



INSTITUT DE FRANCE  
Académie des sciences

## One Year with the Académie des Sciences

2012

Encouraging the Science Community

Promoting Scientific Teaching

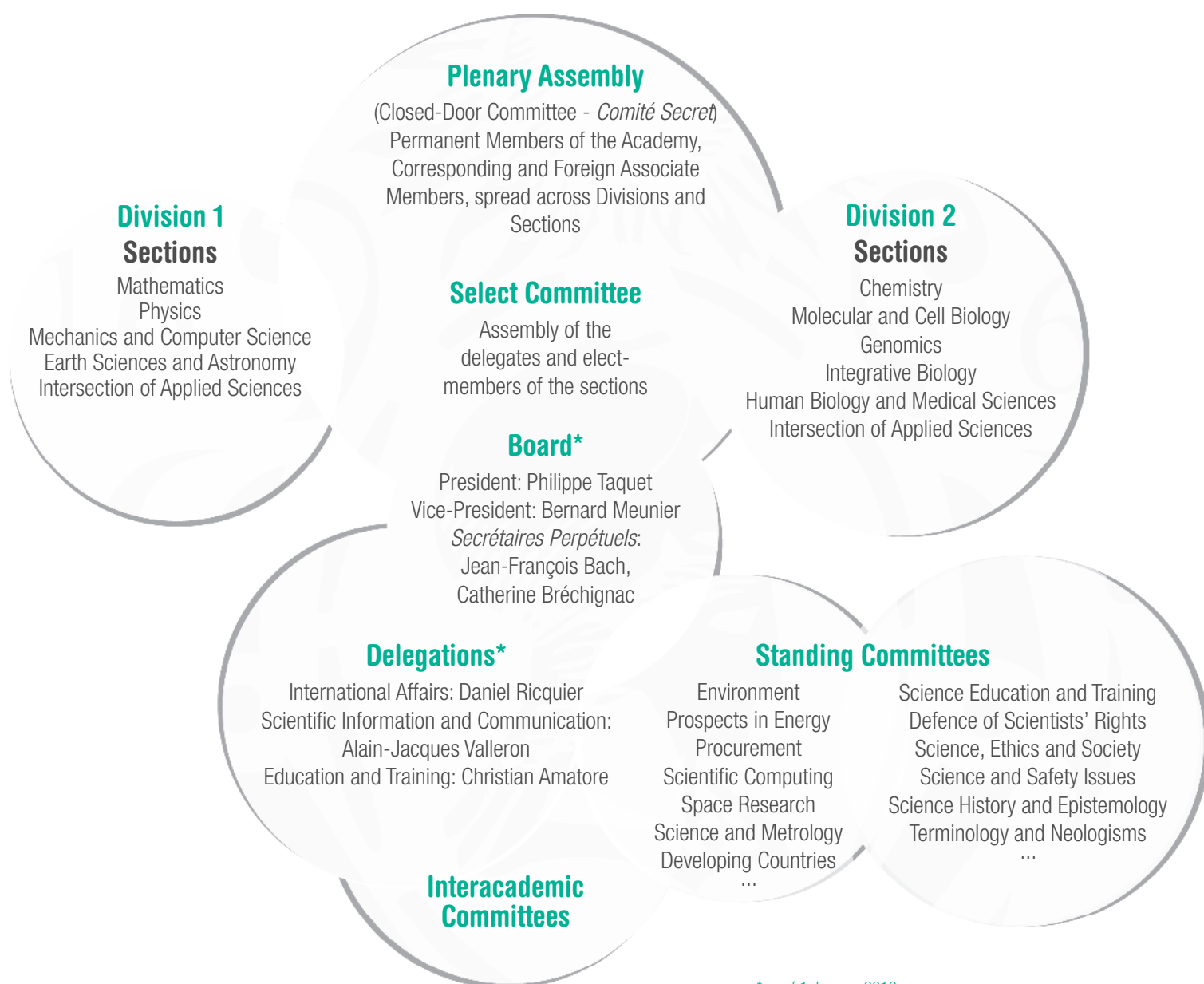
Transmitting Knowledge

Fostering International Collaboration

Playing an Expert and Advisory Role

## The Académie des Sciences: a modernised institution

The Académie des Sciences holds an original position among French scientific institutions: placed under the protection of the President of the French Republic, it is self-governed and only supervised by the French National Audit Office (Cour des comptes). Such independence also stems from the process through which members are appointed: they are peer-elected. Gathering the scientific elite of our country, the Académie des Sciences has adapted to the increasing pace of scientific progress by expanding its membership – now at 245 members aside from Foreign Associate and Corresponding Members – and rejuvenating the profile of the Academy – half of its seats are kept for applicants under 55 years old, which means they are still working – thus making sure the Academy is in direct connection with civil society and economic activities. The Académie des Sciences performs its five missions through finely-tuned coordination between its statutory governance bodies, all members of which have been elected, and Committees providing analysis and advice.



\* as of 1 January 2013



## EDITORIAL

Sciences are amazing drivers of social progress, especially through their technological applications. Medicine, energy, agriculture, transportation, telecommunications: all these common life domains, together with the increase in life expectancy, have considerably benefitted from the scientific breakthroughs achieved since the end of the 19<sup>th</sup> Century.

Such major progresses, however, are sometimes suspected of jeopardising the health of populations or their environment. For several years, incomprehension has gradually been setting in between scientists and society regarding risk perception. Now, how can one act with caution against the threat, whether real or not, that scientific progress may be used for wrong purposes, and yet avoid obscurantism? It is up to political actors to decide between options that impact society. How may political decision makers be given the capacity to make informed choices that respect the principles of democracy? There emerged the crying need to develop mechanisms that may help in the process of decision making.

Among the five missions of the Académie des Sciences – Encouraging the science community, Promoting scientific teaching, Transmitting knowledge, Fostering international collaboration, Playing an expert and advisory role – that of providing advice in the fields of science dates back to its creation. In 2012, at the dawn of its 350<sup>th</sup> anniversary, the Académie has adopted a *Charter*, which provides a framework for such expert activities, based on the work of members of the Académie and of the Standing Reflection Committees the Académie has put in place. On request from relevant authorities or at its own initiative, the Académie des Sciences is in a position to gather the experts on a given issue, who then, after thorough analysis, express their conclusions at the Plenary Assembly of the Académie, for its members to discuss them. *One Year with the Académie des Sciences* emphasizes these crucial activities carried out by the Committees of the Académie in charge of reflecting and making proposals on major issues of society.



**Jean-François Bach**



**Catherine Bréchnignac**

Secrétaires Perpétuels  
of the Académie des Sciences

All through 2012, as this document shows, the Académie des Sciences exercised its responsibilities and assumed its missions while significantly expanding its activities.

Our Académie, driven by the competence, diversity, rigour and independence of its members, as well as by their convictions, has been able to draw on its collegial organisation – of which it is very fond – to fully play its role in front of the French State authorities, beside the scientific community and in the very heart of the community of nations.

In a troubled world, continuously evolving as it finds new balance, and with new questions arising, our societies and our Académie often find themselves taking on new challenges.

In 2012, the conferences, debates, public sessions, interacademic or international colloquia, reports and advice notes, and, among the latter, most particularly the comments and proposals made on the structure of public scientific research in France, have been welcomed, read or heard, appreciated and taken into account by all the actors of our society.

In 2012, the Académie des Sciences has honoured and celebrated the excellence of numerous French and foreign scientists, organised and hosted a warm and fruitful meeting with the youth, and was most pleased to see the first *Maisons pour la science* open. The Académie has also expanded the number of twinning operations between scientists and Parliamentarians, fostered stronger relationships with foreign Academies and strengthened its position as a constructive participant to international summits.

Last but not least, in 2012, the Académie des Sciences was delighted to hear that one of its members was awarded the Nobel Prize - the most prestigious acknowledgement of the work and task of a scientist.



**Philippe Taquet**

President of the Académie des Sciences

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## ENCOURAGING THE SCIENTIFIC COMMUNITY



The Académie des Sciences carries out actions that foster discovery: it organises scientific colloquia and sessions on various themes to promote top-level exchanges, honours the best scientists by awarding them great prizes for their work, and publishes the review *Les Comptes Rendus de l'Académie des Sciences*, thus contributing to the diffusion of knowledge among the international scientific community.

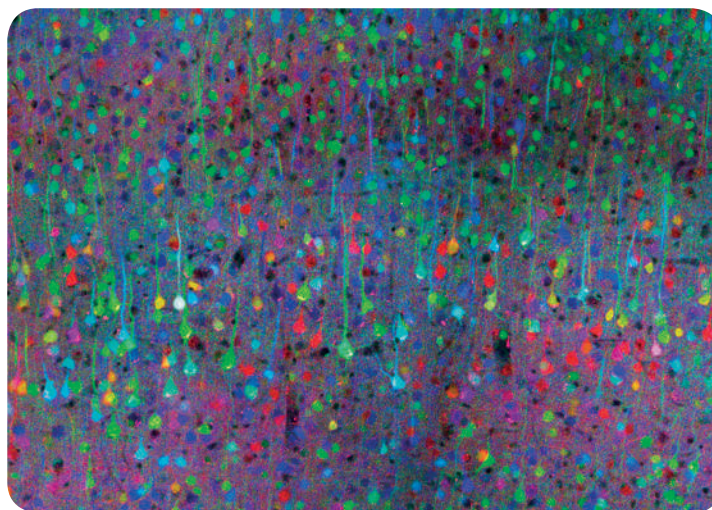
## Colloquia by and for the scientific community

Confronting knowledge and skills is crucial to scientific progress. Boosted by its interdisciplinary approaches and close relations with the research forces, both in France and abroad, the Académie des Sciences organises every year a series of scientific events focused on the frontiers of knowledge.


### Conference Debates

#### ***Life Imaging Technology: Where to? (24 January 2012)***

X-rays, MRI (Magnetic Resonance Imaging), ultrasounds, ...: since the end of the 19<sup>th</sup> Century and the discovery of X-rays, imaging has proved to be a revolutionary tool for medicine and surgery. Recent developments highlight the input of three extremely innovative methods: functional MRI, which is mostly used on the brain and makes good use of the contrast agents that are naturally produced; ultrafast ultrasound imaging of tissue elasticity and blood streams, which utilises, among others, shear acoustic waves; super-resolution imaging, which makes it possible to detect and monitor single molecules, as illustrated by the study of neurotransmitter receptors across synapses.



Stéphane Fouquet - Inserm

 Cortex of a «Brainbow» mouse


#### ***Science and instrumentation (14 February 2012)***

Scientific progress has always built on technological and conceptual progress that make it possible to improve the efficiency of instruments. During this meeting, some very recent historical examples have been presented to show what mutual benefits pure science and instrumentation provide one another.

### The Académie des Sciences in session in Bordeaux



© Jérémie Marchal - Fotolia

 Place de la Bourse in Bordeaux

Since 1996, the Académie des Sciences meets outside Paris in order to communicate its work and strengthen its relationships with the local scientific community involved in scientific and technological research. From 14 to 16 September 2012, the Académie was in Bordeaux, invited by the Regional Council of Aquitaine, City Council, University of Bordeaux, French Alternative Energies and Atomic Energy Commission (CEA), National Centre for Scientific Research (CNRS), National Institute for Agricultural Research (Inra), National Institute for Research in Computer Science and Control (Inria) and National Institute of Health and Medical Research (Inserm). Conferences open to the public have let researchers from Bordeaux to expound their work on topics as diverse as big lasers and their use (from astrophysics to molecular dynamics), numerical simulation and its applications, particularly to oncology, materials chemistry, neurosciences and addiction, oenology, prehistory and anthropology, the environment and its contaminants. Members of the Académie have also delivered lectures, on such themes as future housing, the prevention of sudden unexpected death, brain imaging on a nano (one billionth meter) scale, world energy by the end of the century. A session was especially devoted to the future of science teaching: co-organised with the National Education local Authority of Bordeaux (*Rectorat de Bordeaux*), it gave speakers the opportunity to provide an account of groundbreaking experiences and the Académie des Sciences the occasion to introduce the Foundation La Main à la pâte and its project *Maisons pour la science au service des professeurs* [*Houses for Science to the Benefit of Teachers*].

### ***Synthetic Biology, Rebuilding Life: How and Why? (12 June 2012)***

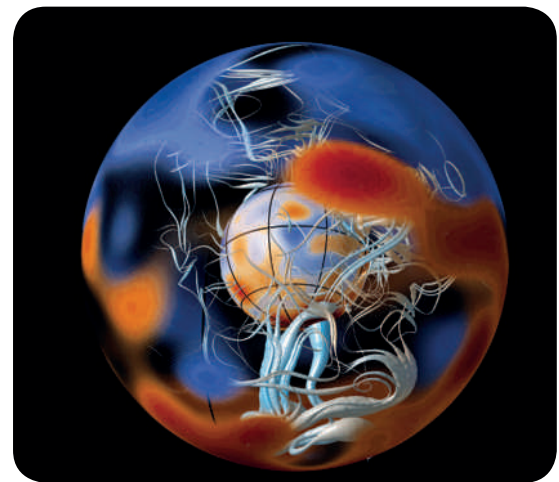
Thanks to the progress achieved in biology, chemistry, physics, biotechnology and computer science, it now becomes possible, as with building blocks, to build up unprecedented entities and living systems that did not exist in nature. What methods, issues, new questions and hopes do synthetic biology raise? What are the risks at stake and the security and ethics problems?

### ***Quasicrystals (15 June 2012)***

Quasicrystals, which won their discoverer, Dan Shechtman, the Nobel Prize in Chemistry in 2011, still trigger many a study, both at the basic level, for example on redefining order in solids, and the applied level, in terms of exploring their mechanical and electronic properties – all features that were discussed during this colloquium organised with the French National Centre for Scientific Research (CNRS).

### ***When Earth can't find True North (19 June 2012)***

The period of magnetic polarity we live in, which began 780,000 years ago, seems abnormally long, compared to the previous ones, and the intensity of Earth's magnetic field has significantly declined in the last two thousand years. Are we at the dawn of an inversion in the magnetic field of the earth? The sun also has a powerful magnetic field, and it reverses at a quasi-periodicity of about 11 years. Where do these differences between the dynamos of the earth and sun come from? From what observations and experiences may we answer these complex questions that geophysicists and astrophysicists raise?



Computer simulation of the Earth's magnetic field

Julien Aubert, Finlay, Jackson, Olson, Gillet - CNRS/IPGP/Univ Paris Diderot

### **Members of the Académie paying tribute to their predecessors**



Henri Poincaré

On a regular basis, sessions have been devoted to members of the Académie whose pioneering work made a decisive impact on science. In 2012, the Académie has thus honoured the memory of:

- ▶ Henri Poincaré (1854-1912), for his work on relativity and in astrophysics;
- ▶ Victor Grignard (1871-1935) and Paul Sabatier (1854-1941), awarded the Nobel Prize in Chemistry in 1912, for their respective work in organic synthesis and catalysis;
- ▶ Marc Julia (1922-2010), for his work in organic chemistry and its applications;
- ▶ Ivan Assenmacher (1927-2010), for his work on neuroendocrinian mechanisms and biological rhythms.

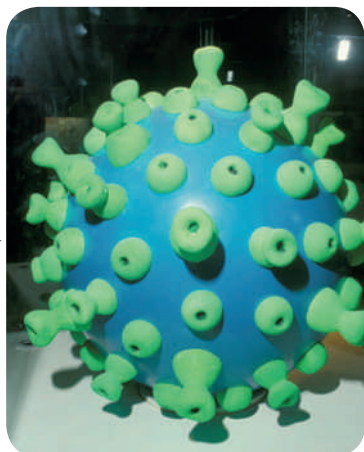
### ***Rare Events and Extreme Risks (9 October 2012)***

Do rare events escape scientific analysis? What extreme risks are our societies subjected to? How can we foresee them and protect from them or invest consequently? Part of the answer may follow from assessing the risk for natural – especially climatic – events to occur, computer networks to collapse, seismic events to take place and, finally, it may follow from the application of the rare event theory to quantitative finance and insurance companies.

