the nervous system, so global society interacts in an analogous way. Sleepless and hyper-connected, the web never stops vibrating and calling to us. Its answers always constitute online thinking — a text that is written as it is being projected on all of us, a story that grows and ramifies infinitely like Borges' gardens and libraries. No one knows the shape or limits of this living labyrinth, but from individuals to states, we all know that we are acting inside it as generators of energy and information flows and, in the best cases, as producers and transmitters of knowledge. In an unprecedented Copernican twist, we have shifted from the "human for himself" proposed by Sartre to the "human node" as defined by network theorists. And thus, just as a flow of information runs through our cells, so our social and cultural connections are part of a universal narrative of which we are an active part at all times. There is no longer a place for isolated stories in this agora where art, philosophy, literature and science are in constant dialog, not only with themselves and by themselves, but also among each other and for everyone. Being a citizen today implies being part of a highly dynamic and changing system incessantly crossed by immense flows of energy, matter and information. Exploring our world has become an adventure again, for the profile of a neuronal texture as drawn by Cajal has grown into the paradigm of Internet.

banquete_ nodes and networks is born of the theoretical and practical demand to investigate the new conditions of "network society" and the space of flows that define the 21st century globalized world. In this context, the model of cultural production in force until now — based on a hegemonic center and unquestionable axes — gives way to a new structure of multiple nodes and changing, evolving networks. This structure is characterized by a constant flow of information as well as connection and dialog in a network where every point is a node, an outlook, a story. In short, we are talking about a new, multi-centered and dynamic system of cultural production and diffusion in which ideas and concepts, like subjects, entities and institutions, are all agents and catalysts of an emerging process of social and cultural transformation.

The present publication is structured in four parts whose contents make up the nodes of a network not necessarily tied to a linear reading. These four threads emphasize the systemic and trans-disciplinary character of the proposal by taking advantage of one of the network's key characteristics: the fact that it is a pattern that works regardless of scale. Thus, the first part, called "Infonobiosocio" shows how the network pattern connects and runs through different space-time scales and contexts, as is set out in the essay, "Trapped in the network: nanoworld, life, society," written conjointly by researchers Carlos Briones, Susanna Manrubia and José Ángel Martín Gago. Their reflections run from nanometric scales of life right up to social and cultural dimensions. Antonio Acín, Maciej Lewenstein and Juan Ignacio Cirac then contribute a description of the innovative field of "quantum communications," where they are researching the processes of "percolation" and "entanglement." Then, Alfonso Valencia offers a "Research Proposal on co-evolution." The first chapter is related to the projects of Álvaro Castro, Pablo Armesto, Raquel Paricio and José Manuel Moreno, José Ramón Berenguer and Laboratorio de Luz. It continues with the dialogue "Networks, the vital principle" co-written by Ángela Delgado and Diego Rasskin-Gutman

and Javier DeFelipe's essay, "Cajal and Neuronal Circuits," which leads us through the works of Águeda Simó, Ricardo Iglesias, Daniel Canogar, Marina Núñez, Evru and Marcel·li Antúnez.

The second part, "Infosociocogno," draws relations among the informational, cognitive, social and cultural dimensions that define the emerging paradigm of network society. It begins with the essays, "Networks and owners of knowledge" by Ernesto García Camarero and "A walk through the realm of art and science today" by Capi Corrales. Pau Alsina takes on the question of "Culture in networks, network culture: emerging dynamics and economic policy" Pedro Marijuán refers to "The role of information networks in the evolution of social complexity" and Fernando Sáez Vacas deals with "Infotechnology: new social forms, noometamorphosis and noomorphosis." This is followed by a selection of works by the artists Marta Gonzalo and Publio Prieto, Dora García, Concha Jerez and José Iges, Aetherbits, Francisco Ruiz de Infante and Eugenio Ampudia. The second part concludes with a selection of contents from the blog "Networks: forms of symbolic and social construction," which was carried out over the course of four months by Santiago Eraso, Jorge Luis Marzo, Arturo Rodríguez and Natxo Rodríguez; as well as the essays "The critical dimension of artistic practices in the web 2.0 system" by Juan Martín Prada, "The web generation: the power of 'us'" by Inma Tubella, an extract from José Luis Brea's text, *On the Internet (a few loose thoughts)*, and "Networks of users and free knowledge" by Javier Echeverría. The artists and collectives related with the close of this second part are Platoniq, Neokinok TV, Pedro Ortuño, Antoni Abad, Daniel García Andújar and Joan Landre.

The third part, "Infosociourban," delves into the urban dimension as a context that catalyzes interactions among social, informational and cultural processes. It brings together and relates Vicente Guallart's *Sociópolis* project and Salvador Rueda's text, "Networks of urban sustainability: towards a model of a knowledge city" with José Antonio Millán's project, "TOTAL QUIDATION (METAGRAPHS: Words, men and time)" and texts and works by Hackitectura, Clara Boj and Diego Díaz, Escoitar and Influenza.

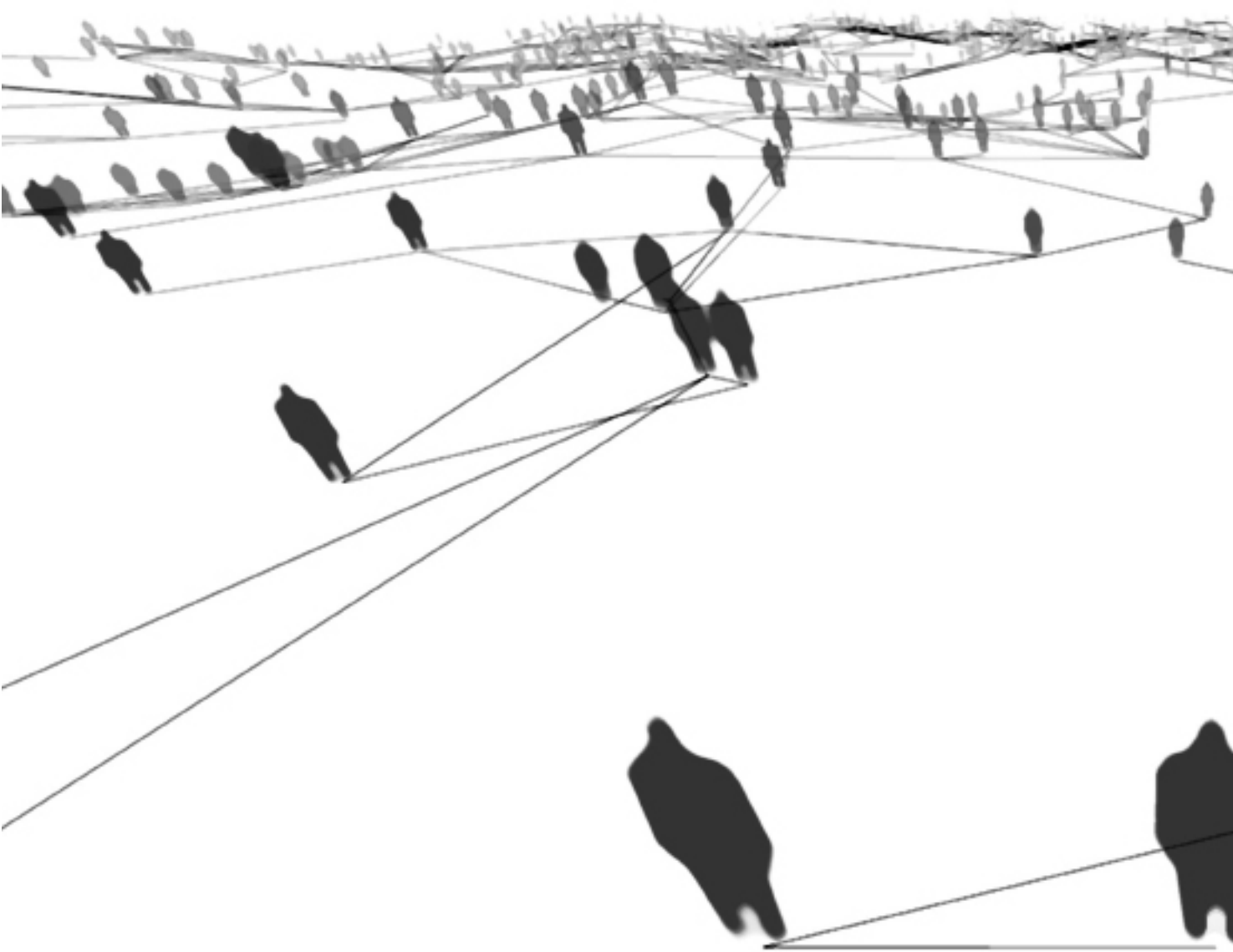
The fourth part, "Infosocioeco", looks at the networks of ecosystems and planetary scales with which global change confronts us, as well as their socio-cultural, economic and ecological implications. José Manuel Naredo and Óscar Carpintero take on the question of "Financial markets and the creation of money in the cybersphere." Ramon Folch studies the relations between "science, networks and art: visual arts and ecology." José Manuel Montoya, Ricard Solé and Miguel Á. Rodríguez delve into "The architecture of nature: complexity and fragility in ecological networks." The section continues with a reflection by José María Baldasano on "Climate change. Sustainability in networks." Ricard Solé and Andreea Munteanu study "The large-scale organization of chemical reaction networks in astrophysics." The artists whose works explore similar concepts and contexts are Alfredo Colunga, Kònic Thtr, Daniel Canogar and Joan Fontcuberta.

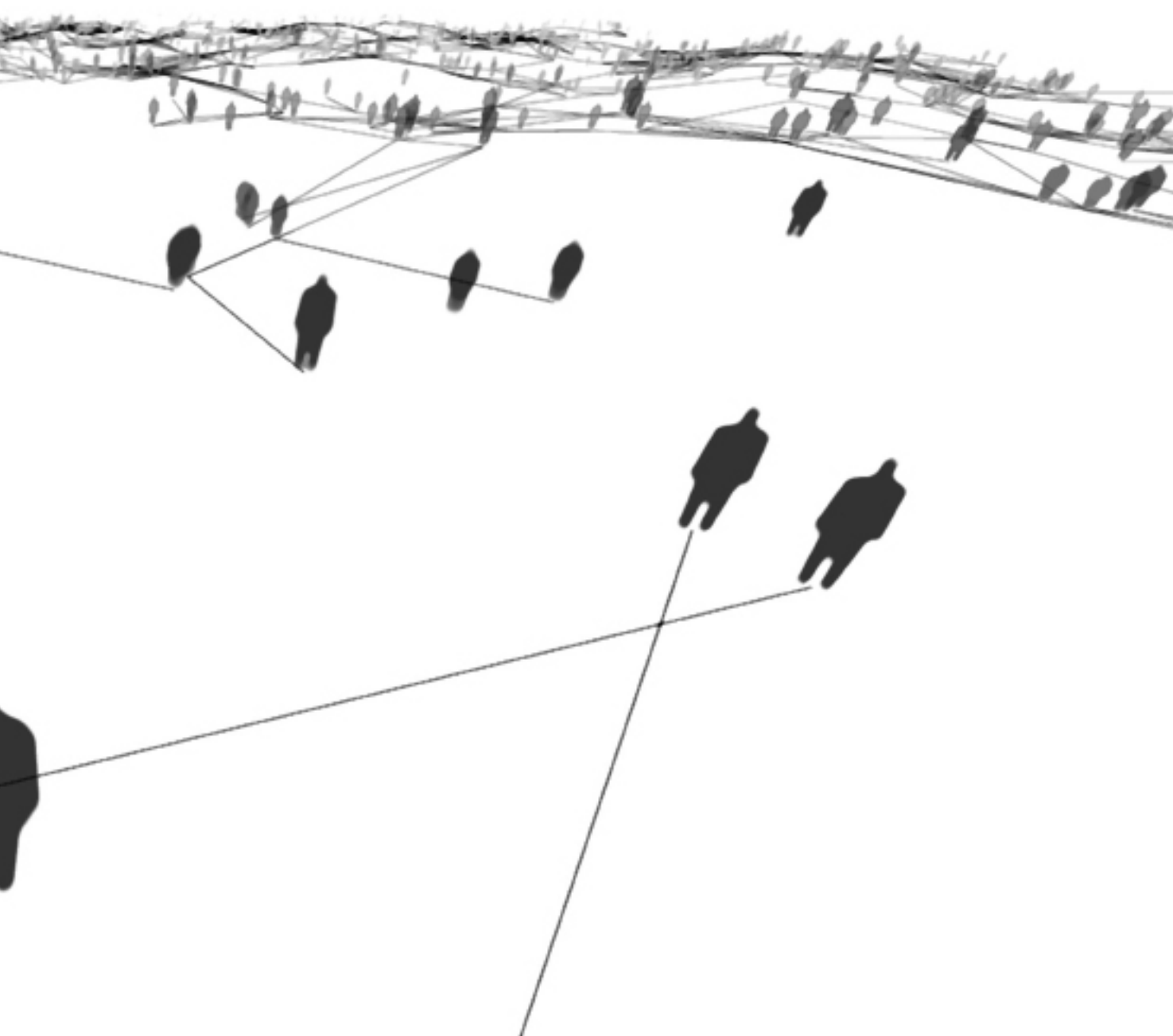
The book concludes with an interview titled "Internet. A new *imago mundi*?" led by Álvaro Bermejo with answers from Juan Aranzadi, Agustín Fernández Mallo, Ramon Guardans, Vicente Verdú and Remedios Zafra,

Technological convergence favors the trans-disciplinary investigation of interactions among living and artificial systems for designing new devices that allow us to expand or improve cognitive and communicative capacities. The incorporation of the humanities and social sciences, and especially the current and most innovative artistic practices — their borders are more and more

blurry because of their capacity to hybridize with other fields and disciplines — can play an important role in dynamizing these interactions and transversal creative processes. At the same time, emerging artistic practices can contribute a symbolic, communicative and socializing function, as well as critical and participative meanings and actions that are fundamental for collectively understanding and metabolizing the vertiginous processes of socio-cultural transformation in which we are inexorably involved.

