

# The BBVA Foundation grants its 2008 Frontiers of Knowledge Awards

The inaugural edition of an international award scheme to recognize and encourage scientific research of excellence, which can be considered second only to the Nobel Prize in the range of disciplines addressed and its combined monetary amount – an annual 3.2 million euros.

**B**etween January 13 and 30, 2009, the BBVA Foundation announced the winning entries in the first edition of its Frontiers of Knowledge Awards. These awards go to recognize world-class research and artistic creation, prizing contributions of broad impact for their originality and theoretical significance. Their goal, as such, is not to honor a lifetime of achievement, but rather specific contributions which have pushed forward the frontiers of the known world. Hence their international scope and the accent placed on the meeting and overlap of different disciplines.

Besides this global reach and interdisciplinary nature, we can number among the distinctive traits of the Frontiers Awards the importance they lay on basic knowledge – with or without immediate application – as a means to expand society's collective choices; their recognition that many decisive advances of our times are the result of collaborative working by large research teams, so it makes little sense to limit the number of winners; the stimulus they provide to four artistic fields – music, painting, sculpture and architecture – that are decisive in shaping the identity of any given era; and their support to research and practical actions addressing two core concerns of the global society of the 21st century: climate change and development cooperation.

The BBVA Foundation Frontiers of Knowledge Awards take in eight prize categories: Basic Sciences (Physics, Chemistry and Mathematics), Biomedicine, Ecology and Conservation Biology, Information and Communication Technologies, Arts (Music, Painting, Sculpture, Architecture), Climate Change, Development Coopera-

Winners of the 2008 BBVA Frontiers of Knowledge Awards		
Category	Nationality	Awardee
Climate Change	United States	<b>Wallace S. Broecker</b> Columbia University (New York)
Development Cooperation	United States	<b>Abdul Latif Jameel Poverty Action Lab</b> Massachusetts Institute of Technology (MIT)
Biomedicine	Spain	<b>Joan Massagué</b> Sloan-Kettering Institute (New York)
Arts	United States	<b>Steven Holl</b> Architect
Information and Communication Technologies	Israel	<b>Jacob Ziv</b> Technion-Israel Institute of Technology (Haifa)
Basic Sciences (Physics, Chemistry, Mathematics)	Spain	<b>Ignacio Cirac</b> Max Planck Institute for Quantum Optics (Garching, Germany)
	Austria	<b>Peter Zoller</b> Institute for Quantum Optics and Quantum Information (Innsbruck, Austria)
Economics, Finance and Management	France	<b>Jean Tirole</b> Toulouse School of Economics
Ecology and Conservation Biology	United States	<b>Thomas E. Lovejoy and William F. Laurance</b> Smithsonian Institute (Washington DC)

tion and, finally, Economics, Finance and Management.

“A central plank of the culture of both the BBVA group and the BBVA Foundation is a stake on knowledge and innovation as a platform for addressing the challenges of our global society and tapping the huge opportunities that are out there to improve citizens' wellbeing and standards of living”, explained Francisco González, the BBVA Foundation President, a few days before the juries began their deliberations.

“We believe there is a lack of recognition for people who devote their lives to research or creative work; who place their talent, motivation and effort at the service of expanding human knowledge. With

these awards, we want to help redress the balance by bringing research and artistic activity to the attention of the wider public”, he added.

## Objectivity, transparency and scientific excellence

The BBVA Foundation has been partnered in this effort by the Spanish National Research Council (CSIC), the country's premier public research organization. The CSIC assisted in the review and selection of award candidates and also the appointment of the prize juries, whose chair was designated by common accord between the two organizations. This collaboration endorses the fairness and transparency of the selection process, in which nominee merits are judged against the best inter-

national metrics in their respective scientific or artistic fields.

Each award category carries a cash prize of 400,000 euros, giving a combined purse of 3.2 million. Their monetary amount and the breadth of the disciplines addressed place the BBVA Foundation Frontiers of Knowledge Awards second only to the Nobel Prize (see comparative table in newsletter no. 11).

The names of the Frontiers of Knowledge laureates for the year 2008 are:

- **Climate Change:** Wallace S. Broecker (Columbia University), a pioneer in predicting global warming and in research into phenomena of abrupt climate change.
- **Development Cooperation:** Abdul Latif Jameel Poverty Action Lab (Massachusetts Institute of Technology), for their use of scientific methods to assess the on-the-ground effectiveness of development assistance as an aid to more effective decision making.
- **Biomedicine:** Joan Massagué (Sloan-Kettering Institute of New York and IRB Barcelona), for elucidating the processes that control cell division, whose

disruption contributes to diseases like cancer, as well as the genetic bases of metastasis.

- **Basic Sciences:** Ignacio Cirac (Max Planck Institute for Quantum Optics, Garching) and Peter Zoller (Institute for Quantum Optics and Quantum Information, Innsbruck) for providing the theoretical model for a quantum computer able to process previously unmanageable quantities of data, and opening up new theoretical avenues with regard to cold atoms and quantum information.
- **Information and Communication Technologies:** Jacob Ziv (Technion – Israel Institute of Technology, Haifa), author of the algorithm enabling the various formats now used as standards for the worldwide transmission of images, documents, music and video: pdf (text), mp3 (sound), jpg, gif and png (image)...
- **Economics, Finance and Management:** Jean Tirole (Toulouse School of Economics), for his contributions to Game Theory and Information Theory, which have refined our analytical weaponry on topics such as competition, finances or financial crises.