## Interacademic sessions and colloquia

### ***Cell Shape Determination: the Converging Evolution of the Cell Wall in Bacteria, Fungi and Plants (13 March 2012)***

Bacterial, fungal and plant cells are equipped with a rigid and thick extracellular matrix: the cell wall. Although their chemical compositions are totally different in these three kingdoms, the architectures of these cell walls have converged into a composite material fortified with fibres, whose orientation determines the shapes of the cells. Evolution endowed these three kingdoms with a cell machinery allowing for the oriented deposition of polymers and their reorganisation during cell growth.



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### ***Futures Vaccination (3 April 2012)***

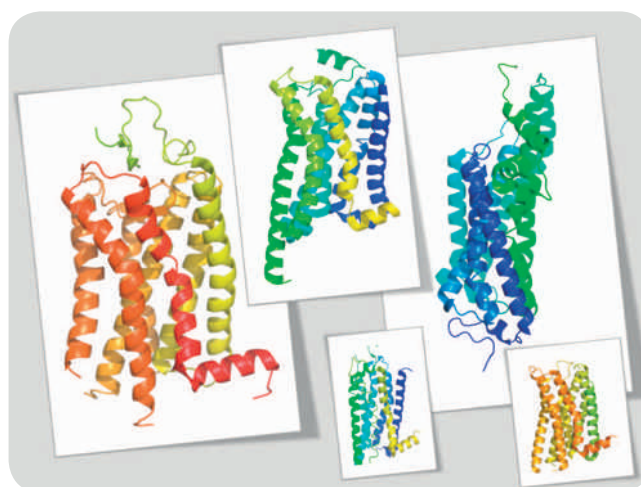
AIDS, parasitic diseases, cancers,... – all diseases which dramatically burden population health – all fields which are explored by leading-edge research projects aimed at developing preventive or curative vaccines. Is recent progress so substantial as to let us envision a short- or mid-term positive outcome, making up for the immense deal of energy that has been spent in this matter over the last decades?

### ***Philosophy Teaching and Sciences (9 May 2012)***

How may cooperation between philosophy and science high-school teachers be promoted, so as to help scientific spirit diffuse in the pupils' minds, some of which shall take teaching positions at all levels? The colloquium concluded it necessary to call for in-service teacher training in this area as well as to wish for science history and epistemology to be part of the preparatory courses to the competitive recruitment of teachers.

### ***A New Pharmacology, a New Physiology: the Superfamily of G-Protein Coupled Receptors (4 December 2012)***

G protein coupled receptors (GPCRs) operate in the great majority of physiological functions and their pathologies, and this is why 30% to 40% of all drugs target them. Yet the functions and ligand of one out of five receptors remain unknown. The study of these orphan receptors thus constitutes an enormous field of research, towards the progressive discovery of new physiological mechanisms and new therapeutic molecules.



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3-D GPCRs



## International Colloquia

### ***A History of Chemistry (19 January 2012)***

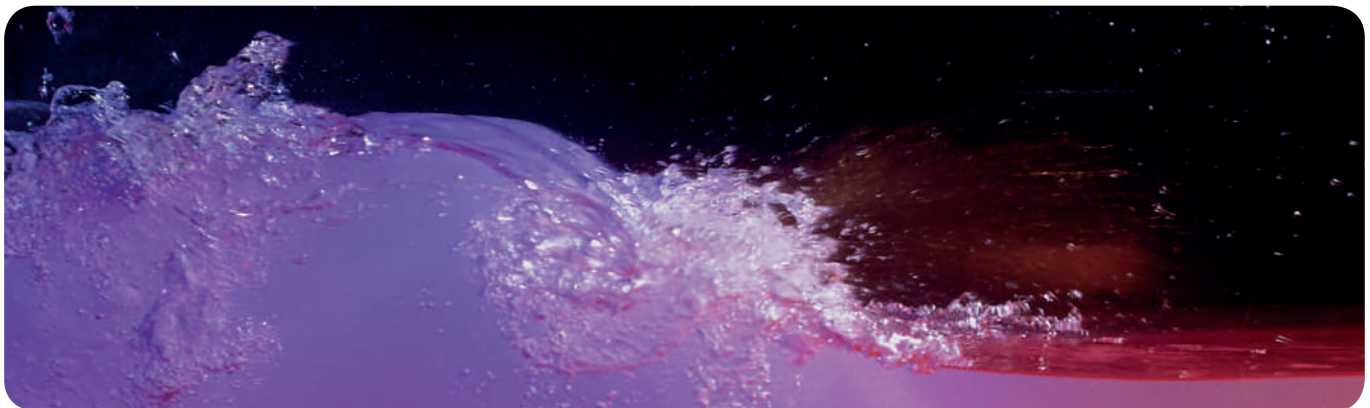
From alchemy and its philosophers to the stage of medicine derived from plants, then derived from drugs that imitate nature and are produced through organic synthesis; from the human needs that led to the birth of industry before all was explained, to the birth of the atomic theory: this colloquium has investigated a great number of the elements that make up the great history of chemistry.

### ***African Forest Fragmentation during the Late Holocene (1 and 2 March 2012)***

The main objective of this colloquium, held at the end of the international year of forests, was to outline the importance of time in understanding the responses of the ecosystems to climate change – a widely shared issue among paleo-environmentalists, geneticists, and researchers in ecology and various human and social sciences (linguists, ethnologists, musicologists, archeologists).

### ***Erosion and Alteration: from Elementary Mechanisms to Geodynamic Consequences (26-27 March 2012)***

Important progress have been achieved in the last twenty years in understanding and modelling alteration and erosion processes, both in trying to characterise their respective roles in geologic and climatic cycles and to understand their responses to tectonic, climatic or anthropogenic forcing. This colloquium was an opportunity to broach the concepts, approaches and methods that have been conceived to study these questions



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### ***The New Microbiology (14-16 May 2012)***

As superior organisms did, bacteria and other microorganisms have developed diverse strategies to express themselves and adapt. Genomic, transcriptomic, proteomic, metabolomic approaches: bacteria are efficient tools in the understanding of certain basic cell mechanisms. Under the organisation of the Académie des Sciences, the German National Academy of Sciences Leopoldina and the Royal Society, the colloquium was the occasion to take stock of the most sharp works in the field.

### ***Tissue Regeneration (13 November 2012)***

The study of ageing mechanisms and cellular death opened a vast area for research. Most recent data on the intimate mechanisms of nuclear (re)programming and its regulation have been submitted during this colloquium, which, most notably, greeted Shinya Yamanaka, who was awarded the 2012 Nobel Prize in Physiology or Medicine for his work on the de-differentiation of human stem cells into induced pluripotent stem cells.

## Awards and medals

Thanks to the generosity of private donors, state organisms and enterprises, the Académie des Sciences awards about 80 prizes every year, spanning over the whole fields of science, whether basic or applied. Many excellent candidates are considered for these prizes. Their selection is performed by juries who abide by rules and regulations that exclude the possibility of conflicts of interest. The juries of prizes that amount to less than €7,500, so-called “Académie des Sciences Thematic Prizes”, are composed by the members of the relevant sections. The “Grand Prizes”, exceeding €15,000, fall under specific juries that include members from several sections or from outside the Académie, where needed. In 2012, 26 Grand Prizes, corresponding to a total sum of €914,450, and 43 Thematic Prizes, amounting to €177,250 in all, have been awarded by the Académie des Sciences. All these prizes are awarded to the laureates during solemn ceremonies under the Cupola of the Institut de France.

### The *Grande Médaille* of the Académie des Sciences

In 1997, thanks to the reunification of different foundations, the Académie created the *Grande Médaille* to single out every year a scientist in the international landscape who has made a decisive contribution to the development of science, as testified both by the originality of his/her personal research and by its international standing and stimulating influence, so seminal indeed as to gain proper following from researchers.

🏆 2012 laureate

Adi Shamir, a professor of computer science at the Weizmann Institute of Science (Israel). He is the father of modern cryptography and, most notably, of the RSA algorithm (Rivest-Shamir-Adleman), whose hundred million copies guarantee the safety of online computer transactions.



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### The *Fondation Générale de Santé* Prize

The *Fondation Générale de Santé* and the Académie des Sciences have attributed, for the first time in 2012, the Cell Therapy and Regenerative Medicine Prize, amounting to a sum of €120,000. The prize equally rewards research from three different fields (€40,000 each, of which €10,000 is for the laureate and €30,000 for his team):

- ▶ basic research, in order to encourage the growth of scientific knowledge;
- ▶ translational, medical research, in order to encourage the fast transfer of knowledge into applications for diagnosis and therapy;
- ▶ clinical research, in order to encourage the development of new therapy for patients.

With these three prize categories, the *Fondation Générale de la Santé* and the Académie des Sciences wish to support each and every step of biomedical innovation, in order to accelerate the transfer of scientific knowledge into clinical or industrial applications at the patients' service.

🏆 2012 laureates



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- ▶ Sophie Jarriault (basic research), a researcher at the Institute of Genetics and Molecular and Cellular Biology (Illkirch);
- ▶ Monique Lafon (translational research), the viral neuro-immunology unit director of the Pasteur Institute (Paris);
- ▶ Marie-Thérèse Rubio (clinical research), a staff physician at the Saint Antoine Hospital of Paris.

## The Special Scientific Awards of the Institut de France in 2012

The Special Scientific Awards of the Institut de France are, in the field of science, attributed by decision or at the proposal of the Académie des Sciences.



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Philippe Bouyer, Alain Aspect and Christophe Salomon

- ▶ **Fondation Louis-D (€750,000):** Christophe Salomon, the director of the Ultracold Fermi gases group at the École Normale Supérieure (Paris), and Philippe Bouyer, the director of the Laboratory of photonics at the Institute of Optics (Bordeaux);
- ▶ **Fondation Christophe-et-Rodolphe-Mérieux (€500,000):** Firdausi Qadri, the director of the International Centre for Diarrhoeal Disease Research in Dhaka (Bangladesh);
- ▶ **Fondation Lefoulon-Delalande (€500,000):** William G. Kaelin, a researcher at the Dana-Farber Cancer Institute in Boston (United States), Peter J. Ratcliffe, a researcher at the Nuffield Department of Medicine, University of Oxford (United Kingdom), and Gregg L. Semenza, a researcher at the McKusick-Nathans Institute of Genetic Medicine, Johns-Hopkins University, in Baltimore (United States);

### ▶ Fondation Simone-et-Cino-del-Duca:

- Special Scientific Award (€300,000): Ben L. Feringa, a professor of molecular science at University of Groningen (Denmark);
- Cancerology Award (€15,000): Hana Raslova, a researcher at the Institut Gustave-Roussy (Villejuif);

### ▶ Fondation NRJ (€100,000):

- Isabelle Arnulf, the head of the Sleep Disorders unit at the Pitié-Salpêtrière Hospital (Paris), and Mehdi Tafti, the co-director of the Centre For Investigation And Research In Sleep at the University-Hospital of the Baroy of Vaud (CHUV), in Lausanne (Switzerland);

### ▶ Fondation Allianz (€75,000):

- Giacomo Cavalli, the director of the Institute of Human Genetics (Montpellier);

### ▶ Fondation René-Turpin (€20,000):

- Jean-Philippe Girard, the director of the Institute of Pharmacology and Structural Biology (Toulouse);

### ▶ Fondation Victor-Noury (€20,000):

- Guilaine Lagache, an astronomer at the Space Astrophysics Institute (Orsay);

### ▶ Foundation for Cardiovascular Research (Danièle-Hermann Prize) (€15,000):

- Catherine Llorens-Cortes, the director of the Central Neuropeptides in Cardiovascular and Hydric Regulation laboratory at the Collège de France (Paris).



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Daniel Mansuy and Ben L. Feringa

## Lamonica Prize

First delivered in 2009, the two Lamonica Prizes (Académie des Sciences - Fondation pour la Recherche Biomédicale - PCL) have been awarded to a French or foreign scientist working in a French laboratory. Part of the funding - a third of the Cardiology Prize funding, a fifth of the Neurology Prize - is to be used by the laureate, the rest of it enabling him/her to fund his/her research.

### U 2012 laureates



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- ▶ Cardiology (€75,000): Ziad Mallat and Alain Tedgui, respectively a researcher and the director of the Paris Cardiovascular Research Centre (Paris);



- ▶ Neurology (€125,000): Brigitte Kieffer, the director of the Institute of Genetics and Molecular and Cellular Biology (Illkirch).

## Fondation d'entreprise EADS Prizes

The *Fondation d'entreprise* EADS Prizes have been awarded since 2007. Three categories are distinguished:

- ▶ The Prize for Computer Science and its Applications (€50,000), designed to reward the whole work of a scientific personality in a French laboratory who has made an outstanding contribution to the vitality and influence of IT research in remarkable cooperation with the industry;
- ▶ The Prize for Information Science and its Applications (€30,500), designed to reward researchers under 50 years old recognized for the original, high-quality and noteworthy work they have carried out in a French laboratory in the field of information science, while maintaining particularly fruitful cooperation with the industry or making a major contribution to subjects of outstanding practical impact;
- ▶ The Prize for Science Applications in the Aerospace Sector (€30,500), aimed at rewarding the work of a personality who, in a French laboratory, has made a contribution to the vitality and influence of research, technology and innovation while maintaining particularly fruitful cooperation with industry and having an outstanding impact on the aerospace sector.

### 2012 laureates



- ▶ Brigitte Plateau, the director of the National School for Informatics and Applied Mathematics (Grenoble);



- ▶ Xiang Hua Zhang, a researcher, and Catherine Boussard-Pledel, an engineer, Institute of chemical science (Rennes);



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- ▶ Patrice Le Gal, a researcher at the Research Institute for Out-of Equilibrium Phenomena (Marseille).

## Georges-Charpak Prize

This annual prize, amounting to €10,000, was created in 2010 by the French Ministry of Higher Education and Research, in memory of Georges Charpak, a member of the Académie des Sciences, the Nobel Prize laureate and founder of the operation La main à la pâte. It rewards the holder of a doctorate who has carried out research in the fields of science history and epistemology (in 2012), science education (in 2013) or high energy experimental physics (in 2014), aged 45 or more in the year the prize is awarded.

### 2012 laureate

- ▶ Fabrice Ferlin, a researcher at S2HEP laboratory (Villeurbanne).

## Irène Joliot-Curie Prize

Created in 2001 by the French Ministry of Higher Education and Research and organised in coordination with the Fondation d'entreprise EADS since 2004, this award is designed to promote women's position in research and technology in France. On the occasion of its tenth anniversary, its scientific relevance has been highlighted by its partnership with the Académie des Sciences and the Académie des Technologies, which have selected the members of the jury designating the laureates. This partnership carried on in 2012. The Joliot-Curie Prize comprises three categories: Female Scientist of the Year (€40,000), Young Female Scientist (€15,000) and Women in Enterprise Award (€15,000).

### 2012 laureates



- ▶ Marina Cavazzana-Calvo, Head of department at the Clinical Investigation Centre in Biotherapy of the Necker Hospital (Paris);
- ▶ Bénédicte Ménez, a University professor at the Paris Institute of Earth Physics;
- ▶ Isabelle Buret, Telecom R&D and product policy at Thales Alenia Space (Toulouse).

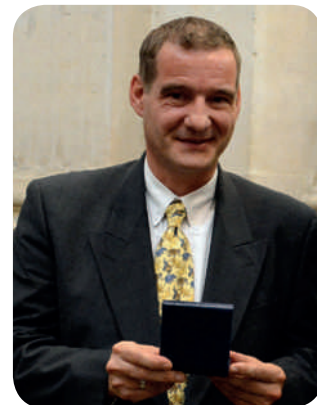
### Great Breakthroughs in Biology - AXA/Académie des Sciences Awards

The Académie des Sciences wishes to highlight the vitality and creativity of young French researchers. Thus, every year, in the Great Hall of Conferences and on the initiative of Pascale Cossart, the Académie des Sciences listens to the lectures given by six young researchers in the field of biology, whose discoveries are of major importance, accompanied by their research directors. The selection is made by a jury following a national call for applications and each laureate receives a prize (€2,500) from the Fonds AXA pour la recherche. In 2012, these are:

- ▶ Sara Al Rawi and her research director, Vincent Galy, from the Developmental Biology Laboratory, CNRS/Pierre-et-Marie-Curie University (Paris), in reward for her research on the elimination of mitochondria from spermatozoa during oocyte fertilization;
- ▶ Chunlong Chen and his research director, Antonin Morillon, from the Molecular Genetics Centre at CNRS (Gif-sur-Yvette), in reward for his research on a new type of non-coding regulatory RNAs in yeast;
- ▶ Nadine Laguette and her research director, Moncef Benkirane, from the Molecular Virology Laboratory, Institute of Human Genetics (Montpellier), in reward for her discovery of the anti-VIH SAMHD1 protein;
- ▶ Joanne Canonne and her research director, Susana Rivas, from the Laboratory of Plant-Microbe interactions, CNRS/INRA (Castanet-Tolosan), in reward for her work on a new bacterial virulence strategy inhibiting the defence mechanisms of plants;
- ▶ Hélène Botella and her research director, Olivier Neyrolles, from the Institute of Pharmacology and Structural Biology, CNRS/Paul-Sabatier University (Toulouse), in reward for her research on the poisoning of the tuberculosis bacillus by zinc in macrophages;
- ▶ Marat Minlebaev and his research director, Roustem Khazipov, from the INSERM Mediterranean Institute of Neurobiology (Marseille), in reward for his research on early gamma oscillations synchronizing the developing thalamus and cortex.