In the contents of this project we find a growing correspondence among different fields and disciplines in methodology, tools, concepts, codes and languages. As it stands, in the new scenarios pertaining to the “society of information and knowledge”, the traditional linear conception of the production and transfer of knowledge based on the science-technology-industry-society axis is transformed into a complex, non-linear network of trans-disciplinary relations. This network surpasses earlier frameworks and fosters permeability and communications among fields of knowledge and production. In sum, the present publication, *banquete_nodes and networks* is an effort to dynamize interaction among the previously mentioned techno-scientific fields, humanities and social sciences in order to help articulate a global viewpoint and the corresponding cooperative action, as mentioned here by José María Baldasano. This process is capable of overlapping a variety of different elements to form a single complex tissue extending in multiple directions. The concept of “network” offers us an excellent leitmotiv for contemplating and connecting scales and contexts — a network that can constitute a new way of interpreting and constructing reality.





Banquete_nodes and networks

Karin Ohlenschläger

The Global Network

The concept of a global network that connects and unites us resonates down the ages as one of the most ancient aspirations of the human race. If we consider the Latin verb *religare*, meaning to bind or to unite, the religious connotation is clearly evident. In the industrial era, it is no longer the gods but their earthly representatives who are instrumental in fashioning a world closely linked by transport and communications networks, and through scientific and technological progress.

In earlier times, these networks were created by opening up routes to travel by land or to sail along rivers and across the seas. By the nineteenth century, thousands of kilometres of cables crossed the Atlantic, railway lines scored the landscape, and road networks joined up towns and cities. Today we continue to use these networks, but we have added satellite links, fibre optics and all kinds of wireless connections that pass invisibly through the air in every direction.

However, even in this era of information and telecommunication technologies, we are still living with the paradox of an interconnected, virtual world with no apparent boundaries and a physical world in which barriers of concrete and barbed wire are being raised, along with other means of confinement and digital control by satellite. We refer to the thousands of miles of borders between North and South America, between southern Europe and North Africa, and between Israelis and Arabs, among others. Thus, at the same time as we champion free access and flows of information, goods and finance, we are strengthening mechanisms of control, censorship and exclusion. Not for nothing do the statistics show that, in this era of real time connections, 20% of the world population control, consume and squander 85% of our planetary resources. And this asymmetry has not diminished: it is actually increasing. Among the conclusions of the World Summit on the Information Society¹ comes a warning of the growing divide between the info-rich and the info-poor. Only 20.89% of the world population has access to the Internet, whilst the majority disappear through the holes in that network.

It is clear that, behind the idea of union or unity, the familiar cravings for power, expansion and appropriation of the Other still exist: the age-old struggle for control and domination continues by means of increasingly sophisticated methods and techniques.

If we analyse the concept of “unity” and its implications beyond the obvious appeal of its positive meaning, we shall see that it rests on a conceptual or material core of absolute, centripetal power. In any system of coexistence, unity involves correspondence and conformity. It means that things are incorporated and integrated to form a body that cannot be disunited without the alteration or destruction of its essence. Unity is therefore closed: its internal structure tends to be stable, self-referencing and non-relational.

In *banquete_nodes and networks*, we begin by assuming that the world is not united, and nor should it be under totalitarian techno-economic directives of the market or the ideology of the *pensée unique* (or single thought). In the current political, economic, social and cultural crisis of the

system, the concept of unity or union sometimes reappears and is even confused — deliberately or otherwise — with the new potential of connectivity. For this reason, in this project, we decided that we would explore the many different modalities of networks of interconnected relationships, and this exhibition and book are the result.

Connectivity is, above all, plural and relational. It presupposes an aggregate of intermittently interwoven singularities in movement and, therefore, only temporarily united. Within an interconnected system, unity becomes a relative, temporary, non-absolute value. Connectivity is a quality inherent to a system with the capacity for development and growth in diversity. It not only describes a state, it is related to action over time whose duration can be very variable. This process occurs in open systems such as living systems that are, by definition, changing and unstable. Connectivity is both a conceptual and a functional tool which enables us to relate very large space-time dimensions to very small ones, helping us to understand the form and function of life. As Diego Rasskin-Gutman and Ángela D. Buscalioni explain in this publication, *“we are built, life is built, organised and selected from the rhythms of the system’s relationships [...] Life as a continuum is a process whose motion began thousands of millions of years ago and it continues to move onward. And all of it thanks to networks”*².

The idea of connectivity — understood as a basic requirement for any process of information exchange — and the concept of an open, evolutionary network were first articulated as the structural basis for neuronal communication at the end of the nineteenth century. Until then, it had been believed that neuronal networks constituted closed circuits, units of command directed from a central point by intelligence and reason. However, the neuronal theory developed by the histologist and neuroscientist, Santiago Ramón y Cajal (1852-1934) challenged the previously accepted idea of unity and permanence³. It questioned the physical continuity between neurons and went on to postulate a system consistent with separate units, interconnected only by means of synaptic clefts.

In accordance with Santiago Ramón y Cajal’s thesis, neuronal networks are conceived as open, changing systems. In relation to the intensity of the stimulus received, the connections between cells can be temporary or permanent. Neuronal circuits can grow in one direction and atrophy in another. They are able to produce new ramifications and generate other connections. Their behaviour is an expression of genetic and epigenetic activity, of the interaction of the hormonal and metabolic systems, and of flows of internal and external signals, stimuli and movements.

The connections between cells form specific circuits, each one communicating with certain cells and not with others. A neuron can transmit information to many other cells located in different areas of the brain. In turn, it also receives and processes information from them. In short, the function of the components of a nerve cell is the transmission of signals. However, within the neuronal network, what makes us think, feel or act in a particular way at any given moment are not the cells themselves but the specific connections and relationships that are established between them.⁴

There is no doubt that the ability to establish new connections and relationships between things is fundamental for the evolution of any cognitive system. If life itself is a process of cognition or, in other words, of learning and coevolution, then so are culture and art. The reticular structure of the connections is specific to each area, each experience and each field of knowledge. The nodes that make up any network are organisationally closed, just like cells, bodies, communities or cities. But, from the functional point of view, they are open in order to be able to relate to one

another, to sustain themselves by means of exchanges of material, energy and information, to grow and to change.

Networks surround us, pass through us, are part of us, entrap us and compromise us; they also allow us to connect and evolve in experience and knowledge by means of their multiple circuits. Each individual is a node and part of a network of relations that cascades over many space-time scales: from the solar system⁵ to the processes taking place within a living cell⁶. The transport and communications networks created through human activity crisscross the earth; technological devices are launched in search of links with other planets and solar systems; networks connect the human body, influence neuronal circuits, invigorate interconnected minds and modulate quantum communications between nanometric particles⁷. The boundaries between biological and technological life have now become blurred by the advent of nanotechnology and the convergence with microelectronics. This means that networks extend outwards from within ourselves to encompass the entire range of human activity, overcoming barriers of space and time⁸.

In the same way that neuronal circuits are constantly changing — as Cajal pointed out — so are the organisational networks between atoms and molecules⁹, as well as networks of relations between people, communities and cultures¹⁰. The network model, present on every scale and in every sphere of life, has all its parts arranged in an open, dynamic, self-organising, evolutionary system. Consequently, we can observe the same pattern in water molecules as in ecological networks, and even in the structure and dynamics of the *World Wide Web*.

It is worth noting that the neurosciences have not found a central storage point for information or memory. This is because there is no closed, autonomous control centre in the brain. For this reason, the concept of an evenly distributed and decentralised information system was as revelational at the start of modern neuroscience as it is today in addressing the challenges of what we call the Network Society.

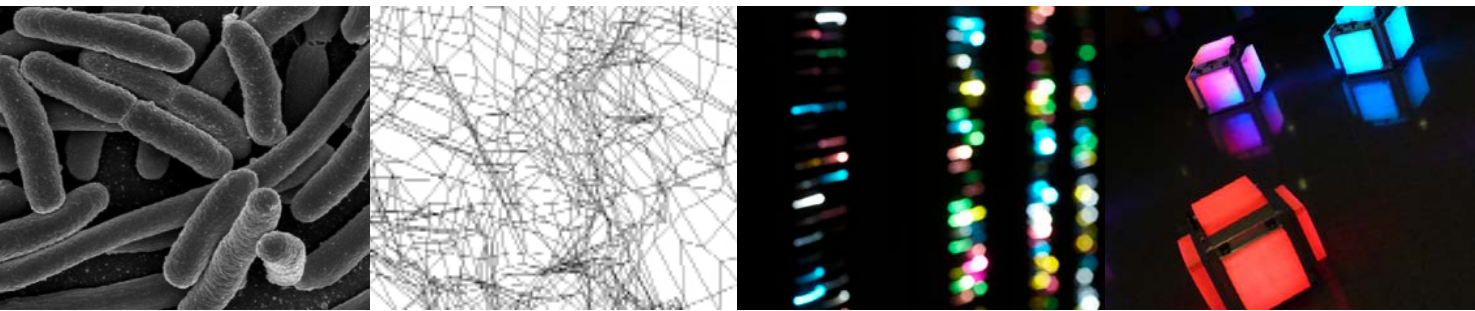
Analogous to the way that neurons operate as nodes of the nervous system, cities in the Network Society have become communicational nodes. In both cases, structures are created whose main value is the connection and communication between their elements. In both cases, the quality that defines them and keeps them operative is not, strictly speaking, their physical structure but their connective capacity to receive (inputs), transmit (outputs) and process information (outcomes). At the present rate, we are on the point of creating an interconnected, dynamic, collective mind — if we have not already done so. It would be a mind whose structure is visible in the urban configuration of the Network Society, and its function, in the constant flow of information: a mind in the form of an *exocerebral network*¹¹. Connectivity, *that personalised form of collectivity*¹², thus emerges as the historical evolution of our social organisation through electronic means, by extending our bodies and our relationships. Analogic and, later, digital devices have merely redirected the organisational form of society towards the pattern that runs through all aspects of life: the network.

Early in our current communications era, which began with radio and progressed to television, the production system was centrally organised with one-way distribution channels from the few to the many by means of broadcasting. Since the end of the twentieth century, we have been able to build one to one or peer to peer relationship networks by means of mobile telephony and the Internet on a space-time scale — and over distances and at speeds — unprecedented in the history of humanity. In his extensive investigation and analysis of the information era, Manuel Castells has concluded

that networks [...] “constitute the new social morphology of our societies, and the spread of their kind of links substantially modifies the operation and results of production processes, experience, power and culture.”¹³

Given that technological systems are produced socially and social production is linked to culture, our current digital era is increasingly defined by a renewed network of transdisciplinary interactions between the arts and the sciences, and between the technologies and their social uses.