- **Ecology and Conservation Biology:** Thomas E. Lovejoy and William F. Laurance (Smithsonian Institution, Washington DC), for their research work in Amazonia, which has been key to understanding the effects of natural habitat fragmentation and enabling scientific simulation of the future of tropical ecosystems.

The Frontiers of Knowledge Awards, in Francisco González's words, are part of BBVA's commitment to build "a better future for all world citizens". A goal, he goes on, which the Foundation pursues "by promoting and disseminating the best knowledge and creative output. We believe it is vitally important at times like these of great difficulty and complexity that creative research and innovation are not viewed as 'optional extras', confined to periods of economic boom. On the contrary, they should now be receiving redoubled support from both public and private quarters. We know that discontinuity is especially harmful in investigative labors, and that innovative structures and traditions can only be sustained by means of a firm and lasting effort, in which BBVA and its Foundation are pledged to play a part".



Announcement of the Biomedicine prize by a panel featuring left to right: Juan Modolell, winner of the latest Santiago Ramón y Cajal National Research Prize in Biology and jury secretary; Rafael Rodrigo, President of the Spanish National Research Council (CSIC); Rafael Pardo, Director of the BBVA Foundation; Torsten Wiesel, Nobel Prize in Medicine and Physiology and chairman of the jury; and Angelika Schnieke, leading expert in cloning from the Technical University of Munich (Germany), also a jury member.

## CLIMATE CHANGE

# The man who predicted global warming and abrupt changes

**T**he BBVA Foundation Frontiers of Knowledge Award in the Climate Change category has found its way in this inaugural edition to U.S. researcher Wallace S. Broecker, who more than three decades ago predicted the existence of climate warming due to human activity. In 1975, Broecker published the article “Climate Change: Are We on the Brink of a Pronounced Global Warming?” in the journal *Science*, marking the first ever mention of the term “global warming” in a scientific publication. In this article, he also foresaw that the rise in anthropogenic CO<sub>2</sub> emissions would weaken the ocean’s ability to withdraw carbon dioxide from the atmosphere, leading to pronounced warming at the start of the 21st century – a prediction that time has proved true.

The jury in this first edition singled out the pioneering quality of Broecker’s work, which has opened up new avenues of research vital to our understanding of climate and its evolution. Special mention goes to the laureate’s knowledge contribution with regard to “abrupt changes”; processes which trigger extreme and sudden upheavals in the climate system. Today’s rapid thawing of the Arctic polar cap threatens to trigger one such abrupt event: the alteration of the main current

distributing heat across ocean basins (the thermohaline circulation, also known as the oceanic heat conveyor belt). In the words of the award certificate, Broecker’s “seminal” research into the oceans’ biological and chemical processes “pioneered the development of Earth System Science as the basis for understanding global climate change, both past and present”.

Broecker is a professor in the Earth and Environmental Sciences Department at Columbia University (New York) and at the age of 77 continues to engage in front-line research. At the time of writing, he is about to travel to Iceland “to conduct an experiment on the subsoil injection of CO<sub>2</sub>”.

The scientist laments that in the more than 30 years that have passed since his article “much has been said but very little done” to stabilize atmospheric concentrations of CO<sub>2</sub>. But he is also aware of the scale of the task. Present concentrations of greenhouse gases – which trap part of the heat given off by the Earth – are the highest in over 650,000 years. They have jumped from 280 parts per million in 1850 to 385 today and the most optimistic forecast is that they may stabilize at around 550 in 2050. “I don’t see us managing to halt atmospheric concentrations before



HELENA ZAPKE

COURTESY OF W. S. BROECKER



Professor Wallace S. Broecker.

they reach double the preindustrial levels. But halt them we must, because otherwise they will triple, and we will see a whole series of ecological surprises”. One of these surprises, he hazards, will be that “rainfall patterns are going to change a lot, and that will certainly affect people since water is already scarce in many parts of the world”.

Wallace is also an impassioned educator. He is currently updating *How to Build a Habitable Planet*, a university handbook that explores the complicated balance between the Earth’s physical and geochemical processes and its vulnerability to human activity. For the business community, he has written *A Business Executive’s Guide to Global Warming* (2005), and governments the world over have been able to benefit from his reflections on *Fixing Climate: What Past Climate Changes Reveal about the Current Threat and How to Counter It*.

## DEVELOPMENT COOPERATION

# Scientific methods to facilitate truly effective development assistance

**T**he Abdul Latif Jameel Poverty Action Lab (J-PAL) at the Massachusetts Institute of Technology (MIT) takes the BBVA Foundation Frontiers of Knowledge Award in the Development Cooperation category. The laboratory and its team of economists perform a role in foreign aid broadly comparable to the audit function in the corporate environment.

Between 1960 and 2008, a total of USD 2.7 billion was spent worldwide on development cooperation. But until very recently no techniques were available to gauge the real effectiveness of this effort. J-PAL analyzes development assistance programs to determine whether the funds invested are being properly utilized and are delivering the desired results. Experts in development economics believe the scientific tools this laboratory deploys represent a before and after in aid program evaluation.