## Constellium Prize

This prize, which derives from the Pechiney Prize created in 1986, is awarded to a researcher of international repute, regardless of his/her nationality, aged 50 or more and whose basic or applied research relates to any scientific field contributing to the progress of the aluminium transformation industry or, more broadly, knowledge in metallurgy and innovations in engineering science, inasmuch as they connect with the production or use of metallic materials useful to this industry. Once the various organisms and personalities have voiced their suggestions, the Académie attributes the Prize at the proposal of a committee composed of members of the Académie des Sciences and the Académie des Technologies [French Academy of Technologies].



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2012 laureate

- ▶ Jean-Marie Drezet, a senior researcher at the Polytechnic School of Lausanne (Switzerland).

## Comptes Rendus de l'Académie des Sciences

Created in 1835 by the French physicist Arago, Secrétaire perpétuel of the Académie, the review *Comptes Rendus de l'Académie des Sciences* enables researchers to make their research promptly known to the wide international scientific community.



This set of seven publications spans the whole field of scientific research, as its titles show: *Mathématique*, *Mécanique*, *Chimie*, *Biologies*, *Géoscience*, *Physique* and *Palévol* (palaeontology, prehistory and evolutionary sciences). Each series is driven by an editor-in-chief with the assistance of an editorial board. The articles submitted are evaluated by two scientists of recognized expertise in the field. These may be notes, announcing significant, new results, or summaries that provide clarification, or conference proceedings, and other thematic issues, under the direction of guest editors-in-chief from France or abroad.

Altogether, close to 750 articles have been published in the 2012 *Comptes Rendus* and 19 thematic issues have come out (8 from the *Physique* series, 4 from *Mécanique* and from *Chimie*, 2 from *Géoscience* and 1 from *Palévol*).

The *Comptes Rendus de l'Académie des Sciences* are now available for hard copy or online subscriptions for individuals (EM *Consulte*) or groups (*ScienceDirect*), abstracts being published for open access on these two websites. Besides, the *Bibliothèque nationale de France* is completing the digitisation of the older issues of the *Comptes Rendus*, with the 1835-1995 years being already open to free access on its website [www.gallica.fr](http://www.gallica.fr).

## PROMOTING SCIENCE TEACHING



Learning scientific reasoning skills, gaining access to knowledge and being taught scientific methods - these are essential steps for future citizens to develop critical thinking and for excellence to transmit within the scientific community through time. As part of its mission, the Académie des Sciences has a long tradition of advising on the quality of science teaching in primary, middle and high secondary schools. Today, it takes action, even on the international level, to strengthen the initial and ongoing teacher training, renew science teaching at all school levels and ensure equal opportunity to all newcomers to this field.

The action of the Académie in terms of science teaching is grounded on three pillars of action: the *Delegation for Education and Training*, with Christian Amatore as Chief Delegate, which is in charge of monitoring current affairs in science teaching, all scientific, administrative and legal dimensions being considered; the *Standing Committee for Science Education and Training*, chaired by Étienne Ghys, which delves into the major science education issues the Académie wishes to take hold of, most often with long term vision as a goal; the Foundation *La main à la pâte*, which was created at the end of 2011 and is since chaired by Pierre Léna.

## A Foundation for Science Education



The Foundation for Scientific Cooperation *La main à la pâte* (i.e. “Hands-On”), created in 2011 by decree-law, started fully operating on 1 January 2012. It was founded by the Académie des Sciences, École Normale Supérieure (Paris) and École Normale Supérieure de Lyon. It stems from the

eponymous operation launched in 1995 by the Académie des Sciences at the initiative of Georges Charpak, 1992 Nobel Prize in Physics, Pierre Léna and Yves Quéré. It gives first priority to the teaching of science based on knowledge building via exploration, experimentation and discussion. First developed in primary schools, it recently extended to middle schools with great success.

Independent from the Académie des Sciences on the administrative side, the Foundation yet remains in very close connection with it, owing to its origins and its operating procedures: many members of the Académie des Sciences take part in the Foundation, at all levels (board of directors, scientific council, *Maisons pour la Science* Programme, field actions, etc.).

The remit of this foundation is to support quality improvement in science and technology teaching at primary and middle schools, where the provision of the common base of knowledge and skills has a decisive influence on equal opportunity. Its action, at the international and national levels, is aimed at coaching science teachers and supporting their professional development. Its goal is to help them implement investigational pedagogy that may trigger pupils into developing their scientific minds, world understanding and expression skills.

In Europe, the Foundation pursues the track successfully opened by the Académie des sciences with the European Commission funded projects Pollen and Fibonacci, developing cooperative actions in science education within the Union (e.g. the current project Sustain, aimed at the science teachers, on issue of sustainable development). Beyond Europe, the Foundation, again developing cooperation agreements signed by the Académie with a diversity of foreign partners or exploring new cooperations on inquiry based science education (IBSE), organises training sessions, offers free access its resources or publications and is especially open to the emerging and developing countries. Every year, the Foundation organises in Paris an International Seminar, with the support of the Ministry of Foreign Affairs and its diplomatic network. Gathering 50 participants from all over the world during one week, it disseminates IBSE and leads to fructuous cooperations.

### *The Maisons pour la Science programme*



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Ongoing teacher training is pivotal to the renewal of science teaching in our country. The *Maisons pour la science au service des professeurs* programme, supported by the French programme *Investissements d'avenir*, takes part in such an effort towards ongoing teacher training development. In order to do so, it draws on close and structured collaboration between the world of education and that of scientists and engineers.

The *Maisons pour la science* actively contribute, not only to the professional development of teachers, but also to the increasing commitment of the scientific and industrial world towards education institutions, to the completion of local projects fostering equal opportunity through science and to the production and dissemination of teaching resources for class.



## Correspondents for Science and Technology

Children's natural curiosity for science develops at school but seems to be fading away during middle school years: at the end of high school, the influx of students applying for science and technology courses is insufficient. The French education system must take up a double challenge: put science and technology back into the pupils' minds and boost their appetite for science and technology courses and professions, so as to secure the contingent of researchers that the country requires and will require in the future. To contribute to this objective, the Direction générale pour l'enseignement scolaire [Executive Office for School Teaching] of

the French Ministry of Education has appointed Correspondents for Science and Technology to the National Education local Officer (recteur) of each administrative district in April 2012, with full support from the Académie des Sciences.

On 6 June 2012, the Secrétaires Perpétuels and Chief Delegate for Education and Training of the Académie des Sciences have invited the newly-appointed Correspondents for Science and Technology to gather at the palace of the Institut de France for their first day of discussion.

### Pedagogical Resources on the Environment

Following solicitation from the National Education Inspectorate in 2002, the Académie des Sciences has submitted to the attention of secondary school teachers an Environmental booklet, comprising a dozen fact sheets that answer the most common questions and provide, as detailed justification for the answers, scientific presentations of the problems. This booklet, available on the website of the Académie in its 2012 updated French version, now also approaches topics such as soil issues and ocean management. It should shortly broaden its offer, with several new titles on algae, the risks posed to human health by current environmental exposures or expected climate changes, and then deal with issues of geoengineering, waste management, the sequestration of carbon dioxide, oil and shale gas, etc.



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## Distance Learning in Haïti



© Élodie Bouchot

Since 2010, the Académie des Sciences cooperates with the Haitian Ministry of National Education and Vocational Training to restructure the basic teaching methods and contents of disciplines crucial to the educational achievement of Haitian pupils, experimental science being at the core of the programme. This cooperation has led to the development of a totally new training plan, allowing for the dissemination of pedagogical contents within the national Haitian network Efacap (*École fondamentale d'application - Centres d'appui pédagogique*), jointly prepared by Haitian and French trainers. In November 2012, the website that provides access to this distance education programme has been launched ([www.programme-teh.com/teh/](http://www.programme-teh.com/teh/)).

## TRANSMITTING KNOWLEDGE



The scientific community owes society to explain and share its knowledge. As part of its mission, the Académie des Sciences is committed to disseminating scientific culture and, in this context, sets public session meetings, at which great scientific problems are presented. The *Delegation for Scientific Information and Communication*, whose Chief Delegate is Alain-Jacques Valleron, is in charge of communications, and operates through a website open to the general public, media relations, a letter, actions towards the youth and pairing researchers, members of the Académie and members of the Parliament. Archives and Museums maintain and highlight the French scientific heritage held by the Académie.

## Public Sessions, Civic Culture

The unprecedented technological rise the world has been experiencing since the middle of the last century has complexified the relations society maintains with science: innovation seduces but inspires fear, ethical questioning is now involved in every process of scientific research. In such a context, the Académie des Sciences invites the broad, enlightened public at the *Défis scientifiques du XX<sup>e</sup> siècle* Conference Series [Scientific challenges for the 21<sup>st</sup> Century] to inform itself on the current knowledge we have of major science themes bearing societal repercussions.

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### ***The Defence Reactions of Insects: a Model for the Study of Innate Immunity (29 May 2012)***

Innate immunity is a first-line antimicrobial defense mechanism allowing living organisms to fight pathogenic agents such as viruses, bacteria, fungi, as well as protozoa. During this conference, Jules Hoffmann, a member of the Académie des Sciences and Académie française, Nobel Prize in Physiology or Medicine, looked back at the discoveries he and his team made on *Drosophila*, leading to discover the Toll-like receptors in mammals.

### ***Epigenetic Inheritance in the Brain (19 June 2012)***

Epigenetics and its capacity to take stable control of the gene regulation, long after a transitory signal has occurred, is probably of major importance to the functioning of the brain, whose activity and connectivity are submitted to long lasting modifications. Recent investigations in the biology of chromatin have opened new perspectives to the exploration of the long term regulatory mechanisms of the neuron function and survival. Catherine Dulac, a member of the Académie, has provided an overview on these investigations and what they imply for the study of the brain, behaviour and mental diseases.

### ***Hazard and Countinuum (2 October 2012)***

Knowing the real world helps intuitively understand certain mathematical concepts such as, for example, the continuity of time and space. Regarding the theory of probability, one of the major issues is to study the behaviour of systems produced by multiple (tending to the infinite) random microscopic components. The objective is to explore, as it were, the link between continuous structures and hazards. Drawing from recent mathematical results, Wendelin Werner, a member of the Académie and Fields Medallist, discussed in his conference some aspects - certain of which are surprising - of this link between the continuous distribution of microscopic hazards and the macroscopic world.

### ***Atoms and Photons (20 November 2012)***

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In the last decades, impressive progress has been made in the understanding of the basic interaction processes between matter and radiation and in mastering atoms and light sources. New research fields have appeared and their study has led to numerous applications, including lasers, atomic clocks or magnetic resonance imaging. Claude Cohen-Tannoudji, a member of the Académie and Nobel Prize in Physics, reviewed on these developments and the perspectives they open.

## Leaving Water: from Aquatic to Terrestrial Life (11 December 2012)

Appeared in most ancient times out of water from the oceans, vertebrates still have not freed themselves from this vital element: water accounts for 95% of the composition of human beings in their first days of life and 60% at adult age. The economy of water and salt, which is crucial to ensure the transition from aquatic to terrestrial life, is the result of a long evolutive process, with progressive adaptation to the new conditions of the environment. Pierre Corvol, a member of the Académie, presented the various regulatory systems - aquaporin, vasotocin and vasopressin, renin-angiotensin-aldosterone - that allow vertebrates to maintain the constant composition of their inland sea, even in extreme conditions.

## Information resources specifically designed for the public



The *Lettre of the Académie des Sciences* is a biannual journal sent to more than 3,000 free subscribers and open to download on the website of the Académie. The 2012 issues have dealt with Consciousness and consciousness disturbance and with Biodiversity.

In 2012, the website of the Académie has attracted 170,000 individual visitors, with 7,000,000 hits and 850,000 pages read. The video section provides Internet users with records of all the sessions, conferences and debates organised by the Académie des Sciences.

Since 2012, browsing automatically adapts to the user's device (computer, tablet or smartphone), thus enabling him/her to keep track of the work of the Académie at any given moment.



<https://twitter.com/AcadSciences>



As for the e-newsletter of the Académie, it is sent to more than 14,000 subscribers, most of whom are scientists or members of institutions. Its purpose is to alert or remind them on a monthly basis of the most important events on the agenda of the Académie. All Internet users may subscribe from the home page of the website.

In May 2010, the Académie concluded a partnership with the publisher *De vive voix* on the launching of an audio book series where members of the Académie share with the general public their passion for their disciplines. In 2012, *Le cerveau* [The Brain], by Yves Agid, and *Einstein et les révolutions quantiques* [Einstein and the quantic revolutions], by Alain Aspect, have joined the 14 other titles already published.



For its partners and all interested publics to perceive how rich its environment is and how important its missions are, the Académie des Sciences has produced in 2012 a presentation leaflet of its activities, which has been translated into English, Spanish and Chinese and may be downloaded from its website.

## 100 Youngsters at the Académie des Sciences

How may scientific vocations be stimulated, so as to see the French research capacity restored by tomorrow? To address such a challenge, the Académie des Sciences invited 100 youngsters to meet, on Saturday 13 October 2012, at the Institut de France, 100 of the most famed French scientists, including many members of the Académie, whether mathematicians, physicians, biologists, chemists or paleontologists. These young participants had been selected for the relevance and high quality of their answers to a national competition conceived and organised by the Académie for participants aged 15 to 20 years old.



100 Youngsters at the Académie des Sciences



Jean-Pierre Kahane, member of the Académie



Yves Meyer, member of the Académie

© Marie-Laure Moynet

### An innovating concept: scientific speed dating

For two hours, the youngsters have met with about 100 scientists, sharing one-to-one informal discussions. Every 7 minutes, a gong would ring and the youngsters would start a new conversation with another researcher. In total, each of them met about 10 scientists during the afternoon - a new way for participants from both sides to share their common passion for science.

### An Exceptional Day

The 100 youngsters have been invited to a discovery trail at one of the oldest shrines to French scientific culture and arts, the Institut de France. After visiting these emblematic places - the Cupola, Mazarine Library and Great Hall of Conferences - they have attended a conference with debate entitled *Renversement du temps, innovation et médecine* [Time reversal, innovation and medicine], lectured by the physicist Mathias Fink, a member of the Académie des Sciences and Professor at the City of Paris Industrial Physics and Chemistry Higher Educational Institution [École supérieure de physique et chimie industrielles de la ville de Paris, ESPCI Paris Tech]. After eating lunch with members of the Académie, they had the opportunity to join in the speed dating, which marked the grand finale of this day dedicated to youth and science.

### Unanimous Satisfaction

What lessons have been learnt from this first - and original, to say the least - operation? The Académie des Sciences has investigated feedbacks and the findings are clear: this event must be repeated! Both scientists and youngsters have expressed unanimous satisfaction: 60% of the former group and 75% of the latter consider the day was « very satisfying ». Greeting by, follow up from and contact with the organisers have also been appreciated. Consequently, youngsters as well as scientists are in favor of repeating this event, which will be organised every two years from now on. In 2016, this operation will take place among the various commemoration events of the 350<sup>th</sup> anniversary of the creation of the Académie des Sciences.

## Adding Value to a Scientific Heritage

The Académie des Sciences holds archives dating to its creation and continues to expand its stock through purchases, donations or bequests from its members. French and foreign researchers, top-level university members, come and consult in the Reading Room these unique documentary sources that make the Académie des Sciences one of the main conservation institutions from where today's research in science history commences. Almost 2,000 items (archive boxes, biographic files, award files, etc.) are communicated every year.