The construction and perception of reality is no longer the preserve of centres or hubs of knowledge and hegemonic power, as Ernesto García Camarero explains in *Networks and owners of knowledge*¹⁴. As a result of the current information and telecommunications technologies, other structures and new connections and communication spaces have emerged. New relationships between experiences and knowledge nourish a large variety of emerging collective dynamics. In fact, any citizen can now participate in the production and circulation of information and contribute to the generation of knowledge today. The user of a mobile phone, a digital camera, a computer and/or Internet connection, is not only the receiver but also the producer and transmitter of signals, narratives, images and sounds. Present-day art in the sphere of digital culture lends itself to all



these new constellations of production and distribution. As the members of the Fundación Rodríguez have stated, “the commitment of artists to a free, universal culture is one of the first steps to flexibilise a whole system of complicated hierarchies that govern the art world, and in which it is essential to defend creativity by sharing it”¹⁵.

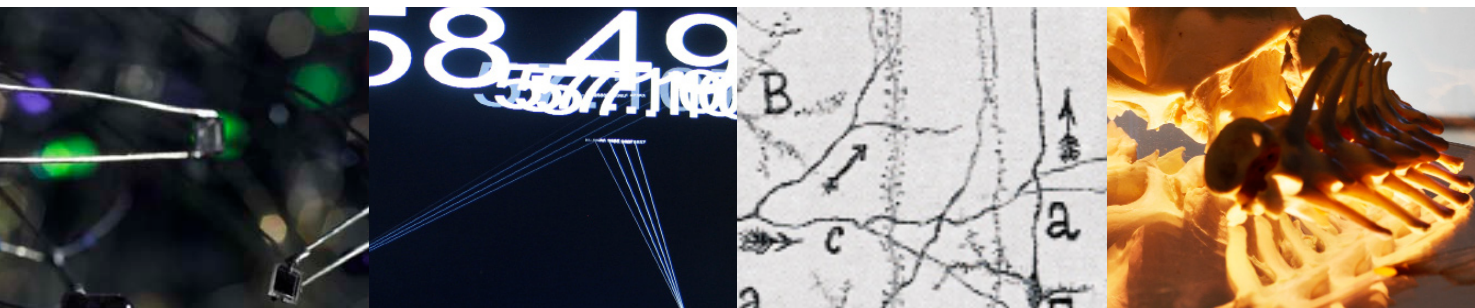
This commitment to structural change in the world of Spanish art can be traced as far back as the new artistic attitudes of the early 1970s¹⁶. Experiences that were closely linked to the political and social movements of the imminent political transition. Artistic methods that advocated the creation of new spaces for, and dynamics of, production and distribution. From that time on, an enormous variety of networks of relations began to emerge.

An example of these would include the dialogue begun in the late 1960s (1968-1973) between art, science and technology at the *Centro de Cálculo* of the University of Madrid¹⁷, while the seminars and research into different codes and languages, as well as the patterns of relations and behaviour in the spheres of visual, architectural and linguistic expression provided a plentiful source of ideas and methods that, decades later, would evolve into diverse areas of digital culture.

In the 1970s, while some experimented with the binary code, others began to explore the world of media communication, challenging the hierarchical structures of the media, and demanding their democratisation and socialisation through independent audiovisual production. *Cadaqués Canal Local* (1974) and *Distrito Uno* (1976) de Antoni Muntadas¹⁸, and the experiments in community video by the collective Video Nou/Servei de Vídeo Comunitari (1977-1983)¹⁹ led to the first networks of communication between artists, local groups and neighbourhood associations for the purpose of creating new methods of production, and environments for self-managed communication independent of the only two state television channels in existence at that time.

The 1980s were marked by the transition from analogical production to the early means of digital production. Video and the first personal computer systems allowed a new transdisciplinary dialogue between the fine, visual, sound and scenic arts. This new form of creation was exemplified by the emblematic *Espacio "P"* (1981-1997) in Madrid²⁰, one of the few independent places run by artists at that time.

Coinciding with the political and economic crisis and the drastic cuts in institutional spending in Spain in the 1990s, similar initiatives were organised by the artists themselves throughout the



country. In the various encounters of contemporary art, *Red Arte*²¹, organised between 1994 and 1997, there were some one hundred independent collectives and initiatives represented from all over the country. Their discussions and proposals dealing with the structural foundation and functional dynamics of the emerging cultural networks were aimed at advancing a new dynamic for dialogue and collaboration between an increasingly heterogeneous mix of proposals and formats.

In the same decade, artists were frequently becoming the creators of virtual communication spaces. No longer were they constructing objects but rather they were involved in new, temporary, participative structures and channels for production and distribution. Internet projects such as *The File Room* by Antoni Muntadas (1994), *Conexión Madrid* (1996) and *Peninsulares* (1996-2000) by Maite Cajaraville, and the platform *Irrational.org* which led to *Technologies to the People* (1996), to give just a few examples, were the forerunners of the idea of online social and cultural networks, as well as the creation of open, self-managed files on the web, about fifteen years before the launch of MySpace, Facebook or Wikipedia.

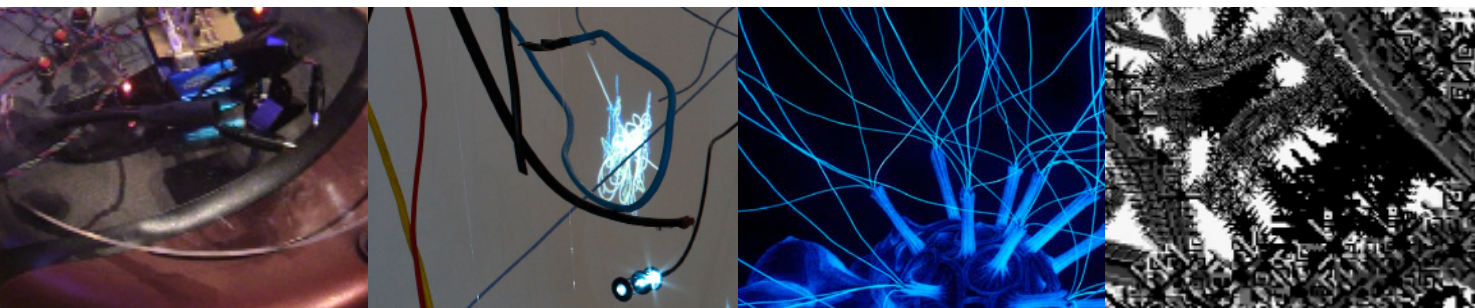
With the current information and telecommunications technologies, these pioneering initiatives have evolved towards new structures and spheres in the public domain that are expressed as

much *on* screens as *between* screens. In fact, in this decade, a vast number of new nodes and networks have been set up between artists, activists and citizens; or between architects, biologists, engineers and programmers, weaving temporary networks of very different kinds and sizes.

The works on show in this exhibition of digital art and culture in Spain analyse networks, question old links and build new ones. They offer and experiment with new ways of thinking, feeling and behaving at both an individual and a collective level. Above all, they create and share new tools for visualising, modulating and participating in the construction of reality.

A large number of the projects are the result of research and dialogue among widely differing fields of experience and knowledge. Their proposals take us from bioinformatics to neuroscience and from sociology to urban planning, spanning the information sciences, economics and ecology.

Banquete_nodes and networks brings together over thirty interactive, digital art projects. They include photographic works, videos, virtual reality installations, artificial life robotic performances and net.art participative projects offering a broad overview that ranges from networks of molecular interactions to the global dynamics that arise from new relationships between people, communities and cultures.



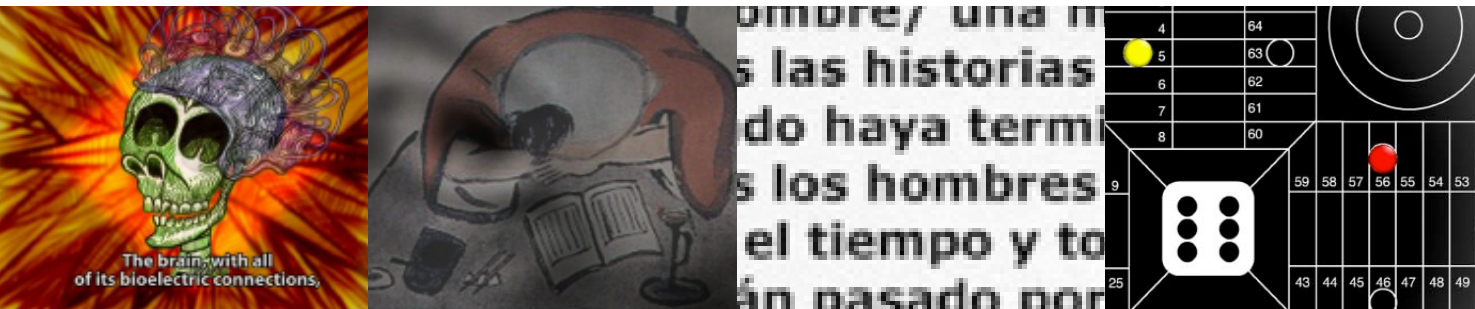
The projects on display in the exhibition *banquete_nodes and networks* explore, visualise or generate networks of relationships at the boundaries between art, science, technology and society; between physical and digital spaces; between local communities and global information flows; and between biological dynamics and technological connections.

As we explained in detail in the first edition of *banquete_metabolism and communication*, the networks of codes and languages that govern the world of information and telecommunications are not exclusive to the current techno-scientific sphere. Our biosphere is also an *infosphere* made up of a network of protocols, biochemical languages and electronic impulses. The introduction of art into the structures and processes of cellular networks significantly broadens the art-life discourse towards the microspheres of nanometric cellular nodes and networks, on the one hand, and towards the hybrid macro-environments of the body-machine interface, on the other. The interactive works and installations of Eugenio Ampudia, Marcel.Í Antúnez, Pablo Armesto, José Manuel Berenguer, Daniel Canogar, Álvaro Castro, Ricardo Iglesias, Laboratorio de Luz, Marina Núñez, and Raquel Paricio and José M. Moreno address new modalities in the conception, perception and interaction between living systems and technological ones.

The project “*Vacuum Virtual Machine*” by the architect **Álvaro Castro** deals with complex systems. He has created a programme able to develop codes by which to modify itself and evolve. Using artificial life graphics software, the author visualises the changing reticular self-organisation of atoms and molecules. His project presents a network in visual form as the evolving, dynamic and structural basis of life.

The work “*Secuencias 24*” by **Pablo Armesto**, explores the combinatory relations of 48 chromosomes on luminous screens woven from fibre optics. It refers to the as yet undeciphered relations of the code of life. Genes are not independent units either, as many of them superimpose and interact in a network, sharing information.

The research project “*POEtic Cubes*” by **Raquel Paricio** and **J. Manuel Moreno** is also inspired by cellular communication networks, represented by nine luminous robotic cubes that behave as a single artificial organism. Each robotic cell changes its behaviour and relations by a process of interaction among all the parts of the system — including the audience present during the performance — that animates a network of communication and coevolution connecting robots and humans



With the interactive installation “*Luci. Sin nombre y sin memoria*”, **José Manuel Berenguer** invites us to explore a network of interactions between light and sound inspired by the behaviour of fireflies. By means of different analogic and digital devices, he shows us the way in which the sounds emitted by the fireflies are synchronised without any centralised coordinating mechanism.

“*Modulador de luz 3.0*”, by the research group **Laboratorio de Luz**, turns an empty room into a space for interaction and random, evolutionary communication. In this environment, the exhibition visitor initiates, explores and experiences the relationship light-space-time/reflection-shadow-movement, in order to generate new sound and space-time relationships.

The communication links between users and machines take on a disturbing form in “*José, un robot autista*” by **Ricardo Iglesias**. This project forms part of his series of investigations into *Evolutional Machines*. In this case, he turns a meek robotic vacuum-cleaner into a machine animated by dysfunctional behaviour and overcome by fear and autism. Interaction with this maladjusted robot is an unusual experience that questions our expectations of the obedient machines which we handle every day.