J-PAL, founded in 2003 by three MIT economists that are now its co-directors – Abhijit Banerjee, Esther Duflo and Rachel Glennerster – has successfully built up a worldwide network of experts. The laboratory promotes

the use of randomized trial methods to evaluate development interventions, similar to those employed

COURTESY OF J-PAL



Abhijit Banerjee, Rachel Glennerster and Esther Duflo, co-directors of the Poverty Action Lab, on a fieldwork trip to Udaipur (India).

to test experimental drugs and vaccines. J-PAL has applied them, for instance, to measure the effectiveness of bednet campaigns in the fight against malaria or of strategies to reduce teacher absenteeism. Its advocacy of this approach has led to it being taken up by numerous international institutions.

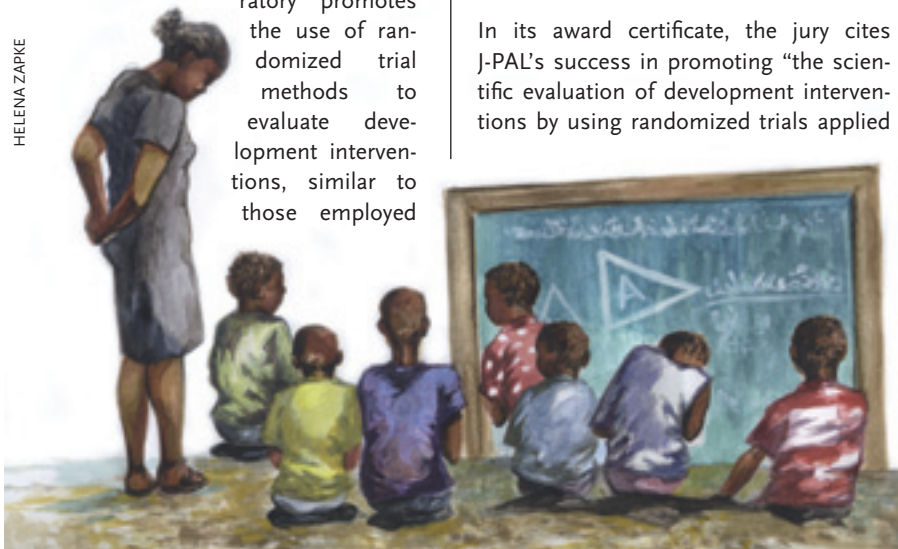
In its award certificate, the jury cites J-PAL's success in promoting "the scientific evaluation of development interventions by using randomized trials applied

to areas including education, health and financial markets". The methods used by J-PAL have been shown to be "a valuable tool for answering specific policy questions", and its work "has led to the expanded use of this approach by development practitioners and researchers".

It goes on to remark that "the method has been extended to policy questions where nobody had previously thought to use it and, in some cases, has led to important policy actions".

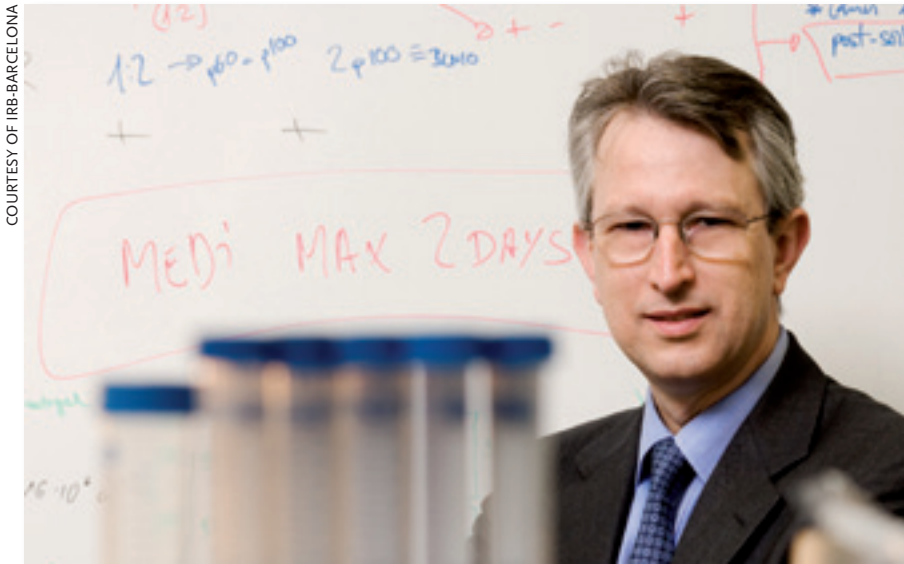
French economist and J-PAL co-director Esther Duflo, speaking on the organization's behalf, stressed that their work "strives to give a precise answer to questions about where development money really goes, and about which programs work and which not, so we can plan better for the future of development cooperation".

HELENA ZAPKE



## BIOMEDICINE

# Spain's most cited working scientist fights cancer with its own weapons



COURTESY OF IRB-BARCELONA

Joan Massagué's research has uncovered new approaches to understand and treat cancer.

**T**he inaugural BBVA Foundation Frontiers of Knowledge Award in the Biomedicine category has gone to cancer researcher Joan Massagué i Solé (Barcelona, 1953), Spain's most internationally cited working scientist. Massagué's research has elucidated fundamental processes that control cell division and identified genes playing a key role in tumor generation and metastasis. This is work "with great potential for clinical application", in the words of the jury chaired by Nobel laureate in Medicine, Torsten Wiesel.