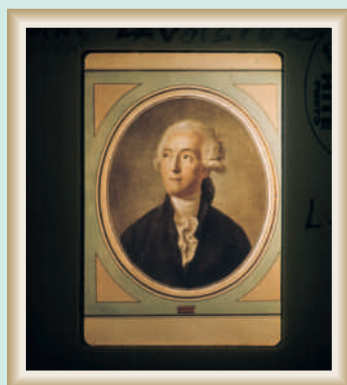
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Several archives have entered the Académie in 2012: letters (from 1779 to 1783) by the abbot Fontana to Louis Bernard Guyton de Morveau, a chemist and member of the Royal Academy of Sciences, then at the first class of the *Institut de France* (1737-1816); the diary of Jean-Baptiste Boussingault (1802-1887), a professor in agricultural chemistry at the Faculté des sciences de Paris [Paris Science Faculty], a member of the rural economy section at the Académie des Sciences, for the years spanning from 1838 to 1842; the second transfer (lectures at the College de France) of the archives of Pierre-Gilles de Gennes (1932-2007), a member of the Académie des Sciences and Nobel Prize in Physics.

New inventory lists have been produced in 2012, now open to consultation. These archives relate to Louis Pasteur (1822-1895), Jean Pierre Joseph Darcet (1777-1844), a member of the chemistry section, Ferdinand Fouqué (1828-1904), a member of the mineralogy section (inventory lists may be consulted under the *Archives* heading of the website of the Académie des Sciences) and André Weill (1906-1998), a member of the mathematics section (supplementary correspondence).

### Publishing Lavoisier's correspondence: a long-term endeavour

From his schooling years to the foot of the scaffold, about 2,500 letters, notes and documents, gathered in Antoine Lavoisier's correspondence (*Correspondance de Lavoisier*), cover the whole of his career as a forefront scientist who was also a higher civil servant. Here, the intellectual and social itinerary of a man from the Age of Enlightenment unveils day by day. Started in 1955, then carried on by the *Lavoisier Committee* of the Académie des Sciences, the publishing of this *Correspondance* comes to an end with Volume VII being brought out, covering the period from 1792 to 1794, when this great scientist was executed.



© Archives de l'Académie des sciences

Antoine Laurent Lavoisier

During the last stage of the French constitutional monarchy, in 1792, and the National Convention, until his trial in 1794, Lavoisier withdraws from political life but his correspondence is more than ever related to the organisms of power, as he was the treasurer of the Académie and a member of the Bureau de consultation des arts et métiers [Office of Consultation for Arts and Trade], involved in the central stage of the preparation for the metric system. By letters and memoirs, he is committed to uphold the existence and functioning of the Académie des Sciences then of the Committee for Weights and Measures. His last letters relate to his arrest and detention and to the Fermiers Généraux [Farmers-general] trial. In line with critical erudition, a rich annotation accompanies the transcription of these joined letters and documents.

*Correspondance de Lavoisier. Tome VII. Hermann Eds, Paris, October 2012*



© Éditions Hermann

## Louis Pasteur and the Académie des Sciences: 1862-2012

Louis Pasteur is one of the most famous, recognized and acclaimed scientific characters in the world. Born in Dole, Jura, France, on 27 December 1822, he spent his childhood in a house in the commune of Arbois, to which he would remain attached all his life and where he would often come back. Furthermore, he realised some of his research there and gradually set a laboratory - the only of his laboratories to have remained intact up to now.

Based on experiment, his research led him to make major discoveries in chemistry as in biology which have been applied to the benefit of mankind. Indeed, after achieving his research on fermentation, he invalidated the dogma of spontaneous generation, which was persistent at that time, thus paving the way for the emergence of microbiology. We also owe him seminal research on the stereochemistry of molecules and vaccinology, including the famous vaccine against rabies.



Louis Pasteur by Champollion

© Archives de l'Académie des sciences



In Louis Pasteur's Lab

© Catherine Bréchignac

The Académie des Sciences has acknowledged Louis Pasteur's merits when it elected him a member on 8 December 1862. The 150-year anniversary of this election gives the Académie and its partners from the region where the scientist was born and lived the opportunity to launch a series of actions intended to pay him tribute and to perpetuate his research methodology, which still inspires many scientists and physicians today.

### Historic Vineyard, Historic House

Louis Pasteur's vineyard in Arbois, the *Clos de Rosières*, was the venue for several research studies, including those which would mark the end of the theory of spontaneous generation. More broadly, Louis Pasteur would conduct in Arbois his studies on wine fermentation, leading him to licence, in 1865, the famous pasteurization process.

While the grape of this historic vineyard was being harvested, the Foundation of the Académie des Sciences *Maison de Louis Pasteur* held its first board of directors on 13 September 2012. The remit of this Foundation is to administer the house of the scientist, bequeathed to the Académie des Sciences in 1991 by the *Société des amis de Pasteur*, and to define the pedagogic programme of the scientific culture activities that are offered.



The Louis Pasteur's historic house in Arbois

© Catherine Bréchignac

## The Centre d'interprétation du patrimoine pour la science *Terre de Louis Pasteur*

In December 2012, the Académie des Sciences announced the creation of the Centre d'interprétation du patrimoine [Heritage Interpretation Centre] *Terre de Louis Pasteur*, in partnership with the communes of Arbois and Dole, and the Conseil général du Jura [Departmental Council of Jura].

Under the best auspices of the French Ministry of Culture and Communications, the Centre has the ambition to breathe new life into such a benefactor to mankind, to the advantage of science, teaching and the memory of the world.



### New scientific and cultural tourism in the Jura department

The department of Jura, and more broadly the region of Franche-Comté, boasts a rich, diversified geographical and historical heritage. In the department, three places have been inscribed on World Heritage list of the UNESCO: the saline lands of Salinles-Bains and Arc-et-Senans and the two palafittical (pile-dwelling) sites of Clairvaux and Chalain. Green tourism is also expanding in almost all communes where hiking trails, farm accommodation and sports activities are growing.

The Centre *Terre de Louis Pasteur* will venture to federate the initiatives oriented towards boosting the scientific and cultural reputation of the department of Jura.

### An innovate way to transmit science, both to teachers and pupils

In partnership with *La main à la pâte*, the Centre *Terre de Louis Pasteur* will also be an open place for the professional development of all teachers in charge of conveying science, from preschool to middle school levels. It will be a unique place where stakeholders from the world of research and of education may share their views. In this perspective, the National Education local Authorities [*rectorats*] of Besançon and Dijon and the Federation of Universities of Franche-Comté and Bourgogne take an active part to the project.



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 Arbois

The Centre *Terre de Louis Pasteur* will also create synergies with other regional initiatives in scientific culture, such as the Atelier Pasteur [Pasteur Workshop] in Dole or the Pavillon des Sciences [Science Wing] in Montbéliard, thus forming a structured itinerary.

### International Attention through UNESCO's Memory of the World Programme

Started up in 1992, the *Memory of the World* programme secures and facilitates every one's access to documentary heritage, the tangible part of the memory of mankind, held in libraries, archives and museums.

The importance of Louis Pasteur's bequest in terms of science and medicine is a legitimate reason for applying to the inscription of its archives in the *Memory of the World* Programme; the *Bibliothèque nationale de France* and the Académie des sciences, as the main holders of these archives, have begun the application procedure. Partly accessible at the Centre *Terre de Louis Pasteur*, these archives make the Centre a genuine focus of international attention.



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## The Académie des Sciences and Key Opinion Leaders

According to a poll published in 2011, 84% of the French opinion trusts the Académie des Sciences to explain them the issues of scientific research and the debates they may trigger (poll made by the *Institut Ipsos* for *La Recherche-Le Monde, La Recherche*, September 2011). In order to expand this notoriety, the Académie implements a strong communications policy towards the press and decision makers.

### The Académie in the Media

With 2,154 releases in 2012, the Académie des Sciences has had a wider presence in the media than in 2011, especially in the written press. The latter represents 50% of all the media visibility of the Académie des Sciences, against 10% for broadcasting (mainly radio, France 3 for television) and 40% for the web, which is consistent with the rising share of the latter in the media landscape. The progress of the Académie des Sciences in the written press is most visible within four categories: national daily press (*Le Monde, Le Figaro, Les Echos, La Croix, L'Humanité, Le Parisien*, etc.), press agencies, such as the *Agence France-Presse* and its regional offices, whose wires mostly feed the regional press, weekly general information press (*Le Point, Valeurs actuelles, Le nouvel Observateur, L'Express, Le Journal du Dimanche*, etc.) and daily regional press.



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The highlights of the Académie, evaluated from their press releases, happened in March and April 2012, on the one hand, and in October and November 2012, on the other hand. The first peak corresponds to the publication of its Report on the major Fukushima accident, to some aspect of vaccination presented in front of the press with the *Académie Nationale de Médecine*, to Jules Hoffmann's election (a member of the Académie des Sciences, 2011 Nobel Prize in Medicine) to the *Académie Française* [French Academy], on 1 April 2012, and to the publication of the *Charter of Expertise* the Académie des Sciences has adopted in April 2012. The second peak reflects the publication of the Report on the structures of public research in France, the awarding of the Nobel Prize to the member of the Académie Serge Haroche, on 9 October 2012, the organisation of the first scientific *speed dating* and, on a more modest scale, the jubilee of Louis Pasteur's election to the Académie des Sciences and the decoration of the Israeli computer science professor and cryptographer Adi Shamir with the *Grande Médaille*.

### Serge Haroche, a Nobel Prize celebrated in the media



© Brigitte Eymann - Académie des sciences

Serge Haroche

An expert in atomic physics and quantum optics, Serge Haroche, a member of the Académie des Sciences since 1986, has devoted his career to exploring the quantum world of the infinitely small. His whole research has dealt with the interaction of light, whether or not visible, with matter and on the wave-particle duality. The experimental methods he has developed make it now possible to detect and manipulate photons and atoms one by one. He has shed light on the groundworks of quantum physics, helped better understand the measurement processes and mysterious aspects of quantum physics, such as the superposition of states or quantum entanglement. As the laureate of the 2012 Nobel Prize in Physics, he adds his name to the hall of fame that gathers the members of the Académie Henri Becquerel and Pierre Curie (1903), Gabriel Lippmann (1908), Jean Perrin (1926), Louis de Broglie (1929), Alfred Kastler (1966), Louis Néel (1970), Pierre-Gilles de Gennes (1991), Georges Charpak (1992), Claude Cohen-Tannoudji (1997) and Albert Fert (2007). This award, with its international impact, has been covered by more than 120 quotations in France in all types of media.

The Académie des Sciences, moreover, continues its partnership with the newspaper *Le Figaro*, which has started in autumn 2011, on the publication of the monthly page «*Les membres de l'Académie des sciences répondent aux grandes questions de l'actualité scientifique* » [Members of the Académie des Sciences Address Major Topical Issues in Science]. In 2012, these issues included the human need for water, chemistry and sustainable development, computer science and networks, immunology, synthesis biology, geomagnetism, the evolution of mankind, exobiology and mathematical finance.

## Twinning Science and Parliamentary Discussion

Today's major social issues often imply science, and research conducted by scientists often take place in a context of political debate: nuclear power, the climate, biodiversity, genetically modified organisms, stem cells, nanoscience, ... sensitive issues are not lacking. Scientists and politicians do not know each other well enough though they have much to say to one another. Thus, bringing about meetings and fostering an exchange of experiences between them are crucial issues the Académie des Sciences and the *Office parlementaire d'évaluation des choix scientifiques et technologiques* (OPECST) [Parliamentary Office for the Evaluation of Scientific and Technological Choices] have decided to tackle.

Launched in 2005 on the initiative of Dominique Meyer, a member of the Académie des Sciences, this twinning operation is based on arranging partnerships between three persons: a member of the Parliament, whether from the National Assembly or the Senate, a member of the Académie des Sciences and a young researcher from a research laboratory, all being volunteers. For what purpose? - To help non-scientific members of the Parliament understand the complexities of the research environment, and researchers grasp the reality and diversity of parliamentary work, in both Chambers as well as in electoral constituencies - with, in the bargain, the establishment of a sustainable and fruitful dialogue allowing for stronger relations between science and society.



The twinning operations take place in three steps: members of the Académie and young researchers are greeted at the Parliament, members of Parliament visit laboratories and scientists visit electoral constituencies. The annual sessions, organised since 2005, have already gathered more than 200 participants.

The vivid interest raised by these twinning events while they were happening, both from the members of Parliament and from the scientists, was of great encouragement and created original associations. It is noteworthy that, on their initiative, three members of Parliament have thrice taken part in a twinning operation and four have twice done so.

Concrete consequences may be put down to the credit of these twinning operations, including:

- ▶ Tighter bonds between OPECST and the Académie des Sciences;
- ▶ Members of the Académie consulted for parliamentary Reports or Bills;
- ▶ Joint actions on science teaching: creation of a partnership between a high school in Montreuil, Department of Seine-Saint-Denis, and two prestigious university-level establishments, the École Centrale and École Normale Supérieure, in order to make pupils and students taking science courses more aware of research and engineering careers;
- ▶ Regional bonds, especially between researchers and SMBs, through the intervention of members of the Parliament.

## FOSTERING INTERNATIONAL COLLABORATION



Science is universal and the challenges to take on have, for a great part, worldwide implications. The confrontation of knowledge, ideas and cultures is a fundamental requisite to the accomplishment of progress. The Académie des Sciences, by way of its *Delegation for International Affairs*, whose Chief Delegate is Daniel Ricquier, also Vice-President of the Académie, takes part in the international networks of Academies, builds bilateral cooperation and carries out actions that target developing or emerging countries, especially in the Mediterranean region and in sub-Saharan Africa.

## A strong Contribution to Interacademic Networking

The Académie des Sciences represents France from the scientific viewpoint and contributes, as such, to the development of the international relations that are crucial to scientific progress.

The Académie is a member of the main European and global networks of Academies in the field of science:

- ▶ The ICSU (International Council for Science), an international organisation whose 108<sup>th</sup> meeting of the Executive Board was held from 13 to 15 November 2012;
- ▶ The IAP (InterAcademy Panel), a global association gathering 106 academies of sciences, of whose Executive Committee France is a member (meeting in Halle, Germany, 26-27 March 2012);
- ▶ The IAC (InterAcademy Council), gathering 15 academies from the IAP and producing specialised reports;
- ▶ The EASAC (European Academies Science Advisory Council), which draws up scientific advice for the European Parliament to consult. As part of this framework, the Académie was present at the Executive Committee meeting of Vilnius (7-9 November 2012), at the EASAC workshops in Frankfurt (8 June 2012 and 25-26 October 2012) dedicated to genetically modified cultures, and at the meeting held at Halle (17-19 September 2012) concerning the NASAC;
- ▶ ALLEA (ALL European Academies), a federation of academies of sciences, literature, social sciences and humanities, whose General Assembly was held in Rome from 10 to 12 April 2012 and whose Board met in Dublin on 10 and 12 May 2012.



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### Joint international relations

Created in 1983 on the initiative of the Académie des Sciences, the Standing Committee for Scientific and Technological International Relations (Carist), thanks to its structure and to the nature of the issues it debates, plays the role of an informal coordinator between the various actors in French research. It allows reciprocal information sharing and concertation regarding the international, scientific and technological cooperation plans conducted by the various ministries, research organisms and associations. The role of the Académie des Sciences is to offer, not only a neutral ground furthering discussions, but also the expertise of its members, who are top-level scientists. At the end of 2012, the Carist chose to orient its reflection on the following themes:

- ▶ What should the French global strategy be on the international level after the recent French Symposium on Higher Education and Research (Assises de la recherche) and the setting of the French National Research and Innovation Strategy (2013-2016)?
- ▶ How can the visibility/projections, and therefore coordination, of the actors in Science & Technology improve on the international level?
- ▶ What should the return on/transfert to innovation or even business management be?

## Bilateral Cooperation

The agenda of the Académie des Sciences on the international level also includes bilateral actions with its various partners, most of them being academies. Thus, 49 scientific cooperation agreements have been settled with Academies of Sciences worldwide, including Israël, Germany, India, Brazil, as well as Romania. In such a context, the Académie des Sciences is still actively involved in several highly valued bilateral awards.