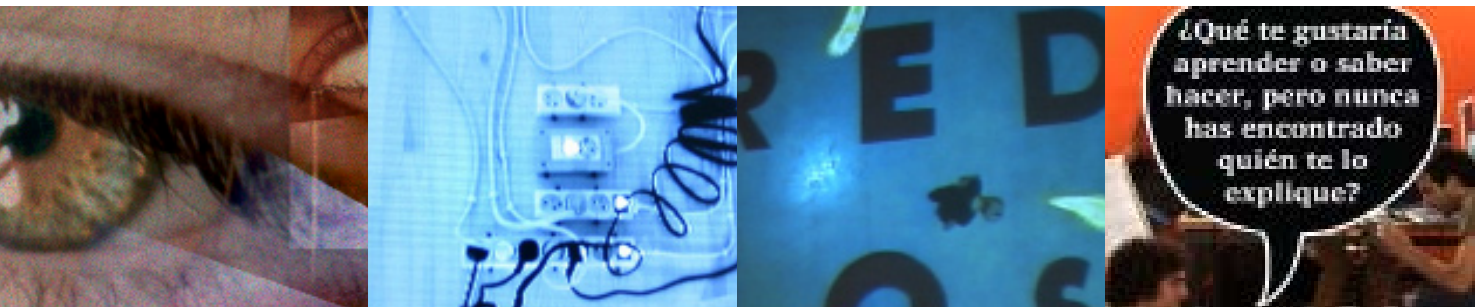
“*Tangle*” is a huge spider’s web of electrical wiring from telephones and computers, and other waste cables from obsolescent communication networks. In describing the installation, **Daniel**

Canogar says that *Tangle* is, above all, a reflection on how technologies create complex emotional connections that unite as well as confine the contemporary being.

According to the neurosciences, the continuous learning process and interaction with our environment can modify the neuronal network connections and vice-versa. In her interactive installation “*Reflecting JCC Brain Research II*”, **Águeda Simó** invites us to interact with the mental map of JCC and explore the relationships between perception, thought and behaviour of an individual whose reasoning is altered by their emotional state.

Evru offers us a playful and intuitive system of communication for connecting minds called “*Tecura*”. In this net.art project, linked up with a full programme of workshops and performances, the artist turns his own visual and sound language into an open source system that he shares with Internet users.

Network society is characterised as much by the new dynamic spaces of online communication and cooperation as it is by the new systems of surveillance and control of everyone by everyone. The video-installation “*Reina*”, by **Francisco Ruiz de Infante** provides some disturbing reflections on neuronal networks and spaces connected via delocalised, omnipresent control systems, but with restricted access.



The man-machine relationship forms the basis of the work by **Marcel.lí Antúñez** called “*Protomembrana*”. It is an interactive lesson of sound and vision on *systemplaywriting* — literally, playwriting for computational systems — that he uses to weave a narrative full of fables about the interconnected, digital being.

In her installation *Sin título (ciencia ficción)*, parabolic antennas, satellites and other devices of the global communications networks give mobility to the bodies floating in space with which **Marina Núñez** refers to the contemporary myth of the *cyborg*. This half-man half-machine is a ubiquitous, weightless, “telepresent”, digital being with heightened perceptions and abilities. In another work of the same series, as well as in one of her most recent videos entitled *Ocaso*, she takes a critical look at the nature of the biotechnological being.

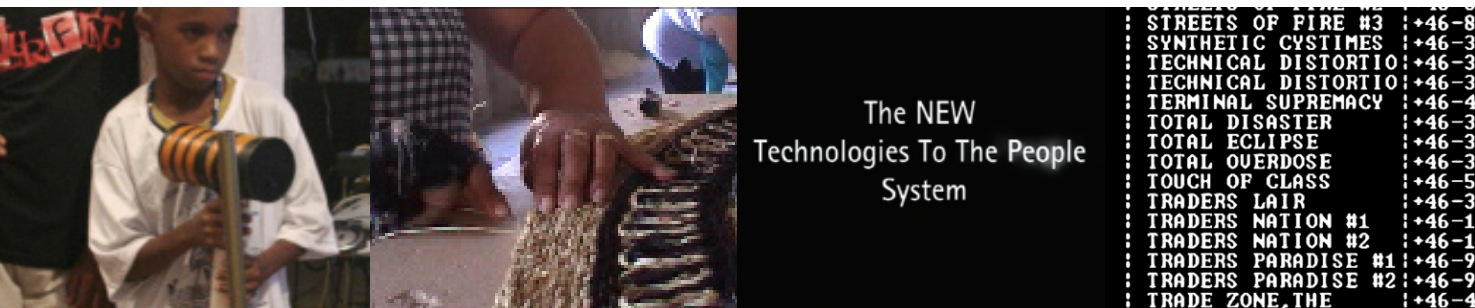
In one of the mural photographs in the series “*Otras Geologías*” by **Daniel Canogar**, several human bodies appear as half-buried rubbish in an impenetrable jumble of the debris of wires and computer parts.

Across from this wasteland, we find “*Crédulos*”, an interactive installation by **Eugenio Ampudia** in which users discover other scales of existence and thereby experience a certain perceptive

disorientation on seeing themselves projected as minute beings surrounded by giant amoebae that react to their presence in real time.

The creation of new techniques and participative tools as catalysts for processes of self-organisation and the production and distribution of experience and knowledge are proposed by Antoni Abad, Alfredo Colunga and collectives like Platoniq or Neokinok TV. The ideological, conceptual and functional relationships between education, creativity and life form the basis of the audiovisual project by Marta de Gonzalo and Publio Pérez Prieto.

In order to foment the self-organisation of new social links, **Antoni Abad** has developed his artistic projects under the common denominator of “zexe.net”. It is based on an operating system that comprises mobile telephony and Internet and is designed to serve marginalised populations in urban areas. Three of his recent experiences, “Canal*Motorboys”, *Barcelona*accessible* and “Geneve*accessible”, undertaken with motorcyclists in Sao Paolo and the disabled in Barcelona and Geneva, are examples of how it is possible to increase the visibility, self-management and self-determination of urban groups through current artistic techniques. In this case, the artist did not take part in the production of the images but



provided the access to the tools and reticular architectures of communication a determinados grupos sociales.

Direct participation in the collective indexation of all kinds of knowledge — from a recipe to a software application or a course in relaxation — is what is proposed by the collective **Platoniq** in “Banco Común de Conocimiento” (BCC). It consists of a platform for the exchange of knowledge and experiences, as well as for connecting everyday oral culture with online digital communication networks that lie outside the criteria of commercial speculation. “BCC” is also a laboratory in which to experiment with new methods of production, learning and citizen participation.

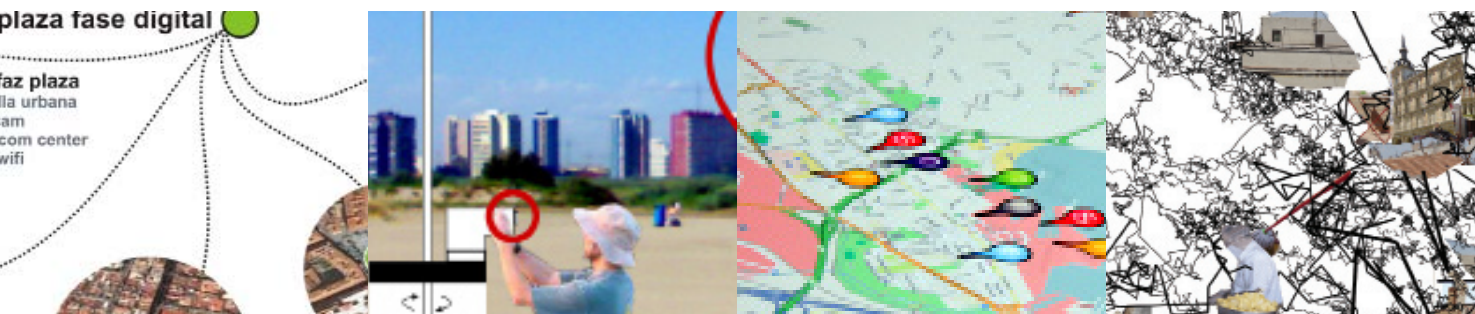
The collective **Neokinok TV** also works on creating educational tools and methods. It generates communication networks and links aimed at fostering the self-determination of the citizens who are most disadvantaged by the growing digital divide. One of their most recent projects, called “*Tvlata*”, joins art to education to create an experimental online television channel with a group of young people from the neighbourhood of Los Alagados, a outer suburb of Salvador do Bahia in Brazil.

“*The intention*” is another of the artistic projects that combine art and education. In their video-installation, workshops and publications, **Marta de Gonzalo** and **Publio Pérez Prieto** offer a critical

review of educational principles that are increasingly tied to a discourse of efficiency, competitiveness and profitability. As an alternative, they present an audiovisual education programme that attempts to restructure the ideological, conceptual and functional relations between education, cooperation, creativity and life.

The interactions emerging between physical and digital spaces, territorial networks, local environments, and their interdependence with global dynamics are investigated and visualised in different ways by the collectives and artists Hackitectura, Escoitar, Influenza, Kònic Thtr, Clara Boj and Diego Díaz, and Pedro Ortuño.

The group **Hackitectura** presents two works that connect the virtual world of networks with the physical space of real places. Their urban architectural project “*Wikiplaza*” transforms an enclosed space of bricks and concrete into a place that is open and permeable to communication flows. Their action videos “*Geografías emergentes*” portray a succesful experiment in coexistence and collaboration between artists, the programmers of free software and the inhabitants of a rural part of Extremadura, in a temporary laboratory set up outside a decommissioned nuclear power station.



In the production workshop “*Aire, sonido y poder*”, the city becomes a source of information and raw material for the creation of soundscapes for the collective *Escoitar* in the weeks leading up to the inauguration of the exhibition at LABoral and at ZKM. The group invited the inhabitants of Gijón and Karlsruhe, respectively, to explore their urban environs and to put together a shared interactive, participative sound map of the city, which would be accessible to both exhibition visitors and internauts.

In “*Observatorio*”, **Clara Boj** and **Diego Díaz** use augmented reality devices to visualise the nodes of free access to wi-fi networks in the city. The close links between urban spaces and these virtual connections for communication also provide the conceptual framework for the interactive installation entitled “*Madrid Mosaic*” by the collective **Influenza**. Their work is a living, changing mosaic that portrays a variety of social environments in Madrid and it is sensitive to the sound produced by visitors to the exhibition.

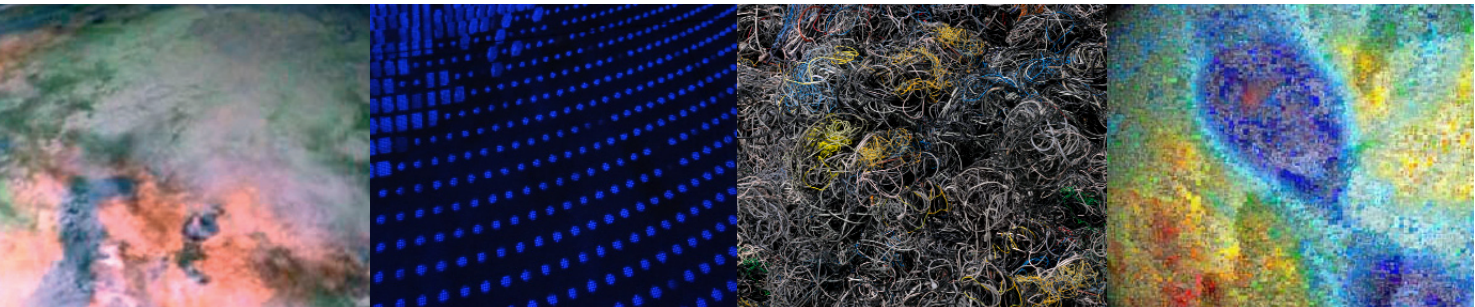
Incessant migratory flows and their influence on individual and collective identities in an increasingly interconnected and interdependent world are the theme of the interactive installation “*Mur.muros/Distopías II*” by the collective **Kònic Thtr**.

The project *“Blanca sobre Negra”* by **Pedro Ortuño** takes a close look at the lives of those in a rural environment whose isolation, poverty, precarious employment and existential uncertainty is growing as fast as the connectivity and wealth of others.