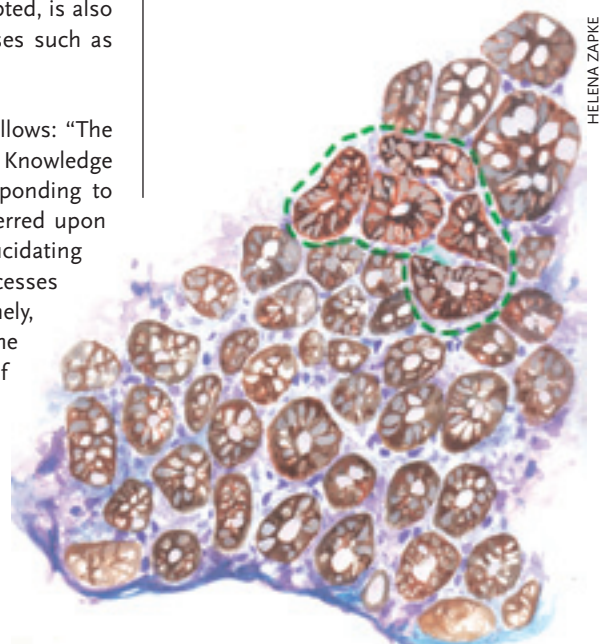
Joan Massagué is Chairman of the Cancer Biology and Genetics Program at the Sloan-Kettering Institute in New York, where he has pursued most of his scientific career. He is also a researcher at the Howard Hughes Medical Institute and Adjunct Director of the Institute for Biomedical Research (IRB Barcelona). He has more than 340 publications to his name in leading scientific journals, which have been cited more than 62,000 times, placing him among the world's fifty most cited researchers of the last twenty years.

The research work of Joan Massagué stands out for the identification and characterization of the TGF-beta protein (transforming growth factor beta). This protein belongs to a large family of factors that regulate the cell division process. It is essential for the organism's normal development but, when disrupted, is also implicated in disease processes such as malformations and cancer.

The jury's citation reads as follows: "The BBVA Foundation Frontiers of Knowledge Award in Biomedicine corresponding to the year 2008 has been conferred upon Dr. Joan Massagué for elucidating one of the fundamental processes that control cell division, namely, the machinery that conveys the growth inhibitory signal of TGF-beta from the cell membrane to the nucleus. Many of the components of this signaling transduction pathway have been identified and functionally characterized by Dr. Massagué. The TGF-beta pathway is crucial

for the development of all animals, and, when disrupted, contributes to diseases such as cancer. Massagué and colleagues have also developed novel approaches to identify genes involved in organ-specific metastasis. These studies have considerably increased the understanding of metastasis and have great potential for clinical application, given that 90 percent of cancer-related deaths are due to this invasive process".

Joan Massagué's research is constantly coming up with new results: "In our analysis of cell division we had overlooked an important component which we have now identified and hope to soon be in a position to report" he remarked shortly after being informed of the award. Regarding his work on metastasis, he underscores that "many metastases are caused by genetic changes that have to do with people's environment and lifestyle, and that is an important part of the response to cancer treatment".



HELENA ZAPKE

## ARTS

# Vanguardism and humanism at the service of cultural and social fundamentals

**T**he Arts award in this inaugural edition of the BBVA Foundation Frontiers of Knowledge Awards has gone to the U.S. architect Steven Holl. Born in Bremerton in Washington State in 1947, he is known as “the most European of American architects” for his humanistic approach to architectural design.

A professor in Columbia University’s Graduate School of Architecture, Holl’s projects stand out for their respect for the building’s historical and cultural context. Among his best known works are the Simmons Hall students’ residence at the Massachusetts Institute of Technology, the Nelson-Atkins Museum of Art in Kansas, the Chapel of St. Ignatius in Seattle University and his addition to the Cranbrook Institute of Science in Michigan (all in the United States), the Makuhari residential complex (Japan) and the Kiasma Contemporary Art Museum in Helsinki (Finland), which he considers his “most representative” creation.

The award jury cited “the progressive position of the work of Steven Holl in more than 30 years of professional practice”, in which he has forged “a personal language and recognizable identity” immune to “external, formal and stylistic compromise”. His projects stand out for their variety, with commissions built or under way in everything from “private houses to major urban projects round the world”. Humanistic values inform a personal trajectory which “promotes social and cultural fundamentals without sacrificing a continued presence in the architectural vanguard”.

It is no surprise then that Holl’s first reaction on hearing of the award was to affirm that the main challenges facing the architectural profession were to “rethink public spaces, give buildings back their humanistic

COURTESY OF MARK HEITOF



Architect Steven Holl.

value and proceed with scrupulous respect for the environment”. These ideas are now being put into practice in Linked Hybrid, a commission under construction in Beijing in the vicinity of the Forbidden City. This complex, built over 220,000 square meters, will encompass eight residential blocks and a hotel. However its central and most eye-catching feature is that public, housing, commercial, educational, green and recreational spaces are all connected up at different levels. Conceived as “an open city within a city”, it aspires to generate random relationships and, simultaneously, to act as a social condenser, offering a different experience of city life to both residents and visitors.

