In the fourth edition of these awards upholding science as a motor of progress

# Carver Mead wins the BBVA Foundation Frontiers of Knowledge Award for making computers ubiquitous with transformative power in our daily lives

- His contributions "have propelled the semiconductor industry and enabled the vast array of computing devices that permeate our everyday lives," in the view of the prize jury.

- It was Mead who coined the name "Moore's Law", which predicts that the processing power of computers will double every eighteen months, and gave it its scientific underpinning.

- The BBVA Foundation Frontiers of Knowledge Awards recognize the role of science and cultural creation as levers of society's progress and wellbeing. Their eight categories span the main scientific, technological, social and economic areas and challenges of our times

**Madrid, January 17, 2012.-** The BBVA Foundation Frontiers of Knowledge Award in the category of Information and Communication Technologies (ICT) goes in this fourth edition to U.S. electrical engineer Carver Mead, for being "the most influential thinker and pioneer" of the silicon age, and for enabling "the development of the billion-transistor processors that drive the electronic devices – for example, in laptops, tablets, smartphones, DVD players, and hybrid cars – ubiquitous in our daily lives," in the words of the jury's citation.

Carver Mead (California, 1934), Gordon and Betty Moore Professor Emeritus of Engineering and Applied Science at California Institute of Technology, was the first to predict, back in the early 1970s, that chips would come to contain millions of transistors, setting the industry on the path of exponential growth.

This insight was based on a profound understanding of the semiconductor physics that he would help make a palpable reality: Mead is the inventor of VLSI (Very Large Scale Integration) devices comprising literally billions of components.

"The richness and diversity of Mead´s work is difficult to overstate," the citation continues. "His work has propelled the entire semiconductor industry and enabled the vast array of computing devices that permeate our everyday lives."

The name of the new laureate was announced this morning in the Marqués de Salamanca Palace, Madrid headquarters of the BBVA Foundation, at an event attended by the jury chair, Andrea Goldsmith, accompanied by Juan José Damborenea, Deputy Vice-President of Scientific and Technical Areas at the Spanish National Research Council (CSIC) and Rafael Pardo, Director of the BBVA Foundation.

**"People didn't believe it was possible"**

"In those years (the early 1970s), people didn't believe you could make transistors very small," recalled Mead on the phone yesterday after hearing of the award . "So first of all the physics had to be worked out to see just how small they could be made. Then of course you had to find ways to put hundred of millions of transistors on a chip. We went a step at a time."

Mead's work elucidated the workings of what he himself termed "Moore's Law", predicting that the processing power of computers would more or less double every eighteen months.

According to the award certificate, "Carver Mead not only coined the name 'Moore´s Law,' but also developed, through his study of fundamental physical laws, the scientific underpinning of this empirical observation, and used that research to predict limits on transistor scaling."

By demonstrating in both theory and practice that these limits were still far off, Mead opened the door to the exponential growth of this technology. His work was also instrumental in *systematizing* design of the new, powerful chips, so even those ignorant of the underlying physical principles could enter the production fray. Mead translated these principles into "basic rules that many more people, even those without a specialist knowledge of physics, could apply to the design of increasingly complex chips. Companies would no longer need to have a theoretical physicist on the team; just an electronic engineer who could follow Mead's guidelines," explains hardware architect Ronald Ho, a member of the jury.

Another Mead innovation was HEMT transistors, the standard high-frequency amplifiers used in cell phones, radar, and satellite microwave communications.

**A primer mover in Silicon Valley**

Mead was also a prime mover in the growth of Silicon Valley during what he described yesterday as a "very exciting time". "It was clear by then that silicon

chips would have a wide array of functions, but there were other applications that none of us could have foreseen."

His influence has also been strongly felt on the business side of microprocessing. It was Mead who introduced rules separating the chip design process from their physical fabrication, "allowing chip companies to focus on research and development without the expense of building and maintaining factories," in the words of the jury. Without this model, the explosive growth of the ICT industry would simply "not have been possible".

Mead himself is a Silicon Valley entrepreneur with some twenty start-ups to his name. Among his more than eighty patented inventions are the sensors used in today's digital cameras; systems facilitating the development of tactile devices, like the touchpad that replaces the mouse in laptop computers; or signal processing systems for hearing aids.

These last developments trace to the career turn executed by Mead at the height of his achievements in microchip design and manufacture. Mead's new object of fascination was the study of biological systems, to which he brought an innovative conceptual approach: to understand the functioning of the eye or ear, he contended, you must first make artificial replicas.

"His vision was to understand biological neural systems by recreating them in silicon, which launched the field of analog neuromorphic circuit design," the citation explains. "Based on this vision, Mead built the first silicon retina and silicon cochlea, which led to some of his entrepreneurial successes."