Social and informational networks on the Internet are the subject of works by Aetherbits, Dora García, Concha Jerez and José Iges, and Joan Fontcuberta. Some of them review the issues of authorship, originality and veracity. Others examine new links between current artistic practices and their relationship to citizens, microproducers and distributors through the World Wide Web. Projects by Joan Leandre, and Daniel García Andújar and Technologies To The People deal with open source network culture.

“Todas las historias” is a pioneering work of micro-narratives in the form of a blog, conceived by **Dora García** as a work-in-progress. Since 2001, this project has continued to evolve with the publication of short stories that talk about anonymous men and women, about experiences, feelings and events woven together by dates and key words on the Net of networks.

In *“Terra di nessuno: Arenas Movedizas”*, **Concha Jerez** and **José Iges** confront the user of their interactive installation with the uncertainties, tensions and conflicts that arise on a virtual Parcheesi board, on which some squares sink the player into the shifting sands of global information networks.



By means of images tracked by an Internet search engine, the Googlegramas *“Ozono”* and *“Prestige”* by **Joan Fontcuberta** visualise the new iconographies of an increasingly globalised, interconnected and interdependent collective memory, including both its successes and its failures.

The Internet project *“E-day for energy”* by **Alfredo Colunga** invites us to reflect individually and act collectively in support of new energy sources for a planet with limited resources.

“Social Synthesizer_Prototype”, by the collective **Aetherbits**, is a polyphonic, audiovisual synthesiser that processes a flow of signals, both images generated in real time by the users of the social network Flickr and sounds produced by Skype users. As its creators explain, *“this interactive project consists of a system of managing audiovisual contents that allows the public to explore the global repository of social memory that is the Internet”*²².

The political, social, economic and cultural implications of freely distributed software, on the one hand, and centralised proprietary software, on the other, form part of two scenarios and two narratives that make up the complete installation *“X-devian”* by **Technologies To The People** and **Daniel García Andújar**. This project plunges into the cultural controversy over software, which some see as a product and others, as an open, participative process.

In his installation “*nostalg2//L'AGE D'OR NFO.EXE*”, **Joan Leandre** offers a tribute to the seminal rituals and protocols of digital contamination: a global dataflow that no node can bring to a halt; an ambivalent network, both creative and destructive.

This overview of the exhibition *banquete_nodes and networks* is to encourage visitors to experience the emerging connections between living and technological systems. These are connections that are present not only in the spheres of science and art and in our everyday surroundings but also in the continuum of discontinuous — open and variable — connections that make up life and the relationships between its parts. This model, that is shared by the microscopic and the macroscopic, the biological, the social and the cultural, is what is tackled in different ways by all the participants in this exhibition. They have developed projects that show the intense and fertile synergy that is being created on the boundaries between art, science, technology and society in the digital culture of today.

The thesis underlying the *banquete* project carries an implicit call for thought and action. In any historical — or post-historical (according to some conservative thinkers) — moment of intense change, where the metamorphoses of human life in all its facets are taking place at exponential speed, it is necessary to retain some perspective. Our overview merely attempts to shed some light on the dynamics in which we are all caught up, although, of course, all knowledge carries within it the potential for change. Perhaps an understanding — however slight — of the nature of open and evolving systems in the Network Society can help us to take advantage of the opportunities to map out our future present. A network is based on the capacity of its nodes to create their own functional configuration in a cooperative way. If determinism and power centres can be kept at bay we are all potential nodes capable of reconfiguring infinitely the map of our own relationships in the Network Society.

Notes

- 1 According to data from 2007, published on the website of the World Observatory of Telecommunications, the sponsor, together with the United Nations Organisation, of the Tunis Summit. <<http://www.itu.int/wsis/documents/index2-es.html>> (accessed January 30 2009).
- 2 Diego Rasskin-Gutman, Ángela D. Buscalioni: “Networks, the vital principle”, p. 78.
- 3 Javier DeFelipe: “Cajal and Neural Circuits”, p. 87.
- 4 Kandel, Eric R. (2007): *En busca de la memoria. El nacimiento de una nueva ciencia de la mente*, Buenos Aires, pp. 84-93.
- 5 José M. Montoya, Ricardo V. Solé, Miguel Á. Rodríguez: “The architecture of nature: complexity and fragility in ecological networks”, pp. 297-305.
- 6 Carlos Briones, Susanna C. Manrubia, José Ángel Martín-Gago: “Trapped in the network: Nanoworld, Life, Society”, pp. 49-55.
- 7 Antonio Acín, Maciej Lewenstein, Juan Ignacio Cirac: “Quantum Communication: Entanglement and Percolation”, pp. 56-57.
- 8 Castells, Manuel (2006): “Informacionalismo, Redes y Sociedad red”, in *La Sociedad Red: una visión global*, p. 31.
- 9 Carlos Briones, Susanna C. Manrubia and José Angel Martín-Gago: “Trapped...”, pp. 49-52.
- 10 *Ibid.*, pp. 55-57.
- 11 Bartra, Roger (2006): *Antropología del cerebro. La conciencia y los sistemas simbólicos*, Barcelona.
- 12 Kerckhove, Derrick de (1999): *La piel de la cultura. Investigando la realidad electrónica*, Barcelona, p. 19.
- 13 Castells, Manuel (2002): *La era de la información*, Vol.1, *La sociedad red*, Madrid, p. 549.
- 14 García Camarero, Ernesto: “Networks and owners of knowledge”, pp. 119-130.
- 15 Fundación Rodríguez (2007): *Estructura-redes-colectivos (un segmento conector)*, Vic, Q07, 2007.
- 16 Marchán Fiz, Simón (1986): *Del arte objetual al arte del concepto*, Madrid, pp. 153-159.
- 17 García Camarero, Ernesto: <<http://elgranerocomun.net/rubrique29.html>> (accessed January 30, 2009).
- 18 *Proyectos-Muntadas-Projects*, catalogue Fundación Telefónica, Madrid, 1998.
- 19 Ameller, Carles, Martín, Leo (2006): “Televisión creates an impresión of humanisation”, in *La televisión no lo filma*, Zemos 98, Sevilla, pp. 250-257.
- 20 <<http://www.sitioweb.com/sitio3/p/espacio/>> (accessed January 30, 2009).
- 21 *Encuentros de Arte Actual, Red Arte y Colectivos Independientes en el Estado Español*, Vitoria-Gasteiz, 1997.
- 22 Aetherbits, “Social Synthesizer_Prototype”, p. 165.

Symbiogenesis, innovation and cultural networks. Towards an ecophysiological vision of knowledge generation and transfer

Luis Rico

Being, doing and knowing, in the domain of life, are, in their origin, undifferentiated, and when they become differentiated they continue to be inseparable. **Edgar Morin**

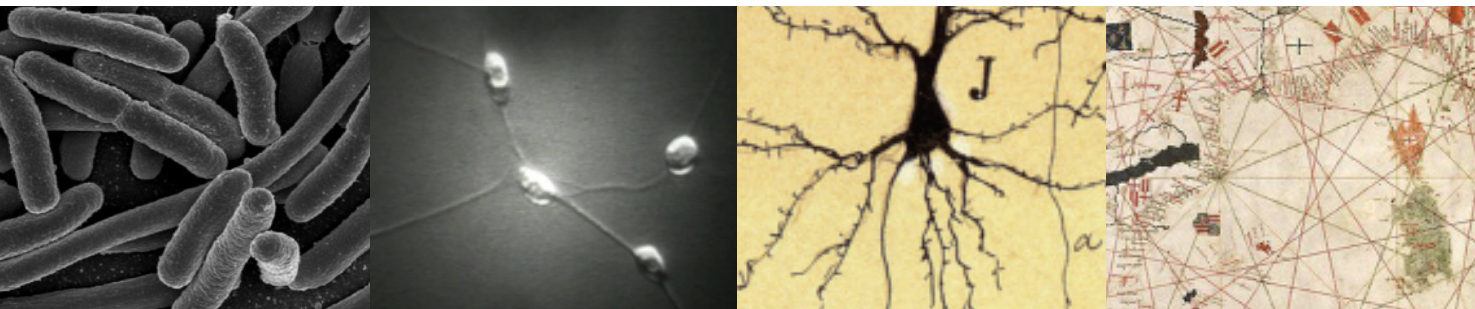
Symbiogenesis is one of the processes that underlies the generation of evolutionary innovation. It deals with long term symbioses (from Greek, *symbioun*, “live together”) between organisms of different species that may lead to a new integrated entity that includes the formerly independent components by means of fusion followed in some cases by the acquisition of genomes. This article considers some of the ideas that inspired the origin and evolution of the *banquete* project since the early 1990s. It explores the potential of symbiogenetic ideas that came to light in the field of biology at the start of the 20th Century with two aims: 1) to interpret the emerging dynamics and structures of knowledge management and 2) to devise a framework for actions that promote the interaction of diverse scientific and social fields, disciplines and methodologies through the use of current infotechnologies. A century after these visionary ideas appeared and were ignored or rejected for decades, they are gaining new life as models for cultural innovation analogs that respond to the needs of the *web society* in the age of *global change*: the exploration of new sustainable ways of interpreting and being in the world that are able to reconnect human societies, the technosphere and ecosystems.

Movement

When we read these sentences, the complex network of electrochemical interactions among neurons that Ramón y Cajal revealed to us is activated. Through respiration, oxygen reaches the brain and enables glucose and other molecules obtained from food to be transformed into metabolic products. Among these, the water and carbon dioxide created by one of these metabolic processes circulate through an intricate web of blood vessels while others enable the neural membrane to respond to variations in the concentration of sodium and calcium ions on either side, to modify their potential and to trigger a nerve impulse. The spread of these movements along complex neural networks is thought to lead to the emergence of mental constructs: symbols, images, concepts and ideas. “Life and thought are integrated into the same flow of material, energy and information transformation. Thinking and being are different aspects of the same physical organization and its actions” (Margulis, Sagan 1997)¹. The evolutionary biologist, Lynn Margulis and the neurophysiologist, Rodolfo Llinás, among others, state that thought is the internalization of movement. Thinking is the movement of mental objects. Its evolutionary origin can be linked to cell motility. It theoretically derives, in other words, from those first protist² movements produced by the waving (undulations) of undulipodia (cilia, “flagella” eucaryotes) that enabled single-celled beings to search for

food, shelter, to interact with other cells, to escape from danger or predators, in short, to survive. Today similar structures (of undulipodia) are found in the rods cells of our eyes and in the tails of sperm. The whipping movements of free-living protists are due to proteins similar to those found in the brain, i.e., microtubule protein. Thus, these movements that facilitate perception and the selection of external signals to make up “intelligent protist behavior” or a form of “basic consciousness” have been transformed over billions of years into structures that carry out the intracellular neuronal movements through which we live and think. This movement continues to be basic to everything we need to guarantee the survival of our species: touch, perception of surroundings or communication among individuals. If we accept the fundamental continuity between body, mind and environment, then perceiving, feeling, thinking, breathing, eating or excreting are like the rest of physiology, the result of a web of interactions that define the chemistry of an organism.

The network of neurons and nerves that make it possible to write these lines share over 3,000 million years of evolution with the brain that is now reading them. This reaches from the origin of life up to today. The first neural structures (those of the craniates) appeared in the Cambrian Period some 540 million years ago. Paleontologists place those early “human” brains on the African savan-



nah about 3.2 million years ago (Leakey’s “Lucy” in Olduvai). Our species, *Homo sapiens*, appeared approximately 100,000 years ago. The two brains that these paragraphs connect, regardless of their culture or background, share the same evolutionary branch that last forked one thousand centuries ago. This may appear to be a very ancient fork from our individual point of view but, in evolutionary terms, measured in geological time, it is very recent, just a snap of fingers in the immensity of the history of the Cosmos. If, as Carl Sagan suggested, we compress the nearly fourteen billion years that have transpired since the Big Bang into a single year, our species wouldn’t appear until December 31 at 11:56:30 pm of that cosmic year. The Neolithic emerged twenty seconds before the end of the year. It is clear that humans are newcomers to the web of life that has evolved on the planet.