Holl believes firmly that “the relationship of all the arts becomes especially patent in architecture, and it is in architecture that it finds its fullest expression. Architecture has to inspire our lives, like music and literature”.

This is possibly the key to the huge variety of Holl’s creative output, which pursues a dialogue with its surroundings (urban or natural landscape, public or residential space) so they become part of the same whole; or the way he uses light as a solid material in order to play with volumes and make the encounter with his buildings a life-enriching experience.

HELENA ZAPKE



## INFORMATION AND COMMUNICATION TECHNOLOGIES

# The algorithm that revolutionized text, music and video transmission

**T**he BBVA Foundation Frontiers of Knowledge Award in the Information and Communication Technologies category has gone to Israeli engineering professor Jacob Ziv. Born in Tiberias (now Israel) in 1931, Ziv is one of the “fathers” of discoveries enabling such vital applications as the compression of the data, text, image and video files used in all personal computers.

Jacob Ziv’s work has enabled the compression of all kinds of information, so it occupies less space and can be transmitted at ever greater speeds; a facility without which the current concept of broadband Internet access would lack any practical foundation. Ziv developed an algorithm (a set of instructions for accomplishing a given task), known as LZ, with the power to identify the most frequent redundancies in the language. In text, for instance, the algorithm could convert a common three-letter word like “and” into a single unit, thereby saving storage space without any loss of meaningful information.

This principle is what has enabled the creation of hugely popular compression standards such as mp3 (for sound), gif or png (image) or pdf (text). Also, Ziv’s ideas have been instrumental in improving the capacity of hard drives and optimizing

BY PERMISSION OF J. ZIV



Professor Jacob Ziv

fax retransmission. The impact of his research work also extends to video compression, and DVD and high-definition television technologies.

Jacob Ziv, emeritus professor at Technion – Israel Institute of Technology and chairman of the TELEM Forum for National Infrastructures for Research & Development, has established a school specializing in the development of intelligent algorithms adaptable to data of

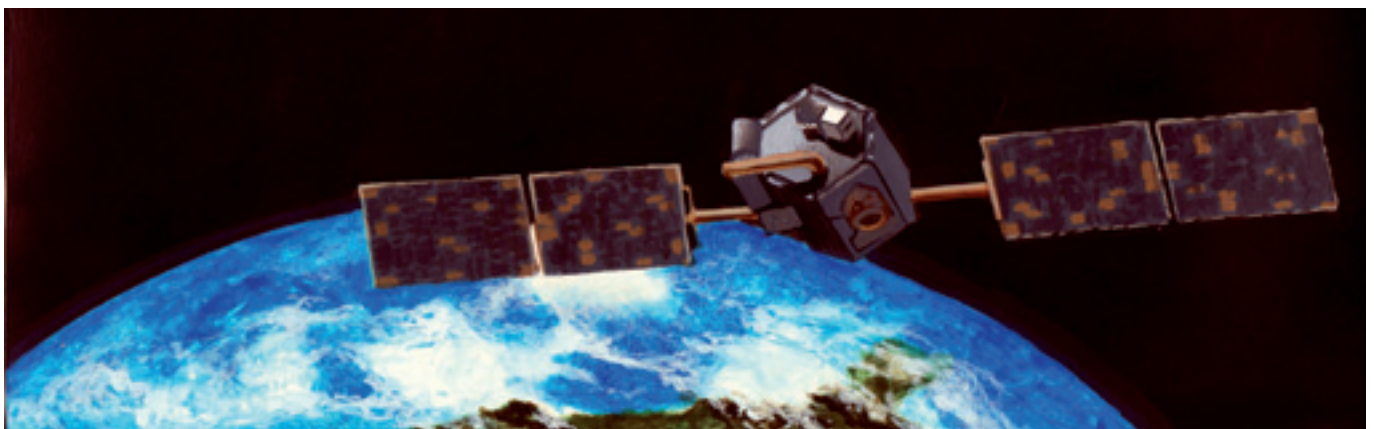
whatever nature with an optimal degree of compression.

### Championing the scientific spirit

On receiving the news, Jacob Ziv declared himself “deeply honored” by the award. “I am especially delighted” he went on “that, in the midst of a world economic crisis, the foundation of a financial institution like BBVA has opted to uphold the importance of the scientific spirit.”

Jacob Ziv considers himself “fortunate” to form part of a “relatively new branch of science, Information Theory, which has laid the foundations for modern communication technologies”.

The jury cited the following merits in Ziv’s work: “His ground-breaking innovations in data compression have had a deep and lasting impact on both the theory and practice of communications and information technology. Ubiquitous in everyday life, his contributions enable efficient storage and transmission of text, data, images, and video. Computer memories, modems, software distribution, and file compression techniques all rely on Ziv’s ideas and inventions. His seminal contributions to information theory have inspired generations of researchers and practitioners alike”.



## BASIC SCIENCES (PHYSICS, CHEMISTRY, MATHEMATICS)

# Drawing the map that will lead the way to quantum computation

**T**he Basic Sciences award in this inaugural edition of the BBVA Foundation Frontiers of Knowledge Awards has been shared by physicists Ignacio Cirac and Peter Zoller “for their fundamental work on quantum information science”, in the words of the jury chaired by Theodor W. Hänsch, Nobel Prize in Physics. Cirac and Zoller’s research is opening up vital avenues for the development of quantum computers, immensely more powerful than those we know today.