### International Scientific Prizes

Scientific friendships have been numerous in Europe and worldwide. One can mention those shared between Newton and Huygens, Descartes and the same Huygens, Gay-Lussac and Von Humboldt, the latter and both Cuvier and Lamarck. The Académie des Sciences perpetuates those fruitful friendships by taking part in the awarding of bilateral, international highly-valued prizes.

#### *Descartes-Huygens Prize*

Created in 1995 at the Hague by the French and Dutch governments, this prize is alternately attributed in the fields of Sciences of Matter, Life Sciences and Human and Social Sciences. Awarded under the auspices of the Académie des Sciences and the Royal Netherlands Academy of Arts and Sciences (KNAW), it rewards every year two researchers of international level, one being French and the other Dutch, both actively contributing to this bilateral scientific cooperation. Amounting to €46,000 (€23,000 for each party), this prize is especially intended to fund the laureate's stay in the other country as an invited researcher.

##### 2012 Laureates (Life Sciences)

Harry F. G. Heijnen, an assistant professor at Utrecht University Cellular Microscopy Centre, Department of Clinical Chemistry and Hemostasis (the Netherlands), and Graça Raposo, the leader of the team Structure and Membrane Compartments at Institut Curie, Paris.




 Graça Raposo, Hans Clevers (president of the KNAW), Pierre Ménat (French Ambassador in Netherlands) and Harry F. G. Heijnen

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#### *Gay-Lussac Humboldt Prize*



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 Hendrik Ziegler, Jean-Michel Raimond, Hermann Nicolai and Elisabeth Giacobino with Johanna Wanka (left) and Geneviève Fioraso (right), German and French Ministers of Higher Education and Research

As an homage paid to the friendship of two exceptional scientists, the German naturalist and explorer Alexander von Humboldt (1769-1859), a Corresponding then a Foreign Associate Member to the Académie des Sciences, and the physicist and chemist Joseph Gay-Lussac (1778-1850), elected a member in 1806 and twice the President of the Académie des Sciences, the Académie contributes to the attribution of the Gay-Lussac Humboldt Prize, awarded to German scientists for the great merit of their work and their contribution to French-German scientific cooperation. Conversely and on the same basis, Germany singles out French scientists.

##### 2012 German laureates

Hermann Nicolai, the Director of the Max Planck Institute for Gravitational Physics in Postdam (Germany), and Hendrik Ziegler, a professor in modern and contemporary art history at the University of Reims-Champagne-Ardenne;

##### 2012 French laureates

Élisabeth Giacobino and Jean-Michel Raimond, both researchers at the Kastler-Brossel Laboratory (CNRS/ENS/UPMC/Collège de France) in Paris.

## Lounsbery Prize

Created in 1978 by Vera Lounsbery in memory of her husband, this prize is placed under the patronage of both the Académie des Sciences and the American National Academy of Sciences. Designed to reward the distinctive achievements of French and American researchers in biology and medicine, this Prize is alternately attributed to a French and an American researcher. It is endowed with €50,000, and €20,000 would add to this amount to cover the laureate's potential stay in a laboratory of the other country.

### 2012 Laureate

Olivier Pourquié, the Director of the Institute of Genetics and Molecular and Cellular Biology (Illkirch, France).



 Olivier Pourquié

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## Franco-Taiwanese Scientific Grand Prize



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 Sylvie Dufour and Ching-Fong Chang

Created by the Franco-Taiwanese Science Foundation established between the Académie des Sciences, the Institut de France and the National Science Council of Taiwan on 10 February 2003, this Prize is attributed every year to French or Taiwanese researchers for their contribution to scientific research of interest to both sides. Laureates should stimulate scientific exchange between both sides, which are in capacity to organise conferences and colloquia in this perspective. The Prize amounts to €38,200.

### 2012 Laureates

Sylvie Dufour, the Director of the Biology of Aquatic Organisms & Ecosystem (BOREA) research unit, National Museum of Natural History, and Ching-Fong Chang, National Taiwan Ocean University, in reward for their work on aquatic animal ecophysiology.

In 2013, the Prize will be awarded in the field of basic and applied research in physical science and mathematics.

## Franco-Croatian day (4 December 2012)

As the Croatian cultural season was taking place in France, the Académie des Sciences, Académie des Inscriptions et Belles-Lettres and the Croatian Academy of Sciences and Arts have organised a joint meeting day on Franco-Croatian interacademic relations through time, on which Miroslav Radman and Emilio Marin held a conference. This day was also the opportunity to rediscover the work of Roger Joseph Boscovich, a mathematician and astronomer from the 18<sup>th</sup> Century and a Foreign Correspondent to the Académie des Sciences, particularly through an exhibition of original documents held at the Académie des Sciences.



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## Franco-Israeli Colloquium

At a meeting in autumn 2011, the Académie des Sciences and the Israel Academy of Sciences and Humanities have decided to strengthen their collaborations in order to improve scientific cooperation between the two countries. On 14 and 15 May 2012, a Franco-Israeli interacademic colloquium on chemistry held in Jerusalem, and would be followed by a similar meeting on the interface of mathematics and computer science organised in Paris, in May 2013.



## Actions Targeted Towards Development

### In the Mediterranean Region

#### *The work of the GID*

The ambition of the Interacademic Group for Development (GID) is to make science and its knowledge the driving forces of human development and progress in emerging countries, in accordance with their social and cultural diversity.

The GID, whose headquarters are at the Académie des Sciences, was born in 2006, on the initiative of André Capron, a member of the Académie, from five core French National Academies (Sciences, Moral and Political Sciences, Technology, Medicine and Agriculture); the Academies of Maroc, Senegal and Italy soon joined, and so did the Alexandrine Library. In 2012, François Guinot, the Honorary President of the Académie des Technologies, took presidency. Because of the important part played by the Mediterranean Academies, the GID programmes lay particular stress on Mediterranean development.



#### *g.i.d.org, a website dedicated to development*

Created in 2010, the website of the GID provides access to the most precise data concerning its four sets of actions:



- ▶ the Parmenides programme;
- ▶ EMAN (Euro Mediterranean Academic Network), the first interacademic network of the Mediterranean region, a crossroad area;
- ▶ the Science, Professions, Societies networks, providing managers from African and Mediterranean developing countries with high-level training programmes in scientific, economic, social and legal issues;
- ▶ WHEP (Women Health Education Program), which advocates women's education as a means to improve universal health.

The Parmenides programme, particularly, is based on a set of international conferences on the priority areas for scientific development:

- ▶ Environment and sustainable development: agriculture, halieutic resources, climate changes (Paris, 2008);
- ▶ Science and health in the Mediterranean region: genetic diseases, emerging diseases (Rome, 2009);
- ▶ Mediterranean wealth and diversity: biology and culture (Alexandrie, 2010);
- ▶ Water, environment and health (Rabat, 2011).

In March 2012, the last conference of the Parmenides programme, *Towards an Integrative Vision of Mediterranean Scientific Development*, aimed at providing an integrative synthesis of the findings of the four *Parmenides* conferences and defining the main areas of focus for the future development of scientific cooperation on both banks of the Mediterranean.

Besides, the GID Symposium, held at the Académie des Sciences on 22 October 2012, focused its analysis on how scientific recommendations may be carried out into political decision making, and what role the scientific community should (or should not) play in implementing this step, which is seldom implemented in an optimal way. This movement of “translation” from the scientists to political and economic decision makers, generally a pivotal one, is especially decisive for the Mediterranean area at the start of this 21<sup>st</sup> century.

### **A French-Israeli-Palestinian colloquium**

On the joint initiative of the Académie des Sciences and the Permanent Delegation of France to UNESCO, the *Science, Networks, Consciousness in the Mediterranean Basin* colloquium held on 4 June 2012 in Paris. With its central theme on scientific cooperation as a vector for rapprochement between the actors in the Middle-East, this meeting gave speakers from both banks of the Mediterranean the opportunity to interact and exchange, together with their Israeli and Palestinian partners, on:

- ▶ already active cooperation programmes in various fields, including nanotechnologies, genetics, water or educational sciences;
- ▶ networks that build on science as a driver for development, such as the Interacademic Group for Development and the operation *La main à la pâte*, both supported by the Académie des Sciences.

This colloquium ended with a round table gathering personalities from the International scientific community who are involved in projects of the future.



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### **The COPED: contemplating Franco-African cooperation**

Infused with a spirit of close partnership with Africa on its creation in 1997, the Standing Committee for Developing Countries (COPED) has gradually enlarged its scope of action to other regions of the world. Under the Presidency of François Gros, Secrétaire perpétuel honoraire of the Académie des Sciences, the COPED embodies the determination of the Académie to contribute, through scientific development, to solving major worldwide issues, by thoroughly:

- ▶ promoting scientific training and research projects;
- ▶ organising fora on topical issues for DCs (Developing Countries);
- ▶ creating and maintaining bonds with national and international organisms dedicated to research on development;
- ▶ tightening the bonds with the appropriate Directorate-Generals of the European Commission;
- ▶ operating in steadfast cooperation with the Interacademic Group for Development (GID).

In 2012, the COPED implemented the following actions:

- ▶ Capacity Building seminar, held in Paris for the representatives of the 17 African Academies of Sciences that are members of the NASAC (Network of African Science Academies);
- ▶ Collect Access International colloquium, held in Paris on the European project to build an open-access network allowing researchers from DCs to access elements of European museology;
- ▶ ANSTS-COPED colloquium held in Dakar, Senegal, on the themes of education, scientific research and development.



## In sub-Saharan Africa



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For more than twenty years, the Académie des Sciences has been devoting an important part of its activity to tightening the scientific and technical bonds between France and Africa, especially sub-Saharan Africa. It has indeed organised many fora and colloquia gathering scientists from France and several African countries, on general issues of research, teaching or training, or specific matters related to health, agriculture, nutrition, epidemiology, demography, as well as natural resources.

### *Advising African Academies as they operate*

African Academies of Sciences play an ever-growing advisory role in the orientation of national scientific policies. They are also major vehicles for communication, describing the opportunities raised by science and technology in the social, economic and cultural development of the African continent. The intention of meeting these responsibilities was one reason why several African Academies of Sciences have united in the Network of African Sciences Academies (NASAC) at the end of 2001, with the support of the International Academy Panel (IAP).



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Philippe Taquet, Catherine Bréchnignac and François Gros



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NASAC/Académie des sciences seminar

African Academies of Sciences can make the most of the lessons elder institutions have learned to continue improving their operations management and set up new science communication initiatives. Indeed, on behalf of its 17 members, NASAC has requested the expertise of the Académie des Sciences, as it previously had of the Royal Society and the American National Academy of Science. The Académie gave a favourable reply to this request then decided to organise with NASAC a series of training sessions for the administrative officers of the various African Academies united within this network.

Consequently, a Capacity Building seminar held at the Institut de France from 26 to 28 January 2012. Members of the Academies, as well as administrative officers, took the floor and participative round tables were organised, thus touching on the missions of a model Academy of Sciences (advising, teaching, encouraging the scientific life) and the various tasks involved in its operation. Administrative departments of the Académie des Sciences have thus shared with their African counterparts their experiences in the management of working committees, publication of Advice Notes and Recommendations, organisation of colloquia, workshops gathering members of the Académie, prize awarding, communications (media relations, website, webradio) as well as international relations. As a booster to their meeting, representatives from the Swiss and Dutch Academies came and expressed their views on the communications missions they perform at their own institutions.

## ***Facilitating third-country access to the European natural history collections***

Natural history collections, which have been gathered in European museums in the course of the last two centuries, have long been considered renewable materials, of minor importance for economic development, which was mostly based on the industry.

Today, these collections raise growing interest, mainly for reasons of:

- ▶ Heritage, inasmuch as they contribute to global biodiversity preservation;
- ▶ Economy, since they may become a source of development for the populations of the countries they come from.

The collected animal and plant species, while they are perfectly suited to their home areas, have sometimes been neglected by the West as it ignored their potential; the Collect Access approach stems from this context, with support from the Académie des Sciences and the French National Museum of Natural History.

The scope of this project is to open access to European collections for scientists from the Maghreb countries, Africa, Asia or South America who are interested in the characteristics of one or another of these species. Opening access could mean extending to these countries the European Synthesis Project, which provides financial support to research travels for scientists working in the EU or countries deemed eligible to the Taxonomic Access Facilities that take part in the operation.

For this purpose, the Académie des Sciences and National Museum of Natural History have organised in Paris, from 18 to 20 October 2012, a preparatory colloquium as a preliminary to the drafting of a project proposal for the European Commission to consider. The meeting gathered representatives from academies or scientific institutions of 16 countries, 6 of them being in Europe (Belgium, Bulgaria, Denmark, France, the Netherlands, Portugal) and 10 in emerging countries (Algeria, Brazil, Laos, Lebanon, Madagascar, Morocco, Senegal, South Africa, Tunisia, Vietnam).

## ***Brainstorming the scientific and technological policies***

The socio-economic boom of the African continent will depend - as that of Western or other emerging countries - on the development of science, technology and innovation. Yet, the transformations that are required still meet with many impediments on the African continent hampering regional and international cooperation and numbing the awareness of national policy makers and of a part of the scientific community.

Bearing this in mind, the National Academy of Sciences and Technics of Senegal (*Académie nationale des sciences et techniques du Sénégal*, ANSTS) and the Académie des Sciences have organised an international colloquium aiming at:

- ▶ conceiving and implementing policies and programmes;
- ▶ making regional and international cooperation more effective and efficient on the theme of Science, Teaching and Technology for Development in Africa.



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On the African side, the purpose of this colloquium was to allow scientists to communicate with decision makers and populations, share knowledge and above all advocate for the development of science and technological innovation. For its part, the Académie des Sciences, which makes sure that the EU contribution and funding increases to aid scientific and technological development in Africa, wished this colloquium may help young African scientists interact with Europe, including France, as well as, when they return to their countries, find a solid basis for expanding their teaching and research experience.



 Strategic booklet of the 2012 Dakar - Symposium

This colloquium, held in Dakar from 30 October to 3 November 2012, was widely open to all African nations, with the general intention to strengthen regional bonds. After hearing African, French and International key political personalities and institutional stakeholders - an opportunity to take stock of the progress achieved from ongoing policies, including the Science and Technology Consolidated Plan of Action of the African Union and various European and global projects (UNESCO, IAP, etc.) - the following sessions took place, focusing on six scientific fields of priority: energy, agriculture, health, environment, mathematics and computer sciences, water. In the end, the question of Funding and Research/Teaching Networks was addressed during a dedicated session.

## PLAYING AN EXPERT AND ADVISORY ROLE



Deciding in matters of scientific and technological options is up to the political stakeholders, who must be able to make informed decisions. Since its creation, the Académie des Sciences performs an advisory role, as indicated in Article 3 of its statutes. Its members' scientific excellence, its pluridisciplinarity and openness to the world allows it to play a key role as an expert organisation. In order to do so, the Académie sets up Committees which are the cornerstones of its activity as they compose Reports, Advice Notes or Recommendations - as many useful decision-making tools that are available for public consultation. In a time when the notion of an "Independent Expert" is sometimes misused, the Académie des Sciences has adopted a *Charter of Expertise*, which makes sure ethics and transparency are respected in the work conducted at the Working Groups or Committees in charge of thematic reflections.

## Committees as Tools to Reflect and Propose on High Societal Issues

The Académie des Sciences draws on its specific feature, i.e. having at hand top-level scientists from all disciplines, to address modern issues in which science takes a part. Standing or Ad-Hoc Thematic Committees, indeed, allow members of the Académie to analyse and review the most recent data and formulate recommendations for action.

Standing Committees most notably constitute the cornerstone of the Académie's advisory mission. Out of presentations & debates organised by members of the Académie, to which external experts are invited when deemed useful, draft reports, advice notes or recommendations are conceived, proposed to decision makers and made available for consultation to all citizens browsing the website of the Académie des Sciences.



## A Pluridisciplinary Reflection on the Environment

The *Standing Committee for Environmental Sciences* of the Académie des Sciences, chaired by Jean-Claude Duplessy, was created in its initial form in 1989, to closely follow environmental issues that are considered from the viewpoint of science. To tackle these issues, which are pluridisciplinary by their very nature, one needs to take into account all the natural elements - water, air, solid ground - and problems - climate, global food, health, demography, environmental contamination - as well as environmental science, ecosystems and ecosystemic systems (i.e. the benefits man derives from ecosystems).