It is, however, astounding to observe the explosion of human diversity and sociocultural complexity that took place in those final “four minutes”. Its shock wave has created and destroyed cultures and civilizations, languages and technologies, developed symbolic systems and equations, poetry, music and even humor like “secretions” of some thinking, feeling, hyperactive glands. The endosomatic interactions that produce thought correspond to the communicative processes

between thinking humans that make up the networks of minds that sustain civilizing and cultural processes. And thus “humans brain tissue has looked outside the frail skull concealing it for an artificial exocerebrum, exposed to the outside world, which provides it with a solid symbolic structure to rely on” (Bartra, 2003)³. This tissue, made up of 6000 million mind/bodies and growing fast, has colonized one planet, so far. The behavior of this *primatemia diseminada* that James Lovelock refers to has disturbed the homeostasis of the Earth and this is seen in the purported anthropogenic nature of global climate change.

Coevolution

The exobrain described by the anthropologist Roger Bartra resonates with the concept of noosphere (Greek, noos, intelligent) developed, at the beginning of the 20th Century, by Teilhard de Chardin (1881-1955) and Vladimir Vernadsky⁴ (1863-1945). For Vernadsky, who coined the term biosphere, humanity is a new evolutionary phase in the biogeochemical process that is Earth. This process includes human bodies as well as all the machines and artifacts we have created in coevolution with the environment. Life, including human activity, “doesn’t ‘adapt’ to a passive environment (...). Instead,



it actively produces its environment and modifies it. In contrast to a mechanical world focused on physics, the metabolizing biosphere regulates itself physiologically” (Margulis 1990)⁵. In this context, the body of each thinking being, with its symbolic extensions and peripheral technologies, constitutes the material and cultural *hulls* that make up humanities’ exobrain network. In turn, each body/node in this mesh, each human being, consists of endless modules and endosomatic subnetworks on different scales, with constant, different atomic, molecular, metabolic, cellular, neuronal, endocrinological, muscular, etc. interactions that participate in social, affective, linguistic, cultural, technological or ecological exosomatic networks (Guardans, 2003). It is astounding to think that our circulatory system would wrap around the world twice if stretched out, about 100,000 kilometers, while it only makes up three percent of our body mass (Schiefelbein, 1986). Likewise, the very fabric of “Humanity” as a whole is only one small sub-network in the planetary “nervous system”: myriad currents of signals and interactions in constant flow. We are just barely starting to see and understand this “system,” from its quantum, molecular or biological communication networks to its social or ecological networks. We do know the genome sequence of many organisms, which is not insignificant, but there remains much to be done before the complexity of the interaction of the signals that lead from

the genotype to the phenotype of the simplest organism can be revealed. This poses a stimulating challenge for science and technology as well as a humbling reminder and cautionary tale regarding the ethical, sociocultural and ecological consequences of tampering with life.

Paradoxically, while humans are destroying many of these networks that sustain us — trophic food, linguistics, emotional, societal and ecological — the paradigm and culture of *the Network* has surged into existence. This movement could be interpreted as an immune-like, intelligent reaction in that it appeals to measure, proportion and context. In other words, this same pattern of organization, the network, that hastens the poisoning of the environment, the repression of citizens or new forms of terror, war and delinquency, also leads to the generation of “antidotes” against some of these problems. We are not referring to the naive view that the network, in a natural way, can solve all problems, since as we have already seen, the global network we inhabit can, with the same naturalness propagate pathological behaviors, toxic substances and epidemics. A good example of this ambiguity can be found in the development of the primitive Internet. The military threat to the United States that caused missiles to be installed in Cuba in 1962 led to a defense strategy that later evolved into the World Wide Web that we all know. The threat or awareness of death activates the life force and builds pathways. “Smarter than hunger” is a popular Spanish saying that captures this idea. Stated frankly and with no apocalyptic overtones, our species finds itself in a situation where it has nowhere left to turn on our planet. There is no place left to stealthily dump the excesses and wastes of one group on another. The web of life reveals how destructive actions against the environment end up affecting all of us. Networks and mass communications, radio, television, Internet, satellites..., show us the consequences of greed, envy and local abuse. This is the new situation that *Global Change* confronts us all with (Carpintero & Naredo, pp. 285-292). The set of economic, social, ecological and cultural indicators describe a common dilemma. We are all in the same boat, on a course that the planet can not sustain.

Fragmentation and uncoupling

Decades ago, David Bohm, the North American physicist who collaborated with Oppenheimer, pointed out that the problem was not the events that we face but the thoughts that generate those problems and also condition our reactions. All frontiers are erected by thought. The fundamental disassociation between mind and body, implicit in “western” thought carries with it a pathological drive that years later has manifested itself in all its power. The radical split between human beings and nature, the organization of knowledge into closed compartments and the quantification of the world to the detriment of the qualitative, have led to a complex, collective, global pathology. To oversimplify, some of the symptoms of this crisis are the anthropocentric alienation and linear, dichotomous, instrumental thought that have characterized, perhaps since its origin, that talking primate who evolved on the African savannah. The truth is that this type of thought has been shown to be very efficient. So much so that it has spread all over the planet, becoming a plague and, as a consequence, devouring and imposing itself on any other way of conceiving, thinking, or being in the world. But this monoculture, by its predatory nature, has finally become a dangerous enemy even to itself. In fact, just as the losses in biodiversity pose a threat to the trophic networks that sustain ecosystems, loss of cultural diversity leads to a lessening of the adaptive capability, of versatility and of sociability all of which are needed to guarantee survival of our species (Montoya, Rodríguez, Solé, pp. 299-307).

In counterpoint, we have seen how this reticular vision of the world has vigorously re-emerged and evolved in western culture since the 20th Century to become one of the paradigms of the current Information and Knowledge Age. This involves a new vision that has transformed biology, physics, the economy, sociology, neuroscience, politics, the arts, communication, activism and consciousness. But perhaps the most important aspect of this vision is that it is changing the relationships among these fields as well as their interaction with society. That is to say that the network template is transforming the structure of knowledge and the behavior of human groups. Although it is quite clear that it is an ancient template, it still resonates with origin myths that “other” cultures and civilizations hold dear. Despite the “West’s” disdain for them as archaic, rudimentary or primitive, such myths have profound correlations to complex current ecological or systemic thought.

Structures of the exobrain

Human history is a chronicle of the emergence, development, decadence or transformation of different types of generation, organization, conservation and transfer of knowledge. Ever since Neolithic times human societies have tried to preserve collective knowledge as a valuable resource that improves living conditions and chances for survival. It has always been coveted by human individuals and groups in order to gain power, converting its control into a source of tensions and conflicts. This is evident in the control that the inner circle of Egyptian priests exercised on the scribe caste, in the power the Church wielded over medieval monasteries and universities, in the resistance to the printing press when it first appeared due to its emancipating potential, and in the numerous forms of censorship that have appeared throughout history. Since the Renaissance, in an attempt to adapt to the discovery of new worlds and to increasingly complex sociocultural structures, new institutions and structures have arisen to try to manage the new situations generated by our eagerness to know and exchange knowledge, to reach out to other regions, to conquer nature and to control other human groups. Religions, churches, sects; monasteries and universities; salons made up of intellectuals and researchers, academies, disciplines and publications; factories and artisan guilds that favored the industrial revolution and the proliferation of associations and societies, the creation of polytechnic schools, professional colleges, museums, congresses, specialized journals, universal expositions, lobbies of all kinds...in short, the evolution of knowledge throughout history has taken different forms based on each culture as well as on the available technology of each age. The establishment of instruments and entities to organize and manage knowledge was, as pointed out by García Camarero (pp. 119-130) and Echeverría (pp. 215-221), determined by the dynamic tension between forms and institutions that are imposed from above and the collectively constructed forms that surge up from the grassroots. The manifestation of this dual process has resulted in a map of structures, disciplines and institutions that, as a whole, make up what could be known as the “genome” of the human exobrain.

As we mentioned in the prologue, little more than a century has passed from when Ramón y Cajal announced that, for the first time in history, a neural network had been observed by itself to the current moment when this same system of networks allows us to observe ourselves socially and collectively. Manuel Castells (The Network Society), Derrick De Kerkhove (Connected Intelligence), Javier Echeverría, Pièrre Lévy (Collective Intelligence), Fernando Sáez Vacas (The

Universal Digital Network) and Fritjof Capra (The Web of Life) among others, have all mentioned this. Today we face the challenge of closing the cycle, of reconnecting current schools of thought and human actions to the bacterial networks that originated them all. To link the behavior of neural, cognitive, electronic and social networks with the biological and ecological networks that sustain them all.

Biomimesis, innovation y sustainability

The Information Age is also the Age of Global Change. These are two aspects of the same complex dynamic that confronts us with an array of new social, ecological, economic and cultural problems that are systemic. The interdependence of these problems overwhelms traditional linear, compartmentalized organizational and management concepts. They demand an urgent change in perspective, sensibility and behavior. This change depends, in large measure, on how contemporary societies perceive such problems, thus making their communicative and educational challenges of the highest priority. Given the gravity of the ecological crisis in the current global situation, we must attend to the processes, strategies and behaviors that the web of life uses to deal with ecological problems. This observation led to the idea of biomimesis, as an attempt to direct ways of human production towards a reconnection with natural dynamics. It is not futile to see life as an R+D+I process (Research+Development+Innovation), based on trial and error and subject to natural selection, that has maintained itself for almost four billion years. Humanity, including the constructs and discourse of its brain, is the result of its biological evolution and to deny this would be as contradictory as continuing to nourish the current model of production and consumption without taking into account its ecological footprint. All this requires a holistic, systemic, transdisciplinary outlook, where techno-scientific progress and emerging social dynamics and artistic practices reveal new perspectives and action strategies to take on these issues in a critical, innovative and efficient manner.

It is quite true that, through force of repetition, “innovation” has become the new all-purpose mantra of contemporary society. We use this word to embellish everything we make and do, from advertising yogurt and cars to political, economic, scientific or cultural policies. In this way, information societies show themselves to be banalized societies which avidly hunt down mere data, which is neither information nor knowledge, or new or “innovative” concepts, then empty them of all meaning before they have a chance to take root in society, thus nullifying any potential they might have had for change. This is happening to some degree with the concept of “sustainability.” After the Kyoto Summit, from one day to the next, companies, policies and products that had no respect for the environment became ecological in a hypnotic cosmetic operation whereby they simply changed the color of their trappings to “green” without changing, in any way, the conditions and behaviors that make them unsustainable. However, these skin-deep, narcotizing distortions — known as “greenwashing” — should not distract us from the value that the combination of these concepts, “innovation” and “sustainability,” can have in meeting the challenges we face today.

To clarify the meaning of innovation in the context of this article, we can identify various degrees or levels of innovation identified by current economic and industrial trends where this concept has acquired primary strategic importance.

- 1) Sector innovation (product or process): the modification of a product or process that affects the very substrate it emerges from. This is often confused with insignificant superficial changes or improvements of a product that in no way modify the context of their production.
- 2) Inter-sector innovation: collaboration between different sectors with the aim of developing a new product or process that expands their former sphere of influence or even leads to the appearance of a completely new field. Today, scientific and artistic innovation occurs on the border between different sciences or areas of research.
- 3) Innovating the innovation. This type of dynamic examines, optimizes and applies the emerging tendencies generated in the development of levels 1 and 2.
- 4) Eco-innovation or biomimetic innovation: this level deals with the study of the ecological and sustainable aspects of innovation processes. That is, it addresses how to go about integrating a transversal factor into the innovations of levels 1, 2, and 3 that monitors ecological footprints in order to develop an environmental, social and symbiotic ecology with which to promote energy efficiency. In other words, can we invest in uncoupling the humans *versus* nature tendency and construct new production models that harmonize human and natural economies?

For over a decade, the *banquete* project has been carried out like an experiment in biomimesis, exploring this 4th level by seeing innovation as an action that can transform the substrate of a given process, program or product. To do this, *banquete* monitors the convergence of biological, social, technological and cultural processes. The study of how living beings transform the chemical composition of the Earth's atmosphere is an outstanding example of this convergence in that it connects planetary "biogeochemical innovation" with sociocultural and techno-scientific practices such as the development of open code and life sciences which are products of the *Information Age*.

The transformation of the Earth's atmosphere from its original oxygen-free composition into the current "breathable" one is probably one of the greatest processes of innovation that has ever occurred on the planet. It was carried out, on a planetary scale, by myriad microorganisms that achieved sustainable macro-behavior, altering the Earth's biosphere.