Spanish researcher Ignacio Cirac, director of the Theory Division at the Max Planck Institute for Quantum Optics in Garching, Germany, declared himself “especially honored because the award distinguishes the advances being made in an especially dynamic field”. Cirac also chose to emphasize “the importance of basic science, which is where tomorrow’s applications are born”. His fellow award winner Peter Zoller, scientific director at the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences, Innsbruck (Austria), greeted the news of the award as “a great honor and a huge recognition for our area of work. It has been amazing to observe how this field has grown in the past ten

COURTESY OF I. CIRAC



Researcher Ignacio Cirac.

years and how our expectations are little by little being borne out”.

Ignacio Cirac and Peter Zoller are regarded as the theoretical physicists of most influence in the areas of cold atoms, quantum optics and quantum information. For more than a decade, their work has broken new ground and opened up new avenues for experimentation. At the core of their research is the use of the microscopic world to build quantum computers and communication systems. Their first major theoretical contribution, dating from 1995, was the description of a theoretical model for a quantum computer. They based their conjectures on what are known as “ion traps”, in which electrically charged and cooled atoms are trapped by an electric field and manipulated with lasers. Today, this technique still holds out the best promise for quantum computation and indeed small-scale prototypes of quantum computers have already been built based on the ion trap idea.

In recent years, work carried out at numerous laboratories has confirmed Cirac and Zoller’s theoretical predictions.

COURTESY OF P. ZOLLER



Researcher Peter Zoller.

### A fundamental effort

According to the jury’s citation, Cirac and Zoller share this award “for their fundamental work on quantum information science”. The innovative theories formulated by both men have inspired the development of new scientific approaches in quantum simulation and systems engineering across a spectrum that runs from atoms and ions to condensed matter.

The microscopic world, where quantum physics reigns, may yield up new sets of rules for handling information on a scale undreamt of in the past, permitting calculations with vast amounts of input data (worldwide weather forecasts, for instance) which now demand the use of several computers, or the quantum encryption of data so they are invulnerable to any kind of attack.

Ignacio Cirac foresees a future rich in new developments: “We must remember that the road to quantum computation is lined with exciting phenomena which we can analyze with the physics we have today, and which will produce other things no less important than quantum computers”.

HELENA ZAPKE



## ECONOMICS, FINANCE AND MANAGEMENT

# Public policies to mitigate information asymmetries in the markets

**T**he inaugural BBVA Foundation Frontiers of Knowledge Award in the Economics, Finance and Management category goes to French economist Jean Tirole (Troyes, 1953). Tirole is one of the world's economic eminences in the theoretical and practical application of Game Theory and Information Theory. He is also a leader in the analysis of inefficiencies deriving from the possession of inside information among economic agents, and the design of contracts and public policies to mitigate the effects of these inefficiencies.

Tirole refers to the reputation gained through his research work as “a matter of luck, being in the right place at the right time”, because, he explains, he began his career “just as two interesting mathematical theories came to the fore: Game Theory and Information Theory”. The former predicts the strategies that will be adopted by distinct players in a given situation and is now among the dominant theories in economic analysis. The latter describes how these players go about using inside information in a strategic way, and Tirole has successfully applied it to the study of public and private organizations of all sizes and how they interact with the markets.

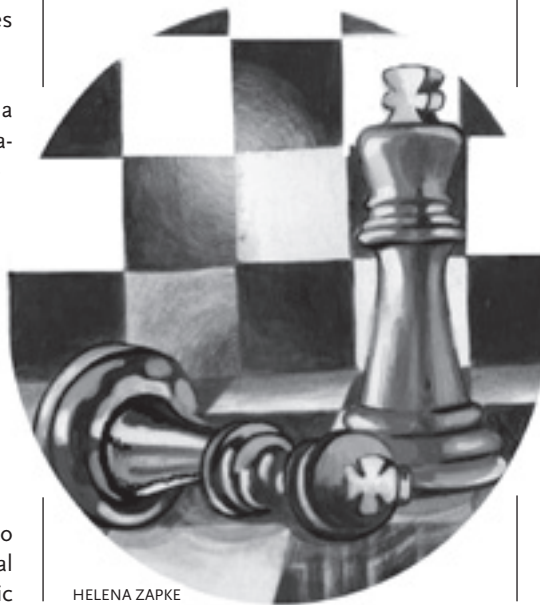
“These theories have allowed me to use a theoretical and applied approach in analyzing specific areas such as competition, finance or financial crises”, Tirole continues. The French economist has also been examining some of the causes behind the current economic situation, such as flaws in financial institution regulation and the dearth of market liquidity.

## From public policy design to financial crashes

Professor Tirole's research has also focused on phenomena such as financial crashes and the collapse of economic

bubbles. He has authored more than 150 articles and a number of books that have become international standards among both academia and officialdom. His innate curiosity has led him to explore fields conventionally seen as separate, resulting in a chain of innovations that run from pure theory (game theory, information economics, psychology and economy) via applied theory (industrial economy, banking, corporate finance, organization theory) to the design of public policies (network industry regulation, banking, labor markets, procurement, etc.).