### Missions

- ▶ to provide scientific elements of such nature as to reconcile the necessary economic and demographic growth with the preservation of natural balances, by assessing the costs and benefits of the decisions that are made, or of decisions not made, concerning the way some features of technical progress are applied;
- ▶ to identify the sectors that require further reflection, following preliminary analysis of the drivers that may hurt the environment, and to determine in what form these should be considered by the Académie;
- ▶ to evaluate the short-term and long-term risks, the forecast methods, the means of prevention, the potential antidotes; to indicate which research would require support to both achieve growth and mind the environment;
- ▶ to make sure the Académie des Sciences participates to national and international debates that concern the environment.

### Contributions

Since the beginning of the 1990s, the *Committee for Environmental Sciences* has been the author of several major publications including, in the last 10 years:

- ▶ *Exploitation and Overexploitation of Natural Living Sea Resources* (2003);
- ▶ *Health Security and Waste Management* (2004);
- ▶ *Continental Waters* (2006);
- ▶ *Extreme Climatic Events: Reducing the Vulnerability of Ecological and Social Systems* (2010);
- ▶ *Demography, Climate and World Food* (2011), after which publication the coordinators of this report participated to the international colloquium *The End of Hunger by 2050? No Taboos, no Fetters*, organised by the Cité des Sciences in Paris on 11 and 12 May 2012.

### Pieces of advice to decision makers

In June 2011, the Académie des Sciences, drawing from work conducted by its *Committee for Environmental Sciences*, has put recommendations forward to the French government concerning the functioning of the future IPBES (International Platform on Biodiversity and Ecosystem Services), an international organisation that will provide information, inventories, assessments and advice on biodiversity and ecosystemic services. The French Ministry of Foreign Affairs has asked all its representatives at international meetings to take into account these recommendations, which notably insisted on the necessity to secure the active participation of scientists in the subsidiary bodies responsible for orientation within this organisation under construction. At the same time, the recommendations put forward in March 2012, by a joint Working Party involving the German Academy of Sciences Leopoldina and created on the initiative of the Académie des Sciences, have had an impact on the decisions that were taken on the creation of IPBES by the United Nations in Panama on 21 April 2012.

Drawing on its experience with the functioning of IPCC (Intergovernmental Panel on Climate Change), to which several members belong, the *Committee for Environmental Sciences* is also in charge of organising, on account of the government, the revision of the draft IPCC Fifth Assessment Report (Tome 1, Scientific Basis), to be published in 2014.

### Ongoing and in Prospect

Scientific and technical progress and, more broadly, the transformations the modern world has gone through have led many questions to arise on issues related to the environment. Amongst others, answers are needed on the following connections:

- ▶ demography and the environment: evolution of mortality causes, issues raised by population ageing, internal and international migrations, effects of the urbanisation; demography and food security, milk, cereals and transportation issues;
- ▶ health and the environment/climate change: assessments of the consequences of environmental pollution, disease propagation, emergence of new pathologies;
- ▶ evolution of the ecosystems and climate change: fluctuation of biodiversity through time, for internal (invasive species, etc.) or external (climate, etc.) reasons, as well as deriving from man's activities (over-exploitation of halieutic resources); coevolution (species/diseases, birds/ticks, etc.); plant pollinisation; biodiversity as a source of molecules for basic research.



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More generally, it appeared necessary, at the Académie des Sciences, to address major environmental issues by focusing on the study of basic science issues: concerning climate, the *Committee for Environmental Sciences* will start an in-depth reflection on using space observation for water cycle, and on the research needs highlighted by the forthcoming IPCC report.

## Precious Expertise for Space Research

The *Standing Committee for Space Research* of the Académie des Sciences, chaired by Jean-Loup Puget, was created in the middle of the 1980s. It focuses its attention on the research that is ongoing or ought to be conducted “by and for” space, the latter being considered both as a means of scientific investigation and as an objective for exploration.



### Missions

To make contributions, through studies and recommendations, to the basic and applied research strategy conducted by France institutions in each field of space science.

### Contributions

The *Committee for Space Research* has been, in the last 25 years, at the origin of several recommendations from the Académie to the government, some of which have been published: Advice Note on the Topex/Poseidon project; resolution of the Académie des Sciences on the European programme of space infrastructure; recommendation on inhabited flights; statement on the integrity of the space environment of Earth; recommendation on the occasion of the 1995 European Interministry Space Conference.

Since then, the Committee has continuously expressed its views in reports or recommendations on research conducted by and for space:

- ▶ contribution to the *White Paper on the European Space Policy* of the European Commission (2003);
- ▶ *French Space Research* (2006);
- ▶ *Space Sciences*, a review of the evolutions that have taken place since the former report (2010);
- ▶ the issue of space exploration, which had not been addressed in the 2010 Report, has been the object of Recommendations and proposed for feedbacks and comments to several European academies of science.

To make sure its reports are carefully reviewed, the Committee called on to research agencies and organisations concerned with space research, to which some recommendations were addressed.



### A voice that counts at the national and European levels

Reports and Recommendations from the *Committee for Space Research* have been widely used :

- ▶ by major French organisations, such as the National Centre for Scientific Research (CNRS), the French Alternative Energies and Atomic Energy Commission (CEA), and the National Centre for Space Studies (CNES), together with the extended use of space data gathered from the observation of Earth. As for today, the CNRS National Institute for Earth Sciences and Astronomy is setting a Working Group to implement some recommendations of the 2010 report;
- ▶ in new fields of study: by geographers, ecologists, hydrologists, economists,...as space competitiveness clusters are being assembled through the Initiatives d'excellence (IDEX) scheme in Paris-Saclay and Toulouse, as well as the centre of Paris and Marseilles;
- ▶ by the French government authorities, for strategic planning on space, in the perspective of the European Ministerial Conference: recommendations expressed by the *Committee for Space Research* of the Académie on the "Science" Part have indeed been directly endorsed.


### Ongoing and in Prospect

Since the decision to extend the remit of the European Union in space matters, which was made at Lisbonne, the integration of space programmes widens. Europe is now the right level to consider very large research infrastructures. In such a context, *the European Academies Science Advisory Council* (EASAC) offers to create a Working Party, to which the Committee for Space Research of the Académie des Sciences should highly contribute in order to share the French positions that needs be expressed inside the EU.

Moreover, the Committee should look into the prospective exercise of the CNES, which is starting and will end in spring 2014.



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 The Planck Satellite on its way to the second Lagrange point (L2)

## Participating to the fundamental debate on energy

The *Standing Committee for Prospects in Energy Procurement*, co-chaired by Sébastien Candel and Bernard Tissot, was put in place in June 2010 to pursue and develop reflection on energy - now a pivotal issue, which needs to be addressed by taking stock of the challenges we need to rise to.



© Catherine Bréghinac

 A solar farm in Seville

### Missions

- ▶ to contribute, from a scientific viewpoint, to addressing the issues of energy, which are at the crossroads of most problems our societies face: environment, health, climate change, economic independence, models of development;
- ▶ to help debates progress on a rational track, by emphasizing how necessary it is to take into account all factors, including scientific, technological, economic, social, environmental, geopolitical ones.

### Contributions

After the *Working Party on Energy* of the Académie des Sciences was put in place and published:

- ▶ *Perspectives on Energy* (2005);
- ▶ *Energy 2007-2050: Choices and Traps* (2007),

the *Committee for Prospects in Energy Procurement* has:

- ▶ contributed to the section on “Nuclear Energy” of the report from the Working Party *Solidarity Japan*, established by the Académie des Sciences following the major accident of Fukushima (2012);
- ▶ written the report *Scientific Research Taking on the Energy Challenges* in the course of 2012 (for publication in January 2013).

## Ongoing and in Prospect

The *Committee for Prospects in Energy Procurement* takes part in the work of the Académie des Sciences on shale gas exploitation, whose results have been published as an Advice Note in November 2013.

At the same time, the Committee will further reflect on the issues of electric networks and intermittent energy storage. Indeed, the dynamics and stability of networks, the notions of intelligent network and the development of massive storage methods are key issues for their integration.

The Committee also continues evaluating the various energy scenarios that may be conceived in the frame of the debate on energy transition.



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### A crucial contribution to energy choices for tomorrow

*Scientific Research Taking on the Energy Challenges* is the contribution of the Académie des Sciences to the national debate on energy transition. The report provides an audacious review of the strong and weak points of all the sources and vectors of energy, in a time when it is now necessary to redefine an energy mix for the future.

The report reminds, indeed, that needs for energy may only be addressed by diversifying resources: the decline in fossil energy, notably imported petroleum and gas, will not be adequately compensated by the sole growth of renewable energy and energy savings. Inserting more renewable energy into the mix will lead to facing considerable difficulties in making sure demand and production are in balance. This transition will not take place until the fundamental economic goals are taken into account and major scientific and technical problems solved.

For France to achieve energy transition which respects its economic goals and its energy independence, and preserves its environmental commitment, the report of the Académie expresses nine recommendations and underlines, in particular, the need to:

- ▶ solve problems of massive energy storage and of integration, within electrical networks, of intermittent electricity produced by renewable energy (from wind, sun);
- ▶ maintain a crucial role for nuclear power because of its assets (massive and continuous production of electricity, complete industrial tool free from the fuel cycle, and expertise that ensures it is safe for use in France), while keeping research efforts up on the management of current and future radioactive waste;
- ▶ review the conditions of use of shale gas, drawing on preliminary studies designed to assess national reserves and techniques that minimize the environmental impact of a potential extraction;
- ▶ develop new biofuels from lignocellulosic biomass (2<sup>nd</sup> generation) or photosynthetic organisms (3<sup>rd</sup> generation);
- ▶ continue studying carbon sequestration while at the same time study what processes might make it possible to use it as a source of carbon for fuel synthesis and of organic molecules for chemistry;
- ▶ build up energy efficiency in all fields, in order to make energy savings.

## Contributing to the (Re)Definition of the Units of Measurement of the International System

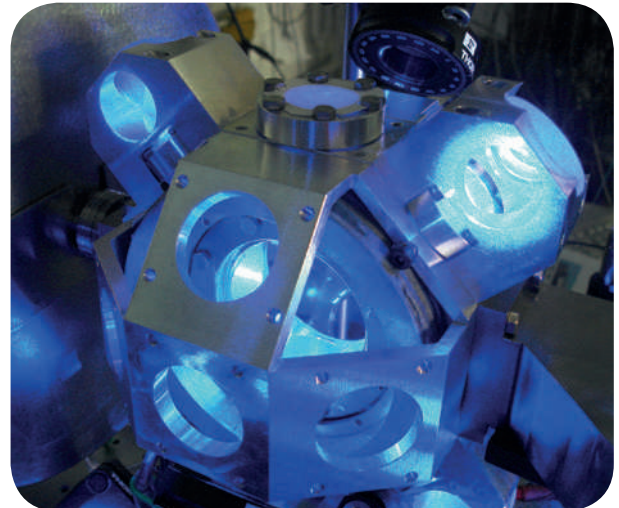
The *Standing Committee for Science and Metrology*, co-chaired by Christian Bordé and Jean Kovalevsky, stems from a Working Party which, between 2003 and 2007, looked into the fundamental constants which underlie the international system.

### Missions

Concerning world metrology, the Académie bears a responsibility inscribed in an international treaty, the Convention of the Metre (1875), which states that the President of the Académie des Sciences chairs the General Conference on Weights and Measures (CGPM).

National laboratories of metrology, as well as the International Bureau of Weights and Measures (BIPM), play the essential role of diffusing standards. They are neither designed, nor sufficiently equipped, to commit themselves to important research on the theoretical bases of metrology. Therefore, the *Committee for Science and Metrology* has been created to:

- ▶ be a scientific discussion partner at the CGPM and in its offshoot, the International Committee for Weights and Measures (CIPM), in order for France to maintain its historic place within this organisation;
- ▶ play a national role by boosting the commitment of French laboratories to such new research and coordinate it;
- ▶ develop a prospective vision of metrology by pondering the metrologic applications of progress in scientific research.



🇫🇷 A strontium optical clock

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### Contributions

- ▶ Positions expressed at the Consultative Committee for Units of the CIPM, in charge of redefining the units from fundamental constants, opposing to the arbitrary adoption of the Avogadro's number for the mole, and in favour of keeping vacuum permeability at the basis of electric units, of using Planck constant for the redefinition of the kilogram and Boltzmann constant for the kelvin;
- ▶ audit of French National Laboratory of Metrology and Testing: recommendations in the fields of chemistry, electricity, optics, radiometry and watt balance;
- ▶ Presidency of the 24<sup>th</sup> CGPM, October 2011;
- ▶ exploration, on the theoretical level, of some aspects of future metrology, related to modern physics concerning, notably: quantum electrical metrology, quantum limits to the measurements, redefinition of the unit of time and its deep relation to the unit of mass and impact of the theory of general relativity on the metrology of time;
- ▶ setting up, with other organizations, of several colloquia on the determination of the Boltzmann constant, on atomic clocks and inertial sensors using atomic waves, on the definition of the meter and second, and on the quantum Hall effect and its applications to metrology. Several thematic reports have been written and published in the *Comptes Rendus de l'Académie des Sciences*.

### What metrology for tomorrow?

The *Committee for Science and Metrology* will continue contemplating the evolution of metrology and considering, especially, the following points:

- ▶ the discrepancy between the practical definitions of the units and their theoretical relations to fundamental constants is in evolution as experimental methods and knowledge in physics progress. It is therefore all about drawing a course of action that makes sure future metrology will take such a discrepancy into account. Optic clocks may serve as examples: as it is the case with today's cesium clocks, the definition of the second they realise cannot be reduced to the simple interplay of fundamental constants between one another. In these conditions, what are the prospects for a new definition of the second?
- ▶ what impact on the measure of temperatures will the use of acoustic, optical and electric methods have in the definition of Boltzmann constant?
- ▶ should the role of gravitation be taken into account in the redefinition of the system of units, as well as for the measurements of space, time and mass? What would the impact of unified theories of gravitation and electromagnetism be on fundamental metrology?
- ▶ metrology is more and more quantum-based: how far will this evolution go? What role does decoherence play in this new metrology paradigm?
- ▶ in chemistry, what should be done to get to the new mole?

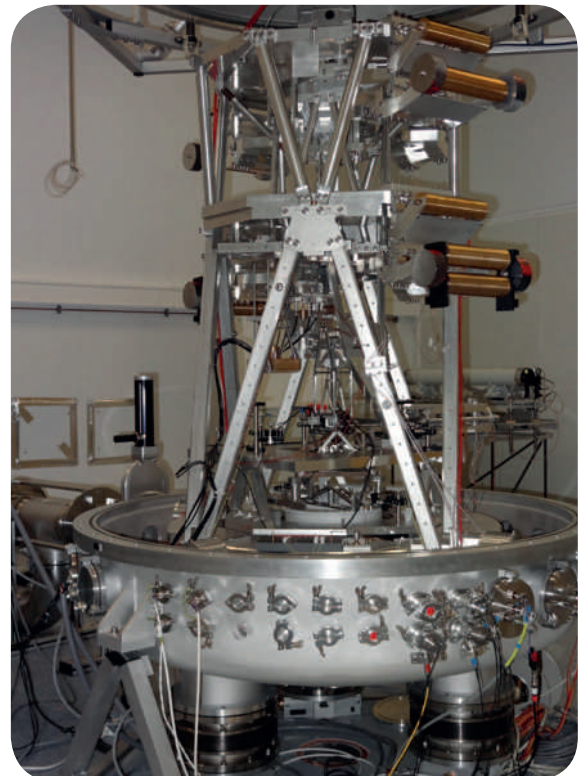
### Ongoing and in Prospect


Beyond these questions raised on future metrology, the *Committee for Science and Metrology* has started reflecting on:

- ▶ the necessary standardization of the results obtained from measurement techniques in such disciplines as geophysics, climate or environmental sciences, and medical physics;
- ▶ the necessity to apply an epistemological method on metrology;
- ▶ metrology teaching in France.

The *Committee for Science and Metrology*, moreover, ought to articulate new definitions of the units, integrating relevant and rigorous physics contents, while being at the same time understandable by the general public.

It would again participate to the Consultative Committee for Units in June 2013 and would organise a colloquium to celebrate the centenary of the Sagnac effect on 10 October 2013.