Some of the living beings that populated the oceans two thousand five hundred million years ago began to generate oxygen as a byproduct of their photosynthetic metabolism and this gas oxidized all of the susceptible compounds in the hydrosphere. Once the oceans had absorbed all the oxygen they could, the gas started to be released into the atmosphere until, a billion years later, current atmospheric levels were reached. Oxygen is, however, toxic for many living beings and so its increase led to the evolution of "detoxifying" systems such as aerobic respiration. Life produced oxygen, our planet changed and life adapted to a new oxygen-filled world. This story is a good example of co-evolution between life and the planet, a process that has managed to regulate the conditions needed by the evolution of life despite successive alterations and climate changes. This immense network of sustainable eco-innovation, which is basic to our survival as a species, is a dynamic "micro" with "macro" consequences based on the open, horizontal and massive transmission of signals with "no one" in charge. That is due to the fact that networks of global communication and behavior started on a bacterial level billions of years ago. It should be noted that integrated climate study, mediated by the hydrosphere-atmosphere dyad, favors the development of an inter- or transdisciplinary approach since it deals with a phenomenon that includes the inter-

action of a multitude of processes on different scales. This reveals another key characteristic of networks and their patterns: their freedom from scale (Solé and Munteanu, p. 310).

These characteristics of the web of life, open, horizontal information transfer and communication and interaction among different scales, represent some of the most innovative practices of the *Information Age*. Open code and free software have transformed the ways knowledge is generated and transferred on a global scale. The model for this emerged from a civil society based on leaderless cooperation, analogous to the bacterial behavior mentioned earlier (Guiu 2003)⁶ that has modified scientific research methodologies, the organization and management of many public administrations and the business models of a considerable number of companies, including software, information or knowledge based industries and businesses (Martin Prada pp. 180-199). In addition to its practical uses, this movement has modified social relationships among its users generating a culture of online innovation based on “hacker ethics,” described by Pekka Himanen⁷ as an open and cooperative culture, driven by its creative passion for researching, developing and sharing new knowledge and experiences. This movement, promoted by Richard Stallman arises from the sociocultural, political and economic restlessness that has appeared as an alternative to the closed, proprietary attitudes of software and knowledge development and distribution. The correlation between this alternative culture and the web of life’s networks of innovation plays a significant role in promoting a global ethic that has melded the terms “ethos” and “eco.” These terms have now become inseparable from new ways of acting on the world.

Also, the culture of online open code, has had an impact on the life sciences. Today research groups all over the world share huge databases that are essential to the advancement of our understanding of the basis of life. These questions can only be addressed collectively; an individual node cannot deal with them. This is how the web of life demonstrates its systemic nature. This situation brings to mind Humberto Maturana’s 1980s statement that communication was not just the mere transmission of information, but also implied the coordination of behaviours. From the power of “we” proposed by Inma Tubella (pp. 210-214), we might be able to approach an understanding of the web of life. It is not in vain that each human being is a “we.” That is, each one of us is an integrated community of organisms in a symbiotic relationship. 10% of the dry weight of a human body is made up of bacteria and other microbial symbionts without which we would not be able to survive. In fact, every single cell of our body is a “we,” a symbiotic community of components, cellular organelles such as mitochondria, which had lived independently as bacteria previously. (Folch, pp. 293-299). Moreover, in the last decade we have learned that almost half of our genome comes from genetic fragments that were originally in the genome of other species and that over the course of evolution have reached us by means of “transporting elements” such as retroviruses. This tells us, first, that viruses and not just bacteria have made us what we are and second, that our genome, like the genomes of all living beings, is a mosaic of other genomes. An information puzzle. We wouldn’t exist without the rest of the biosphere.

The biomimetic question, suggested by these analogies, is whether we are capable of integrating two apparently unrelated and at times diametrically opposed cultural threads; ecology and digital culture into the same process. The challenge is how to make proper use of infotechnology to coherently confront environmental degradation, by turning a corrosive and degrading

social and environmental dynamic into a more constructive and ecologically concerned one. In other words, how to integrate Fernando Sáez Vacas's digital noomorfosis⁸ (pp. 150-156) with the five principles of ecoliteracy proposed by Fritjof Capra — interdependence, recycling, association, flexibility and diversity — to develop an ecological organization that promotes the reconnection of humans with the planet (DeFelipe, pp. 85-96) or, at least, a co-evolutive vision of both approaches that puts technology at the service of the environment instead of the reverse (Valencia, pp. 60-64). Maybe this integration or co-evolution can help to overcome the egocentric excesses and alienating anthropocentric beliefs that have been nurtured by the dominant occidental culture.

Paradoxically, in their period of greatest dominance and power, humans find themselves overwhelmed and fragile when faced with extreme weather phenomena that result from climatic and global changes, in which we play a decisive part. Actions that derived from predatory ways of thinking about nature return with unsuspected and confirmed virulence. The most plausible strategy to avoid this situation seems to be to eliminate all unnecessary consumption, or at least, to reorient it towards obtaining energy efficiency and promoting an “ecosophy which unites environmental ecology with mental and social ecology.”⁹ Also, the extravagant behavior associated with the imperialist and neo-colonialist tradition, shows signs of exhaustion. A dialogical and receptive attitude of re-connecting with the environment is seeping through its cracks. Beyond any ideology, this change encourages new survival tactics; coherent and consistent actions that affect us as a species. In this context, the junction of Art, Science (Ciencia in Spanish), Technology, Society and Environment (ACTSA) represents an emerging process with great potential for the production of innovation, value and wealth, and constitutes a key vector for the stimulation and democratization of R+D+I culture.

In the Information and Knowledge Age, biology and technology, science and conscience, ethics and sustainability, are all part of the same system. We must ask ourselves if we are able to redesign and reorient our cultural institutions and social structures according to this new paradigm. Can we collectively devise, from a biomimetic perspective, new social organizations that behave with the same fabulous plasticity and functionality shown by cellular and neuronal structures, or even our own systems of sensing and communicating? Is it possible to generate and transfer knowledge based on an eco-physiological vision, more akin to metabolic and informational processes than to rigid, mechanical and compartmentalized determinism? Could a perspective with these characteristics help to reconnect and recombine that which might just be divided in our minds?

Symbiosis, transdisciplinarity and cultural networks

Symbiosis is the mutually beneficial shared life, in physical or metabolic proximity, of different organisms. Stable long-term symbiosis that leads to evolutionary change is known as symbiogenesis. This refers to the origin of new organelles, tissues, organs, organisms and even species by means of permanent long-term symbiosis. These associations, true biological fusions, are a powerful motor of the evolution of species. Two organisms from different species unite and, after evolving together, produce a third organism. From a symbiogenic point of view we can interpret the ACTSA environment as an emerging cultural process that generates a fluid, permeable and transdisciplinary body of knowledge that can relate and integrate diverse and dispersed, previously independent, disconnected elements. The properties and structures of this dynamic “body,” with its changing forms, arise from the

network of flows and interactions among different ideas, subjects, entities and institutions that, in turn, organize the system and thus determine its functions, physiology and behavior. Their development requires a new set of conceptual instruments of a systemic nature along with novel organizational and management tools that encourage their evolution, transfer and social implementation. The aim is to structure the atypical, transdisciplinary and inter-institutional routes that maintain the metabolism of ACTSA entities. These routes, most of which are not clearly established, generate unusual alliances and consortiums among subjects (creators, researchers, managers) and entities (collectives, institutions, businesses) that discover that they have complementary properties and functions within this new context. The consolidation of these environments requires a communication system that facilitates collective identification and self-observation of the process itself and promotes trustworthy networks to encourage and sustain them. From this dialogue and interaction new “sybiogenetic” ways of thinking and doing, new transversal practices and discipline, new entities and institutions can evolve. A crucial aspect of these dynamics is the importance of contact and coexistence with other realities, sensibilities, languages and methodologies to ensure one’s own awareness. To this end, the creation of uninhibited, undisciplined situations can encourage the emergence of collective creative processes that integrate diverse participants from different fields of knowledge and experience. It is important to emphasize that these ACTSA processes, by definition, put concurrence before competition. Thus they can be complementary and interstitial in relation to current hyper-specialized, departmental structures.

All of the above-mentioned makes it a first priority to develop hybrid structures that facilitate cooperation. They must be able to manage and collaborate with both institutional structures as well as grassroots movements that channel the creative drive of citizens and communities. Unfortunately, we see too many waning entities that attempt to imitate emerging networks in an effort to domesticate or neutralize change by trying to co-opt the dynamic network space with strategies anchored in a classical concept of space, understood as a closed and static container. This perspective fundamentally contradicts current knowledge of the world and is a permanent source of conflict and frustration. In addition, it is profoundly unsustainable since it wastes a great deal of energy and resources on trying to legitimate itself with meaningless, expensive, highly visible, cosmetic advertising campaigns to shore up the sham. Managing and resolving the conflicts that are constantly created by this obsolete dynamic leads to stagnant public administrations. To deal with this situation, it is imperative that new structures be made available to these processes of innovation rather than the continuing to attempt to control and exploit them. Manuel Castells states that, “when governments or large companies take control of innovation they wither them. This is not an opinion, but the result of two decades of experience observing them.”¹⁰ He concludes by saying, “this means of innovation can’t be designed. It forms organically, spontaneously and even accidentally, but it can be destroyed if deprived of an adequate institutional, financial growth medium of tolerance and liberty.”¹¹ Thus it is no longer acceptable to speak of an *Information and Knowledge Society* while ignoring or scorning the new processes of artistic, scientific, technological, social and environmental production and dissemination that are emerging in the Network Society. Nor is it admissible to promote a culture of innovation (R+D+I) and, at the same time, penalize creativity for being too new or inconvenient. These schizoid contradictions, written into current systems of production and transfer of knowledge must be overcome (A. Rodríguez, Marzo, N. Rodríguez and Eraso, pp. 180-199).

Nevertheless, many of these emerging artistic practices, openly hybridized with diverse forms of activism and/or techno-scientific development, spend their energy on generating structures, processes and tools to facilitate the shared creative drive rather than on creating artistic objects (Guallart, pp. 251-252). It becomes more important to achieve a certain dynamic than a hypothetical final object, since the result is the transformative potential of the process itself. The relationship between author, work and public becomes a creative, open and collective process that evolves from the interactions between the actor/agent participants in these new innovation environments. In this manner, the concept of audience as consumers of “closed” objects moves towards the idea of consumer as participant in the process of reciprocal learning exchange that creates communities with shared motivations and interests. This sharing acquires new qualities of consistency and courage. “Network as Artwork,” as Roy Ascott said in the seventies. Likewise, the static concept of space is transformed into a moldable geometry and thus into an event that emerges from the movement and interaction of its elements. “Network Space” defines its identity and function according to the flow of information, the dynamic and the network of interactions it is a part of (Briones, Manrubia & Martín-Gago, pp. 49-57, Corrales, pp. 131-137).

This knowledge and experience, accumulated over decades, should be borne in mind more often when devising cultural, educational, and environmental policies such as R+D+I, and even to strengthen their synergy since in the current network system it is meaningless to conceive of them as separate entities. One of the key issues in the transition from a fragmented or segmented pattern to a systemic, networked one is that, within the latter, each component of the system can contribute to the production of other components or to the common substrate. Hence, constructing the network can be a community building process. Networking also encourages non-linear feedback loops as opposed to classical linear, sequential and compartmentalized models that tend to limit the system’s communication and functionality resulting in the isolation of its components.

Noosphere and e-proprioception

As mentioned earlier, Vladimir Vernadsky’s concept of the *noosphere*, posed in the 1920s, referred to a new evolutionary geological change in the biosphere. According to this, the presence of humans represents another phase in biogeochemical evolution. It is a special layer of organized thinking material that grows on and changes the surface of the Earth. The change has accelerated dizzyingly, first during the industrial revolution and now in the microelectronic and nanotechnological revolution. Vernadsky believed that humanity and technology are an accelerated but integral part of the planetary biosphere. It is true that the anthropogenic roots of the current *Climate Change* are related to these accelerations. But today it is also possible to use these communication networks to bring the visionary *noosphere* into focus and develop a new collective, electronic and distributed proprioception¹² that could be called “e-proprioception.” “Proprioception, the perception of movement and orientation in space that comes from stimuli within the body, is a physiological concept. Our proprioceptors constantly inform us of whether we are standing, tilting our head, tightening our fists or moving at 50 kilometers per hour. Proprioception, sensing oneself, is probably as old as our sense of being ourselves. Herds of extinguished dinosaurs, and other animals before them, already enjoyed the benefits of their own proprioceptive social communication; the global nervous system didn’t start with the origin of people. Physiologically regulated, the Earth, benefited from global

proprioceptive communications long before we appeared. Gas emissions and soluble chemical compositions from tropical plants, insects ready to procreate or bacteria under threat of death circulated through the air in our atmosphere. The speed of proprioception has, however, increased enormously in the electronic and digital age.”Although these ideas have been “percolating” through different cultural settings for decades, the current increased access to knowledge and technology can boost the democratization of artistic and scientific creation and research. Their methodological and strategic similarities and the fact that artists, engineers, scientists and activists all share the same languages and tools encourage transdisciplinarity, the creation of open platforms, spaces and processes which generate new ways of relating among institutions, citizens and settings.