Jean Tirole first trained as a civil engineer then went on to obtain a PhD in mathematics from the University Paris-Dauphine, and another in economics from the Massachusetts Institute of Technology (MIT). He is currently director of the Jean-Jacques Laffont Foundation – named for an economist he worked with in the past – at the Toulouse School of Economics, and Scientific Director of the Industrial Economics Institute of the same French city.



HELENA ZAPKE

C. LEBEDINSKY/CNRS PHOTOTHEQUE



French economist Jean Tirole.

One of his latest and most novel research lines aims to refine traditional economic models, incorporating the results of psychological studies in order to nuance premises that rely too much on the rationality of economic agents. This work has provided new insights into the interrelation between monetary incentives and social motivations such as identity, social reputé and self-esteem, and the ways in which the environment determines the effectiveness of self-control.

In the jury's words, Jean Tirole “was deemed to merit the award for his economic analysis of optimal contracts and optimal design of public policies in a variety of contexts where asymmetry of information and conflicting incentives play a key role, including regulation, corporate finance and the analysis of economic organizations”.

## ECOLOGY AND CONSERVATION BIOLOGY

# Revealing the long-term consequences of habitat fragmentation

**T**he inaugural BBVA Foundation Frontiers of Knowledge Award in the Ecology and Conservation Biology category is shared by biologists Thomas E. Lovejoy and William F. Laurance of the Smithsonian Tropical Research Institute (United States).

The new laureates' three decades of research in Amazonian Brazil have been of seminal importance, according to the jury, enabling us "to measure the manifold consequences of habitat fragmentation for the integrity of tropical forests" for the first time ever, and to scientifically simulate how their ecosystems will cope in the future.

Lovejoy and Laurance launched the Biological Dynamics of Forest Fragments Project (BDFFP) in the late 1970s. Fragmentation is among the direst threats facing the natural ecosystems of our planet. The BDFFP's study area spans more than 1,000 km<sup>2</sup> of virgin forest, including a series of experimentally isolated fragments. Researchers there track the "before and after" of ecosystem fragmentation with regard to the abundance of species, and have come up with novel data of immense value.

The jury of the BBVA Foundation Frontiers of Knowledge Awards also singled out both researchers' endeavors in training new generations of Amazonia researchers and in successfully transmitting



Thomas E. Lovejoy.

skills and knowledge so their work can be carried on for years to come; indeed their conservation practices have become benchmarks of their kind.

In the words of its citation, "the awardees are recognized for their contributions to understanding the effects of land use change on biodiversity and ecosystem processes (...). Their work has revealed many unexpected features of habitat fragmentation, such as dramatically increased mortality in forest trees, with far-reaching consequences for the preservation of forest biodiversity and carbon pool dynamics. Insights from this study have significantly influenced conservation science and practice". The awardees were also applauded for their analyses of the impact of global change phenomena on tropical forests, and for developing the crucial conserva-



William F. Laurance.

tion policy mechanism for protecting natural landscapes known as "debt-for-nature swaps" (forgiveness of countries' foreign debt in exchange for nature preservation), which have successfully channeled over 3 billion dollars to conservation work in countries like Bolivia, Costa Rica, Ecuador, the Philippines, Madagascar, Jamaica and Zambia.

Thomas Lovejoy warns that "Amazonia is now perilously close to the point of no return. Ecosystem degradation is advancing much faster than we imagined, though we must take hope from the ambitious conservation initiatives that are now starting up". William Laurance adds that ecosystem fragmentation is now conspiring with "other pernicious processes like climate change and deforestation. We need to understand now how this interaction comes about".

FUNDACIÓN BBVA



Biomedicine jury: Bruce Whitelaw, Dario Alessi, Angelika Schnieke, Torsten Wiesel (chair), Josep Baselga, Juan Modolell and Robin Lovell-Badge.

## Endorsing the rigor, objectivity and scientific excellence of the awards

**T**he BBVA Foundation Awards honor fundamental advances in leading-edge research and artistic creation. They also attach a very special importance to basic knowledge, on the grounds that however valuable the other forms of applied scientific research may be, basic knowledge remains the principal driver of scientific change and, indirectly, of our material progress, wellbeing, and cultural development.

This recognition attains its full value when candidates are assessed against the best available scientific metrics. And it is in this task that the Foundation has been aided by the Spanish National Research Council (CSIC), the main nexus for science implementation in Spain. The CSIC not only participated in the appointment of the 49 members serving on the eight prize juries, but also proposed the chairman or chairwoman in each case. Drawn from a total of eleven countries, the jury members in this inaugural edition were all eminent international experts in their respective fields.

Frontiers of Knowledge Award in **Bio-medicine**. The jury was chaired by Torsten Wiesel, Nobel Prize in Medicine and Physiology, and formed by Angelika Schnieke

of the Technical University of Munich (Germany), an expert on cloning and second author of the “Dolly” paper; Bruce Whitelaw, a leading expert in transgenic animals from the Roslin Institute (United Kingdom); Dario Alessi of the Scottish Institute for Cell Signalling (United Kingdom); Robin Lovell-Badge, of the National Institute for Medical Research (United Kingdom); Josep Baselga, oncologist in

the Research Institute of Vall d’Hebron Hospital, Barcelona; and Juan Modolell, Severo Ochoa Molecular Biology Center, Madrid, holder of the “Santiago Ramón y Cajal” National Research Prize in Biology.