 A watt balance

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## Averting Threats to Biosafety

The *Standing Committee for Science and Safety Issues* of the Académie des Sciences, chaired by Henri Korn, stems from the Scientific Action for Defence Committee, which had been created by the Académie in 1992 and, in 1995, had written a report on the danger of biological weapons. The *Committee for Science and Safety Issues* has been created in 2005, following the signature, by the Académie des Sciences and 67 of its counterparts over the world, of the InterAcademy Panel Statement on Biosecurity. It gathers a group of experts from fields pertaining to the life sciences and medical sciences: cell biology, molecular biology and genetics, bacteriology, virology, risks induced by the use of toxins, immunology, chemistry, computer sciences, plant biology, the environment and, more recently, synthetic biology.

### Missions

The mission of the *Committee for Science and Safety Issues* is to encourage the scientific community and public authorities to make every effort to avoid progress in the life sciences from being used for malevolent purposes. These sciences are indeed of a dual nature: conceived for the benefits of mankind, they, as all biotechnologies, have achieved progress that now make it possible to alter evolution and modify the functioning of living materials, thus creating a real potential for abusive use and scope creep. It is recommended to make sure they may not be used to produce biological weapons for military or terrorist purposes; such weapons would have countless impacts on public health and the environment.



A certain number of challenges should therefore be taken up, requiring to develop a new ethics for life sciences and ponder the abusive uses and how they may be avoided, including:

- ▶ making sure that the progress of scientific research is solely devoted to general welfare and avoids the careless dissemination and inconsiderate diffusion of sensitive data;
- ▶ reconcile the requirements of security and safety with those imposed the researchers' freedom and independence, which are recognized as preconditions to the development of knowledge and innovation.

### Contributions

- ▶ *Cryptology, Science and Safety*, a Report from the Académie des Sciences (2006);
- ▶ *Biological Threats: Biosafety and the Scientists' responsibility* [Les menaces biologiques - Biosécurité et responsabilité des scientifiques]. H. Korn, P. Berche, P. Binder; Presses universitaires de France (eds), April 2008;
- ▶ Interventions at international conferences on biosafety: Hamburg (March 2008), Budapest (March-April 2008), Wilton Park (September 2008) and Washington D.C. (November 2008);
- ▶ Organisation of the joint USA/Iran/France meeting (15-25 November 2009) on the theme: *Encouraging Appropriate Use of the Products of Scientific Research*;
- ▶ Participation to teaching sessions (Master 2 Level) on health risks induced by radioactive, biological and chemical sources (Val-de-Grâce School/ French Alternative Energies and Atomic Energy Commission/ Pierre and Marie Curie University);
- ▶ Organization of the Académie des Sciences Conference Debate *Synthetic Biology - Rebuilding Life: How and Why?* (June 2012).

### Weapon regulation for biosafety

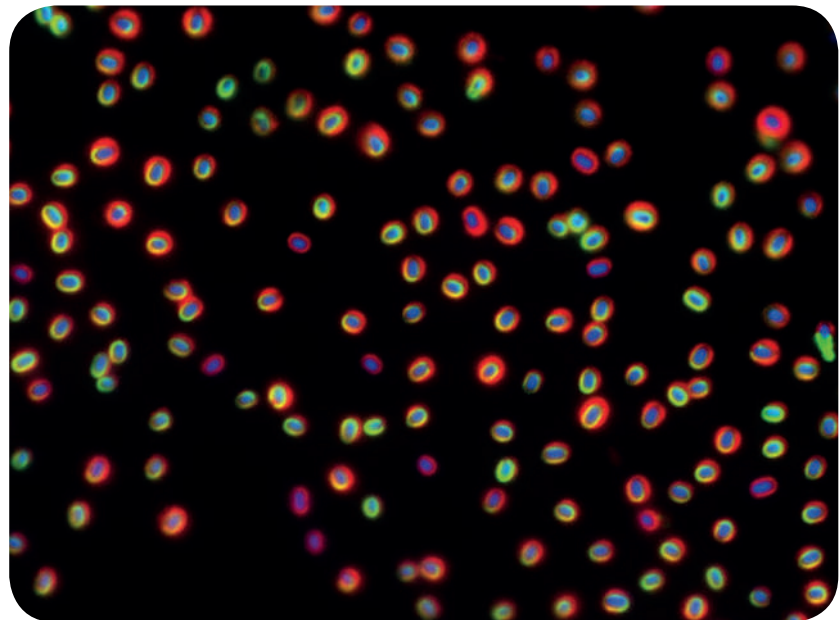
Several international conventions against the proliferation of biological and chemical weapons have been adopted since the beginning of the 20<sup>th</sup> Century: the *Geneva Protocol* in 1925, the *Biological Weapons Convention* in 1972 and the *Chemical Weapons Convention* in 1993.

It still remains of prior necessity to see that biosecurity and biosafety regulations within laboratories are complied with and that legal and regulatory dispositions as well are observed in France and throughout the world, in order to ensure staff protection. At the same time, existing biosecurity regulations, designed to limit the risks of scope creep and abusive use (whether voluntary or not) occurring, should be implemented.

In the same perspective, members of the Committee should participate to the Review Conferences of the Biological and Toxin Weapons Convention (1972-1975) and of the United Nations Security Council Resolution 1540 (2004) on the proliferation of nuclear, chemical and biological weapons.

### Ongoing and in Prospect

Threats to biosecurity are permanent, expanding and more and more complex. As recommended in *Biological threats: biosafety and the scientists' responsibility*, the Académie des Sciences, boosted by its *Committee for Science and Safety Issues*, might propose the creation of a surveillance organisation in matters of biosecurity where science is deeply involved, sharing much the same values and interests as the American NSABB (National Science Advisory Board for Biosecurity), created by the National Academy of Science after the 2001 terrorist and anthrax attacks. In liaison with Intelligence, Security and Health services, scientists would achieve a vital, high-level advisory mission and expertise, setting such targets as:



 Anthrax

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- ▶ defining the regulations of research when its applications are not permitted (e.g. making a pathogen microorganism more virulent, developing techniques that aim at weakening immune defences), while avoiding to any infringement on the freedom of research, as it is a precondition to scientific and technical progress;
- ▶ examine the contents of work published in national reviews, so as to avoid sensitive data from disseminating (e.g. the genetic sequences of dangerous or deadly viruses, if not the methods for reconstituting the genomes of extinct microorganisms such as the virus of poliomyelitis or Spanish flu).

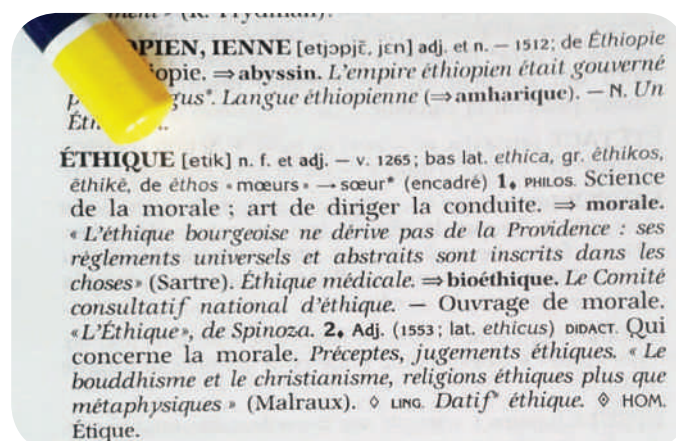
Drawing on its past experience and galvanized against these new security issues, the *Committee for Science and Safety Issues* will be conducting interdisciplinary investigation in this direction.

## Pondering the Ethics of Scientific Activity

The *Standing Committee for Science, Ethics and Society* of the Académie des Sciences, chaired by Anne Fagot-Largeault, is composed of about twenty members. It has followed in 2011 from the Science and Society Working Party (2000-2006), which had then become a Standing Committee (2006-2010), given the high importance of this theme within the whole scientific community, including the foreign academies and academy networks.

### Missions

The *Committee for Science, Ethics and Society* deals with issues of scientific integrity - publications, evaluations, conflicting interests, researcher's conducts at their laboratory towards the public, media or requests from the industry - as well as issues related to the researchers' responsibilities, the image of science within society, relations with the media, the notion of progress, research funding, etc. The Committee has also set itself as a mission to investigate on the issues of internal deontology that are specific to the very functioning of the Académie. Personal issues, though, have been excluded from the scope of its actions



### Contributions

The group, and then the *Committee for Science, Ethics and Society*, have considered about twenty topics, some of which have led to the release of:

- Recommendations on: human embryonic stem cell experimentation (2002); draft government bill on the Law on research orientation and programming (2005); postdoctoral researchers (2008);
- Reports: structure of public scientific research (2004); bone meals (2005); higher education reform (2007); attractiveness of careers in research (2008); individual evaluation of researchers and teacher-researchers (2009);
- Advice Notes: taking stock of the *12 July 1999 Law* on knowledge transfer from public research to the industrial sector.

Since 2011, the *Committee for Science, Ethics and Society* has:

- formulated rules for the attribution of the Académie des Sciences Awards, which have been adopted at the Closed-Door Committee session of the Académie held in January 2012;
- expressed its opinion, on request of the President of the French National Assembly, on a draft parliamentary bill and a draft resolution intended to better circumscribe the application of the principle of precaution, including in the field of health;
- replied to solicitations from external groups: represented the Académie through the intervention of its members at various international groups that deal with scientific ethics, such as the ALLEA (All European Academies) Standing Committee on Science and Ethics and the Committee for Scientific Integrity of the IAP-IAC (International Academy Panel - International Academy Council), or national groups as the French National Ethics Advisory Committee (CCNE); took part in the work of the French National Commission for UNESCO, particularly in the review process of a document written in 1974 on the situation of researchers; invited at the Institut de France the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) to an extraordinary general session in Paris in July 2012, and participated to its public session.



## Ongoing and in Prospect

In line with its investigation on internal deontology issues, the *Committee for Science, Ethics and Society* has set up several recommendations designed to better regulate the election of the new members of the Académie. Once approved by the electoral Commission and the Closed-Door Committee, these proposals will come into effect during the campaign for the election of 17 new members in December 2013.

### Private funding for public research: what modalities?

Private funding, particularly from the industrial sector, is a very useful, and sometimes vital, supplement to the achievement of many research programmes; on the other hand, the industry often ask researchers for help in developing innovative products and benefit from their credibility and reliability. In all these moments when the research teams and manufacturers share relations, and often complex ones, the scientist's activities should take place in a precise regulatory and ethical framework. The *Committee for Science, Ethics and Society* of the Académie des Sciences has started thoroughly examining this wide-range issue, drawing on case studies and diverse statements from observers. Such work aims at producing recommendations that lay down the ethical conditions and rules in the boundaries of which collaboration with the industry may take place, each paying respect to the other, for the benefit of everyone. This also sends a strong signal to society and boost its confidence in the principle of public/private partnerships in scientific and technological research.

In order for science and scientists to have an increased impact on society and the media, the *Committee for Science, Ethics and Society* has proposed several actions intended to improve and develop external communications at the Académie:

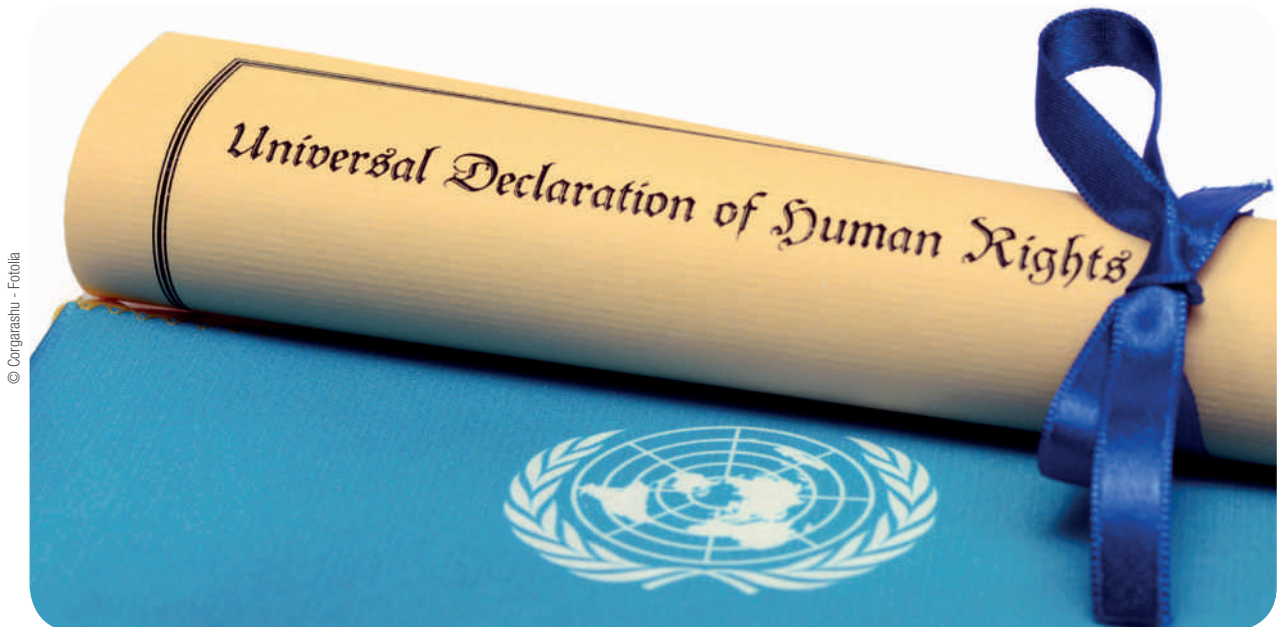
- ▶ organising the accrued and better-targeted dissemination of the reports from the Académie, as they are serious and evidence-based documents whose impact should be even higher than it now is;
- ▶ writing a series of small-sized publications for the general public on various fundamental issues - the scientific method, notion of expert, ethics, etc.



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## Protecting Scientists Throughout the World

The *Standing Committee for the Defence of Scientists' Rights* (CODHOS) of the Académie des Sciences, chaired by Claude Cohen-Tannoudji until 2013, was created in 1978. According to the statutes of the Académie des Sciences, it looks into the violations of rights that experience across the world scientists, physicians, researchers in human and social sciences, engineers or students.



### Missions

- ▶ to intervene, on its own initiative, in favour of scientists whose rights are flouted, mainly by writing letters to the authorities of the relevant country: the objective is to obtain clarification on those cases and see that the prisoners are released when evidence prove their detention is abusive, and make sure they can resume their work;
- ▶ to take part in the International Human Rights Network of Academies and Scholarly Societies: CODHOS and other member institutions of the network take action on an autonomous and discretionary basis but are invited to inform its Coordination Office of their actions and the results they achieve. They take action, in the cases drawn to their attention by the network, by writing protest letters and appointing observers to attend the trials of the scientists under accusation.

### Contributions

- ▶ In the beginning of the CODHOS activities: letters of support or invitation sent to Russian, Polish or Bulgarian researchers wishing to take part in scientific conferences "in the West" and whose visa application had been rejected;
- ▶ Enlargement, then, to the Middle East (Iran, Iraq, Syria, etc.) or Africa (Ethiopia, Sudan, etc.), with also some actions concerning occidental countries (France, Switzerland, Italy, United States of America, etc.);
- ▶ In 2012, CODHOS has raised the attention of foreign authorities on the case of 38 persons in 7 countries (the Kingdom of Bahrain, United Arab Emirates, Equatorial Guinea, India, Iran, Syria, Turkey) whose rights and liberties had been flouted;
- ▶ The 2012 biannual meeting of the international network, focused on health and the mistreatment of healthcare staff, looked into the case of physicians and other health professionals who had been treated with high cruelty (torture, assassination) in order to bar them from dispensing care to persons wounded at demonstrations - thus contravening the duty of governments to respect medical neutrality. A public appeal to the King of Bahrain and the President of Syria was written and distributed on the occasion of this meeting.

Where Human Rights are involved, it is often difficult to evaluate the impact of the actions carried out. However, positive effects have been observed: visa delivery, mitigation of the conditions of detention, provisional or definitive freedom, presidential pardon. Along the last five years, CODHOS was pleased to hear 20 scientists had been liberated throughout the world.