The first images of Earth as seen from the Moon were globally broadcast on television. This is a good example of the sociocultural impact of electronic proprioception. The science and technology developed over decades was transformed into symbolic energy, a commonly felt experience. Today’s electronic proprioceptive network with its multiple scale accesses, from planetary to nanometric, local to global, could lead to the development of José María Baldasano’s (pp. 308-309) cooperative global vision as stated in his description of *Climate Change*. It becomes imperative to add value to the cultural dimensions of scientific and technical research and development processes. The symbolic energy implicit in scientific information can multiply the value of what, from a strictly utilitarian and quantitative point of view, is considered mere data. Art, science and thought are artificial categories that should not create ghettos, isolated from social and environmental realities. Thus it is vital to encourage a broader social perception where science and technology are considered cultural expressions and art and literature are accepted as forms of knowledge in one integrating process of social innovation.

It’s important to remember that about every 30 years, the number of scientific disciplines has doubled. In the early 70s there were three or four thousand. Nowadays, the number is closer to seven or eight thousand. With reductionist analyses, there is no need to integrate disciplines since entities are studied in isolation, then “frozen” and analyzed as closed systems. In order to deal with the challenge of global climate change and to understand the cycles of life, a holistic approach that integrates disciplines is needed since these are open systems. As Pedro Marijuán states, “a biological wisdom of the flow of information that integrates open systems has not yet been achieved by science”. The mechanical reductionist model used in the natural sciences to date has succeeded at the expense of a loss of integrative vision that has made consciousness, emotions and creativity disappear. The time has come to explore and devise new relations among all these dimensions.

With the goal of exploring this new proprioceptive network, the R+D+I program, *Nodos y redes*¹³ is developing the e-biolab in cooperation with an international network of researchers and creators, along with research, training, production and cultural outreach centers, ACTSA (Art-Science-Technology-Society-Environment).

e-biolab

e-biolab aims to contribute to the construction of socially and environmentally sensitive cultural networks that are able to flow easily from nanometric to ecological or planetary climate scales. These are complex networks of eco-innovation and cultural communication linked to and in tune with the networks of life. These networks interact in a “Gaian” manner. They accept the biosphere, lithosphere, hydrosphere and atmosphere as parts of the same planetary system that includes us

and, in turn, commits us to practice a new social, cultural ecological and technological ethic on an equally planetary scale. It must be said that we are not speaking of cultural totalities. As Edgar Morin said, “the very idea of complexity excludes the possibility of unification since once uncertainty is taken as a given, the inexpressible must be faced.”¹⁴

With its biomimetic focus, the e-biolab online platform operates as a system that connects and mediates among processes, disciplines and institutions to promote new hybrid entities or the creation of transdisciplinary dynamics and communities. It is a transmitter of what is happening in education, the environment, industry or international cooperation. Its function is analogous to the behavior of certain genes or proteins in relating diverse interactive networks: the key role that nodes connecting these networks, or the modules within them, acquire. Although early on, more emphasis was placed on the study of well-connected nodes, which in biology would correspond to genes whose mutation is lethal to an organism or produces significant changes, it has become increasingly clear that genes that are crossed by many paths, connecting groups despite having few connections, carry out a fundamental role in the organization, evolution and functioning of networks. These genes act as bridges between functions. Biology considers them connectors of different functional groups that transmit, for example, what is happening in metabolism to what is happening in regulation. They are the intermediaries between processes although they appear to have no fundamental role in any of them. This highlights the catalyzing potential of the so-called “weak-connections” in the evolution of networked systems. One example of this was when the misnamed “junk DNA,” after being scorned for years because it didn’t codify proteins, recently attained unexpected relevance and influence in the regulation of gene expression (Marijuán, pp. 142-149)

To develop these eco-innovation processes, e-biolab extrapolates to the realm of knowledge generation and transfer, Salvador Rueda’s sustainability equation (pp. 254-259) in which he compares the energy efficiency of natural ecosystems with human production systems. The idea is to manage the increase in complexity without increasing the demand for resources or, even, reducing it by means of cooperative development strategies. In other words the tendency to hyper-specialize overrates the main activities of institutions, entities and businesses to the detriment of those secondary activities that, ignored by specialized competitive pressures, become undervalued residual knowledges. The idea is to recycle this type of knowledge, presumed to be secondary, and add value to its connective potential in order to create new relationships and hybrid environments. This would, in addition, allow new sustainable and reproducible models of knowledge generation and transfer, ACTSA to be designed. From this point of view it is possible to experience new production relationships that transform the linear concept of the “science-technology-industry-society” sequence into another based on complex non-linear relationships among research-training-production-communication-outreach.

Another important requirement is to promote free access to knowledge, since free-ranging knowledge, due to its enormous multiplying effect on creativity and the production of new knowledge, is one of the greatest treasures of an emerging society (Alsina, pp. 138-142). This, in turn encourages citizens to accede to and participate in, not only expositions of the results, but also the processes of researching, creating and producing them. The situations that emerge from these apparently chimerical processes have great innovative and productive potential that is aided by the emphasis given to creativity that dominates these innovation strategies and policies. Scientific institutes and laboratories in collaboration with companies would develop artistic creations

that feed their own processes and research contexts back to them. In the same manner, artistic, intellectual and social collectives provide knowledge and experience, not only to foster the development of new scientific and technological research and development projects and strategies, but also an ethical and yet critical vision. This type of dialogue leads to a system of reciprocities that enliven and inspire new artistic endeavors which in turn also influence scientific and technological research and innovation. All of these allow new forms of producing and transferring knowledge, creating value and wealth along with new sources of employment to be explored.

In conclusion, e-biolab is an attempt to collectively construct productive models based on an ethical and eco-physiological vision of the generation and transfer of knowledge, both to increase social and ecological consciousness and to respond to a change in the knowledge model paradigm since biological forms and structures that are basically homeostatic are making it possible to supersede mechanical models. *E-biolab* is open to new ways of thinking and acting and to improving the integration of societies in their natural environments.

Summary

As mentioned in the prologue, the first 2003 edition of the project called *banquete*, examined the correlation between lifestyles and communication, exploring analogies between metabolism and communication, understood as processes of matter, energy and information transformation. In 2005, the second edition emphasized the evolutionary character of both processes. In this third and last edition, it explores the underlying reticular structures below the processes of life and communication, as well as those of social, economic, cultural and ecological dynamics.

One century ago, science had to overcome the dichotomy between the observer and the observed, and had to renounce objectivity in order to be able to better understand the phenomena and processes it was investigating. Heisenberg's Uncertainty Principle changed the course of science. This fact has influenced or been in synchrony with similar situations in other fields of cultural and social dynamics throughout the 20th Century: from the question of the "art-life" dyad, the idea of the open ended work of art and the transformation in the relationship of author, work and audience in the context of interactive art, to the emergence of different forms of activism and citizen participation in the collective construction of reality. On the verge of the 21st Century, the concept of an open network and shared knowledge might be the construct needed to transform the very substrate of both the means of production and the transfer of knowledge. In this new emerging context, aesthetic experience, the democratization of scientific and artistic knowledge, ethical commitment and participative action are all part of the same shared creative stream. It is a stream that, in fact, follows the path taken by life on our planet. It is no longer enough to think about problems and write reports that only experts read, or to mount strategic educational campaigns about isolated issues that respond to the needs of whatever political party is in power. A new range of possibilities for negotiation and collectively constructed as well as distributed knowledge and experience has been made available.

Every change in the paradigm entails a process of adaptation. "In revolutionary France, neither the classical universities, nor the academies sufficed to generate the necessary knowledge to build a new society" (García Camarero, p. 127). The new consciousness appeared from "beyond the pale," precisely from the recognition and legitimation of the excluded. In fact, it was after a century and at the "Salon of the Rejected," where the first "impressionist" vision emerged, and claimed as its own the newborn 19th Cen-

ture. But, actually, we always encounter the same sequence of events. It was not in vain that philosophy and science, as we understand them nowadays, were developed by a generation of intellectual outliers, in both pre-classic Athens and the temples of mainstream knowledge. Exemplary thinkers including Thales and Anaximander of Miletus, who, with the same curiosity they used to study the atomic roots of matter, dared to examine both the Cosmos and Man and made both disciplines compatible. As Rasskin-Gutman & Buscalioni pointed out (pp. 78-84), in the field of life, the anatomy of the network determines behavior and, as a result, its functions. It is fitting that we explore the properties and condition of the current structures and networks of communication, which mediate the new social practices, as well their production dynamics and knowledge transfer systems in order to try to overcome the yet unsolved antagonism between development and sustainability. This equation forces us to reorient infotechnologies towards a social, open and humanist model that will reconnect us to Earth and to the processes of life.

It is an old debate, but the new field of negotiating among an unprecedentedly heterogenic profusion of forces and tendencies, offers, as we have been able to see here, new conditions with enormous transformative and innovative potential. Both philosophy and the emergent physiology that connects biological, electronic and cognitive aspects, challenge us to, individually and collectively, take on this new point of view and new consciousness. The resulting macro-behaviour depends on the sum of and interaction among the micro-actions carried out by each individual. If, as Lynn Margulis states, we are symbiotic beings on a symbiotic planet, it is not strange that our behavior, as well as our social and cognitive structures, interact and evolve symbiotically. Perhaps, this evolution can take place in an open and participative manner, at once transdisciplinary and transversal, capable of reaching critical mass and acquiring true power to perceive and activate the right strategies at the right time to confront our global crisis.

Notes

- 1 Margulis, L., Sagan, D. (1997): *Descartes, Dualism, and Beyond in Slanted Truths. Essays on Gaia, Symbiosis, and Evolution*, New York.
- 2 Protists led to the evolution of plants, animals and fungi. The Protist Kingdom includes amoebas, ciliates and all algae, making it an extremely diverse Kingdom.
- 3 Bartra, R. (2003): *Consciousness and the Exobrain*, published in *banquete_metabolism and Communications*. In press.
- 4 Vernadsky, V. "The biosphere and the Noosphere", *American Scientist* 33:1 (January, 1945).
- 5 Margulis, L. (1990): "Big trouble in Biology: Physiological autopoiesis versus mechanistic neo-Darwinism", in *Doing Science: The Reality Club*, 2, New York, pp. 211-235.
- 6 Guiu, Ll. (2003): "Open Code and Bacteria", in *banquete_metabolism and communication*. In press.
- 7 Himanen, P. (2006): "La ética hacker como cultura de la era de la información", in *La sociedad red: una visión global*, Madrid, p. 505.
- 8 <<http://antoniofumero.blogspot.com/2006/08/noomorfosis>>.
- 9 Guattari, F.: "Pour une refondation des pratiques sociales". *Le Monde Diplomatique* (October 1992).
- 10 Pascual, M. (2006): *What world do we live in: conversations with con Manuel Castells*, Madrid, p. 227.
- 11 Ibid. 9, p. 240.
- 12 Guerrero, R. Margulis, L., Rico, L., Sagan, D. (2003), *Proprioception: when the environment becomes the body in banquete_metabolism and communication*. In press.
- 13 *Nodes and networks* is the R+D+I program developed by Banquete Cultural Association in which this publication, *banquete_nodes and networks* exhibit as well as the e-biolab platform are registered.
- 14 Morin, E. (2005): "Complex Thought and the Ecology of Action", interview published in *Iniciativa Socialista*, nº. 75, <<http://www.inisoc.org/morin75.htm>>.