## Biography of Carver Mead

Carver Mead was born in Bakersfield, California, on May 1, 1934. He grew up in Big Creek in the Sierra Nevada mountains (California), where he attended a backwoods school with around twenty pupils and one or two teachers, depending on the year. He remembers vividly how his sixth grade teacher introduced him to the world of mathematics and science: "He gave me a book that contained some elementary trigonometry and I saw how to tell the height of a tree without climbing it." His father got him interested in electrical phenomena by bringing home cast-off batteries, switches and other gear from his job at the local power plant.

In 1956 he received his BS in electrical engineering from California Institute of Technology (Caltech), where he would spend the rest of his academic life. He obtained his MS there in 1957, followed by his PhD in 1960. And it was there he began the teaching career that would culminate in his appointment as Gordon and Betty Moore Professor of Engineering and Applied Science. Author of more than 200 scientific papers and over 80 patents, he has been distinguished with the National Medal of Technology (the highest honor for technological innovation

bestowed by the U.S. Government), the Lemelsol-MIT Prize, the IEEE John Von Neumann Medal and a score more of accolades.

## The BBVA Foundation Frontiers of Knowledge Awards

The BBVA Foundation established the Frontiers of Knowledge Awards in 2008 to recognize the authors of outstanding contributions and significant advances in a broad range of scientific and technological areas characteristic of our times. The quality of the nominations received, the stature of the international judges, appointed in consultation with the Spanish National Research Council (CSIC), and the excellence of the laureates in the first three editions have earned them a place among the world's foremost award families.

In the midst of a severe economic crisis which has pushed science, culture and the environment lower down the list of public priorities, the BBVA Foundation Frontiers of Knowledge Awards enter this fourth edition firm in their commitment to the individuals and teams working for a better future for people through the advancement of knowledge and its dissemination to society.

The eight categories of the BBVA Foundation Frontiers of Knowledge Awards, each carrying prize money of 400,000 euros, reflect both the knowledge map of the early 21st century and the great global challenges of the day. Hence their inclusion of two dedicated environmental categories in the shape of "Climate Change" and "Ecology and Conservation Biology".

The BBVA Foundation primarily engages in the generation and diffusion of scientific knowledge and culture. This effort materializes in research projects, advanced training, lectures and publications, and a series of award families aimed at recognizing and drawing public attention to the work of scientists and creative practitioners.

Among the BBVA Foundation's areas of activity are basic sciences, biomedicine, ecology and conservation biology, the social sciences and literary and musical creation. Its initiatives mesh with the BBVA Group's strategy of fostering innovation and knowledge as development drivers and an effective means to expand citizens' individual and collective choices.

### International jury

The jury in this category was chaired by **Andrea Goldsmith**, Professor of Electrical Engineering at Stanford University (United States), with **Ramón López de Mántaras**, Director of the Artificial Intelligence Research Institute at the Spanish National Research Council (CSIC) acting as secretary. Remaining members were **Ronald Ho**, hardware architect at Oracle Laboratories (United States), **Oussama Khatib**, Professor of Computer Science in the Artificial Intelligence Laboratory at Stanford University (United States) and **Nico de Rooij**, Director of the Institute of Microengineering at the École Polytechnique Fédérale de Lausanne (EPFL), in Switzerland.

The ICT award in the last edition was granted to Donald E. Knuth for "making computing into a science" in the words of the prize jury. Considered "a giant

among giants", his work is the scaffolding upon which modern computer programs are built.

The award in the second edition went to Thomas Kailath for a development permitting the production of increasingly small size chips. Methods of his invention are able to pattern integrated circuits with components finer even than the lightwaves used in their production, rather like drawing a line that is finer than the point of the pencil.

Finally, the winner in the inaugural edition was Jacob Ziv, the mind behind such hugely popular file formats as MP3, JPG or PDF.

## UPCOMING AWARD ANNOUNCEMENTS

| CATEGORY | DATE |
|---|---|
| **Basic Sciences** | Tuesday, January 24 |
| **Biomedicine** | Tuesday, January 31 |
| **Ecology and Conservation Biology** | Tuesday, February 7 |
| **Contemporary Music** | Tuesday, February 14 |
| **Economics, Finance and Management** | Tuesday, February 21 |
| **Development Cooperation** | Tuesday, February 28 |

**LAUREATE'S FIRST DECLARATIONS AND IMAGES**

A video recording of the new laureate's first impressions on receiving news of the award is available from the Atlas FTP with the following name and coordinates, along with photographic images and an audio MP3 recording of the announcement event, featuring more declarations:

Server: **213.0.38.61**
Username: **agenciaatlas1**
Password: **amapola**

The name of the video is:
"FBBVA PREMIO TIC"

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