Frontiers of Knowledge Award in **Economics, Finance and Management**. The jury was chaired by Spaniard José Manuel González-Páramo, Professor of Public

FUNDACIÓN BBVA



Economics, Finance and Management jury: Timothy J. Besley, Peyton Young, José Manuel González-Páramo (chair), Guido Tabellini and Hervé Moulin.

Finance at the Complutense University of Madrid and a member of the Executive Board of the European Central Bank, and formed by Timothy J. Besley, professor at the London School of Economics and Political Science (United Kingdom) and president elect of the European Economics Association; fellow Briton Peyton Young (The Brookings Institution, United States); Italian Guido Tabellini, the chancellor of Bocconi University in Milan (Italy); and Frenchman Hervé Moulin of Rice University (Houston, United States).

**Frontiers of Knowledge Award in Development Cooperation.** The jury was chaired by Mark R. Rosenzweig, director of the Economic Growth Center at Yale University (United States), and formed by Jonathan Morduch, Professor of Public Policy and Economics at New York University; Norman Loayza, from the Research Department of the World Bank; Jonathan Temple, Professor of Economics at the University of Bristol (United Kingdom) and José García Montalvo, chairman of the Department of Economics and Business at Pompeu Fabra University, Barcelona.

**Frontiers of Knowledge Award in Basic Sciences.** The jury was chaired by Theodor W. Hänsch, the 1995 Nobel Prize in Physics, and made up of nanoscientists Hongkun Park of Harvard University (United States) and Sandip Tiwari of Cornell University (United States); Douglas Abraham from the University of Oxford (United Kingdom); Martin Quack of ETH Zurich; and Gerardo Delgado of the Spanish National Council for Scientific Research (CSIC).

**Frontiers of Knowledge Award in Arts.** The jury was chaired by classical music critic Reinhard Brembeck, and formed by composers Helmut Lachenmann (Germany) and Luis de Pablo (Spain); the Spanish architects Antón García-Abril and Ramón Sanabria; the German Armin Köhler, director of the Donaueschingen Music Festival; the British art critic Richard Whitehouse; and Wulf Weinmann, managing director of German music label NEOS, acting as secretary.

**Frontiers of Knowledge Award in Information and Communication Technologies (ICT).** Chairing the jury was Andrea Goldsmith, Professor of Electrical Engineering at Stanford University and president of

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Development Cooperation jury: Mark R. Rosenzweig (chair), Jonathan Temple, José García Montalvo, Jonathan Morduch and Norman Loayza.

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Basic Sciences jury: clockwise from the left, Douglas Abraham, Martin Quack, Gerardo Delgado, Hongkun Park, Sandip Tiwari and Theodor Hänsch (chair).

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Arts jury: Ramón Sanabria, Armin Köhler, Luis de Pablo, Reinhard Brembeck (chair), Richard Whitehouse, Helmut Lachenmann, Wulf Weinmann and Antón García-Abril.

the IEEE (Institute of Electrical and Electronics Engineers), the most influential professional association in the world of advanced technology. Other members were Ronald Ho, the engineer leading the VLSI Research Group of IT company Sun Microsystems; Oussama Khatib, a leading specialist in robotics working at the Artificial Intelligence Laboratory of Stanford University (United States); Nico De Rooij, Head of Laboratory in the Institute of Microtechnology, University of Neuchâtel (Switzerland); and Spaniards Ramón López de Mántaras, director of the Artificial Intelligence Research Unit (IIIA-CSIC) and Sergio Verdú, Professor of Electronic Engineering at Princeton University (United States).

**Frontiers of Knowledge Award in Climate Change.** The jury was chaired by Edward S. Rubin of Carnegie Mellon University (United States), and formed by Kenneth J. Davis (Pennsylvania State University and director of the Center for Advanced Carbon Research and Education, in the United States); Hans J. Schellnhuber of the Potsdam Institute for Climate Impact Research (Germany); Bjorn Stevens of the Max Planck Institute for Meteorology (Germany); and the Spaniards Carlos Duarte (Mediterranean Institute for Advanced Studies, CSIC-University of the Balearic Islands) and Sergio Alonso (University of the Balearic Islands).

**Frontiers of Knowledge Award in Ecology and Conservation Biology.** The jury was chaired by Daniel Pauly, professor at the Fisheries Center, University of British Columbia (Canada), and formed by leading international experts in environment-

related areas: Joanna Burger of Rutgers University (United States); Daniel P. Faith of the Australian Museum (Australia); Ilkka Hanski of the University of Helsinki (Finland); Robert D. Holt of the University of Florida (United States); Gary Meffe, editor of Conservation Biology (United States); and Pedro Jordano of Doñana Biological Station-CSIC.



Information and Communication Technologies jury: Ronald Ho, Nico de Rooij, Andrea Goldsmith (chair), Oussama Khatib, Ramón López de Mántaras and Sergio Verdú.



Climate Change jury: Sergio Alonso, Carlos Duarte, Edward S. Rubin (chair), Bjorn Stevens and Kenneth J. Davies. Hans J. Schellnhuber took part in the deliberations through videoconference.



Ecology and Conservation Biology jury: clockwise from the left, Pedro Jordano, Gary Meffe, Daniel P. Faith, Ilkka Hanski, Robert D. Holt, Joanna Burger and Daniel Pauly (chair), in the midst of their deliberations.

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