## Ongoing and in Prospect

The *Committee for the Defence of Scientists' Rights* is preparing the 2014 meeting of the International Human Rights Network of Academies and Scholarly Societies, at which it should be agreed to increase the number of members of the Executive Committee of African or Asian origin. This meeting will also focus on the theme of education, a field in which the Académie des Sciences has traditionally been providing strong expertise.



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### Still a crucial mission in the 21<sup>st</sup> Century

Most states have signed one or more written documents establishing international regulations that protect human rights. The most famous of them is the Universal Declaration of Human Rights, proclaimed by the United Nations in 1948. However, there are also many governments that, while having ratified these agreements, regularly violate their clauses. With this context in mind, in 1993, on the initiative of the American National Academy of Sciences, the International Human Rights Network of Academies and Scholarly Societies was created, to achieve the following objectives:

- ▶ to promote respect for and protection of the human rights of scientists;
- ▶ to alert governments on the violations of these rights that may have occurred on their territories;
- ▶ to help scientists persecuted or unjustly detained for exercising without violence the rights secured to them by the Universal Declaration of Human Rights;
- ▶ to support the independence of sister academies throughout the world.

## Promoting high-level science education for all

The *Standing Committee for Science Education and Training* of the Académie des Sciences, chaired by Étienne Ghys, was created in 2005, to fulfil one of the missions of the Académie mentioned in its Statutes: *to watch over the quality of science teaching and take action in order for the achievements of scientific development to pervade the human culture of our times*. Indeed, the concerns of the Académie are not only related to the training of future researchers and engineers, but they also include the objective that all pupils acquire high scientific culture, which will be vital for them as they grow into citizens.

### Missions

- ▶ To provide response to requests for external advice, especially emanating from the French government, on plans to reform science teaching;
- ▶ To develop, at its own initiative, a prospective analysis and actions on key or sensitive issues concerning teaching and scientific culture.

### Contributions

Discussion seminars, with hearings of external personalities:

- ▶ Methodology of the scientific evaluation of pedagogic programmes (Evidence Based Education): experimental approaches;
- ▶ International and comparative assessment: taking stock on the PISA (Programme for International Student Assessment) study and its results, which show how difficult it is for France to secure success for pupils from deprived areas;
- ▶ Assessment at the French Ministry of Education: rise of the Education Assessment Approach and tools put in place;
- ▶ School dropout and cultural origin: what actions should be taken?
- ▶ What are educational sciences?

Advice Notes, Reports, include, recently:

- ▶ *Masterization<sup>™</sup>: the Training and Recruitment Process of Science Teachers (Primary, Middle and High Schools) (March 2009)*;
- ▶ *The Académie des Sciences and the High School Reform (November 2010)*;
- ▶ *Joint G8+ Science Academies Statement: Education for a Science-Based Global Development (May 2011)*;
- ▶ *Fighting Innumeracy (2012)*;
- ▶ *Teaching Computer Science in France: Tomorrow Can't Wait! (May 2013)*.



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Colloquium:

- *Philosophy Teaching and Sciences (May 2012)*, with the French National Academy of Moral and Political Sciences and the General National Education Inspectorate: proposals have been made to improve interaction between science and philosophy teachers in high schools - even at tenth grade, with schedules reorganised. A follow-up colloquium, *Philosophy Teaching and Sciences: New Perspectives*, would take place on 13 November 2013.

## Ongoing and in Prospect

In collaboration with the *Committee for Science History and Epistemology*, the *Committee for Science Education and Training* initiates in 2013 a collection of histories on science, received from wilful members of the Académie. These written documents describe exemplary scientific paths and review the evolution of some concepts and scientific fields, as well as they reflect on the scientific aspects of issues of high social impact. Their objective is to gather a body of texts, available for consultation on the website of the Académie to different audiences and users (teachers, pupils and students, researchers, etc.).

### An appeal to reach computer literacy



In its report *Teaching Computer Science in France: Tomorrow can't Wait!*, the *Committee for Science Education and Training* observes computer science is devoted too small a space in the education of pupils and French citizens, while, at the same, time computer science and technology now have conspicuously high potential to boost the economic and cultural growth of our modern societies. Far beyond digital education, i.e. hardware and software use education, which helps reducing the digital divide, the Académie des Sciences puts forward the necessity to teach computer science as a unified, autonomous discipline, with its own ways of thinking and results. The report insists a fundamental distinction should be made between “computer science teaching” and “digital education”, between teaching the perennial basics of computer science methodology and learning the use of tools and techniques which are invented and go out of date very fast. The Académie des Sciences therefore recommends to create in France a structured and adapted computer science teaching course, provided by professors specifically trained for it.

## Promoting History and Philosophy of Science

The *Standing Committee for Science History and Epistemology* of the Académie des Sciences, chaired by Claude Debru, was created in 2005.

### Missions

- ▶ To organise meetings on themes that relate to the history of sciences or epistemology, sometimes with a very contemporary dimension to them;
- ▶ To promote the publication of the minutes of these scientific meetings and, more broadly, of historic and scientific information;
- ▶ To contribute to prize awarding in its areas of expertise.



### Contributions

- ▶ *The Enlightenment and Veterinary Schools (September 2011)*: the meeting was followed by publication in the Biologies series of the *Comptes Rendus de l'Académie des Sciences*;
- ▶ *A History of Chemistry (January 2012)*: the meeting was followed by publication in the Chimie series of the *Comptes Rendus de l'Académie des Sciences*;
- ▶ *Philosophy Teaching and Sciences (May 2012)*, with the French National Academy of Moral and Political Sciences and the General National Education Inspectorate: proposals have been made to improve interaction between science and philosophy teachers in high schools - even at tenth grade, with schedules reorganised. A follow-up colloquium, *Philosophy Teaching and Science: New Perspectives*, would take place on 13 November 2013.
- ▶ *Enlightenment - Yesterday, Today and Tomorrow (February 2013)*: a French and German interacademic conference, coorganised by the French National Academy of Moral and Political Sciences, *Deutsche Akademie des Naturforscher Leopoldina* (nationale Akademie der Wissenschaften) and the Berlin-Brandenburgische Akademie der Wissenschaften, as part of the commemoration events of the 50<sup>th</sup> anniversary of the Elysée Treaty. The minutes of the Colloquium have been published (*Les Lumières, hier, aujourd'hui, demain - Science et société. Hermann Eds, 2013*).

## Ongoing and in Prospect

In collaboration with the *Committee for Science Education and Training*, the *Committee for the Science History and Epistemology* initiates in 2013 a collection of histories on science, received from wilful members of the Académie. These written documents describe exemplary scientific paths and review the evolution of some concepts and scientific fields, as well as they reflect on the scientific aspects of issues of high social impact.

Their objective is to gather a body of texts, available for consultation on the website of the Académie to different audiences and users (teachers, pupils and students, researchers, etc.).

### Clairaut's genius praised at the Académie

Alexis Clairaut (Paris, 13 May 1713 - 17 May 1765) is, considering his work on the shape of Earth, optics and astronomical motion, one of the greatest mathematicians of his time, alongside Euler, Bernouilli and d'Alembert. Invited to read before the French Royal Academy of Sciences while not yet thirteen years old, he was admitted a member of the Académie at eighteen years old, on extraordinary authorisation of the King because of his young age, for his *Recherches sur les courbes à double courbure*. He took part in the expedition to Lapland, whose goal was to confirm the oblateness of the Earth. He also managed to reconcile the movement of the moon with the Newtonian theory of universal gravitation, and predicted by calculation the return of Halley's Comet. An original educator and influential member of the Académie, Alexis Clairaut taught to Émilie du Châtelet and became her main scientific advisor, especially when she translated Newton's *Principles*. The Académie des Sciences has paid tribute to such a great character from the Enlightenment on 13 and 14 May 2013, on the occasion of his 300<sup>th</sup> birthday, through a colloquium organised in cooperation with the Observatoire de Paris and the Université Pierre et Marie Curie, and a public session.



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 Alexis Clairaut

## A Charter of Expertise to even improve in its advisory mission

For about twenty years, Western countries have been experiencing a major crisis of expertise, partly related to the occurrence of several health and environmental crises that have caused some to distrust the experts and have even led to reconsider progress achieved through science. Indeed, the standard model of expertise, producing statements based on the state of knowledge and made legitimate by the very authority of science, has been strongly challenged. A new hybrid/participatory model, relying on debates that gather scientists and lay people, and made legitimate by the democratic nature of its procedure, has been more and more put forward and used. This orientation leads to blurring the very notion of an expert.

This is why a third, more procedural model has progressively emerged, to fix the flaws of the standard model with the organisation of extensive and contradictory scientific debates, in a transparent perspective, yet made legitimate by rigorous scientific principles and very strict procedures. It is in this frame of mind that, in March 2012, the Académie des Sciences adopted its *Charter of Expertise*.



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### Defining expertise

All Advice Notes and Reports of the Académie are not expertise documents. Indeed, the Académie subscribes to the definition of expertise proposed in 1997 by Philippe Roqueplo: *the expression of a knowledge formulated in answer to a demand from those that have a decision to make, knowing that this answer is intended take part into a decision process*<sup>1</sup>. The procedures prescribed in the Charter of Expertise, therefore, are only implemented if what is planned matches the definition of an expertise. To confirm this is the first, so-called qualification step of the project.

### Choosing experts

This is a four-stage activity:

- ▶ the Select Committee of the Académie identifies which members of the Académie are competent on the question to consider and may be deemed experts in the relevant field;
- ▶ the latter decide whether external experts are needed and in what timeframe conclusions should be submitted;
- ▶ the contacted experts, whether or not they be members of the Académie, declare any link they may have to certain interests related to the expertise and which may compromise their neutrality;
- ▶ given these pieces of information, the Board of the Académie decides on their participation to the expertise procedure.

### Transparency as a goal

The Académie makes available the list of selected experts, their curriculum vitae and any potential link between the experts and the parties concerned by the expertise.

A document is written - a convention, or a specification document in the case of own-initiative investigations - where the object, the timetable and the conditions of the expertise are detailed: what form the awaited reply should take, how its findings should be communicated, what potential funding may be attached to it...

<sup>1</sup> *Entre savoir et décision, l'expertise scientifique*. Coll. Sciences en questions, Ed. Inra, Paris



## Taking diverging opinions into consideration

Minority opinions are taken into consideration and expressed at two different levels:

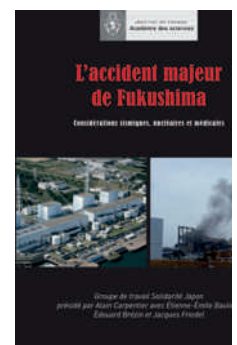
- ▶ the actual Expert Report mentions questions that the current state of knowledge does not make it possible to settle with sufficient certainty. It elucidates the controversies, whether or not linked to these uncertainties, and mentions the potential diverging views that would have been expressed at the experts committee. It reminds that the questions settled with sufficient certainty are only so according to the state of scientific knowledge of the time;
- ▶ given this Expert Report, the Closed-Door Committee of the Académie expresses its opinion as a panel of scientists and citizens who have no expertise in the question raised but can confirm the quality of a methodology. This opinion is submitted to simple majority voting and then added to the Expert Report, together with minority opinions.

The Final Report, composed of the Expert Report and the opinion expressed by the whole Académie, is handled to the authorities who have ordered it or, in the case of own-initiative investigations, to the relevant authorities. Exceptions left aside, the findings are made available for the public.

## Some Reports and Advice Notes

### The major Accident at Fukushima Dai-ichi

Made public in June 2011 and published in its final version in March 2012, this report has been produced by the ad hoc Working Party *Solidarity Japan* established by the Académie des Sciences in the aftermath of the nuclear disaster, whose remit was to analyze on the events and review the situation of seismic and nuclear risks in France. The Working Party was composed of three sub-groups gathering the expertise needed to study the three parts - seismic, nuclear and sanitary - of this tragedy. For each of these aspects, the analyze of the events observed in Fukushima was completed with a reflection on the strong and weak points of France, in order to formulate recommendations and answer questions of scientific and social matter that the public may ask.



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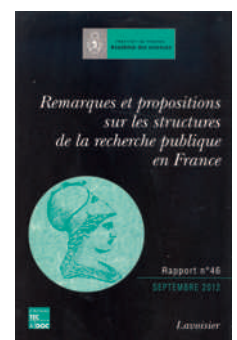
### Comments and Proposals on the Organisation of Public Research in France



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12 July 2012: Geneviève Fioraso has chosen the Académie des sciences to announce the creation of the Steering committee of the French Symposium on Higher Education and Research, chaired by Françoise Barré-Sinoussi, member of the Académie des Sciences.

This work is in line with such previous publications as *Individual evaluation of full time and academic researchers in theoretical and experimental sciences* (2009) and *On the proper use of bibliometrics to evaluate individual researchers* (2011). The Working Party has investigated on the excess of bureaucratization linked to the complexity of management structures that have expanded in the last two decades and seriously impede French research, as they stifle creativity and innovation while discouraging scientists from employment opportunities. Ten points, considered crucial, have been analyzed and, for each of them, proposals have been made. This report has been transmitted to the government before the opening of the French Symposium on Higher Education and Research held on 26 and 27 November 2012.



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## Scientific Research Taking On the Energy Challenges

Prepared by the *Standing Committee for Prospects in Energy Procurement*, this report presents the contribution of the Académie to the debates on energy, and especially on the issue of energy transition. In order to define the right balance between types of fossil, nuclear and renewable energy, it is necessary to set precise targets within rational, long-lasting policies, with help from existing technologies and innovations that scientific and technological research has fostered. The wished-for transition towards reducing fossil energy and increasing the share of renewable energy will bring about immense difficulties that needs be considered with realism. Approximations will not suffice to make sure demand and production are in balance and it will be necessary to understand that such balance shall not be obtained until major scientific and technical problems are solved. Nine recommendations are formulated to address the difficult questions raised by, among others, renewable energy intermittency, massive energy storage, the development of nuclear energy, efficient use of fossil energy sources, improvement of energy efficiency in all fields, etc. The goal is to boost the research we require to achieve transition and fulfil the fundamental economic objectives, while aiming at energy independence.



### Reports, Advice Notes and Recommendations of the Académie in 2012



- ▶ Communiqué on Nuclear Power in France - Advice Note (January 2012)
- ▶ The major Accident at Fukushima Dai-ichi - Report in French (L'Accident majeur de Fukushima - Considérations sismiques, nucléaires et médicales. EDP Sciences Eds, Paris, March 2012)
- ▶ G-Science Academies Statements 2012 - Advice Note (May 2012)
- ▶ Comments and Proposals on the Organisation of Public Research in France - Report in French (Remarques et propositions sur les structures de la recherche publique en France. Tec & Doc Lavoisier Eds, Paris, September 2012)
- ▶ Joint Advice Note issued by the French National Academies of Agriculture, Medicine, Pharmacy, Sciences, Technologies, and Veterinary sciences in regard to a recent publication by G.E. Séralini et al. on toxicity of a genetically modified organism (GMO) (October 2012)
- ▶ Advice Note on Teaching Reform - In French (Avis sur la Refondation de l'enseignement, October 2012)
- ▶ Lavoisier's correspondence - Book in French (Œuvres de Lavoisier - Correspondance – Volume VII. Hermann Eds, Paris, October 2012)
- ▶ Scientific Research Taking On the Energy Challenges - Report in French (La recherche scientifique face aux défis de l'énergie. EDP Sciences Eds, Paris, December 2012)



## From Louis XIV<sup>th</sup> to today

1666

Jean-Baptiste Colbert, France's Comptroller General, laid the foundations for the Académie des sciences, a small assembly of 'savants' which advised the King on scientific matters.

1699

At the initiative of Louis XIV<sup>th</sup>, the new assembly, under His Majesty's royal protection, increased its membership and became known as the Académie royale des sciences.

1793-1795

Although disbanded for some time, the various Academies reappeared as the 'classes' of the National Institute of Sciences and Arts.

1805

The Institute left the premises of the Louvre Palace and installed itself in the Collège des Quatre-Nations, quai de Conti, in Paris.

1816

The Academies - Française (1635), Inscriptions et belles-lettres (1663), Sciences (1666) and Beaux-arts (1816) - recovered their name and their independence with the renamed Institut de France. They are joined by the Académie des sciences morales et politiques in 1832.

Today

The Académie des sciences has the status of 'Public legal entity', carrying out its missions in accordance with provisions set out in the so-called programmatic law 'for research', April 18<sup>th</sup>, 2006.



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