



INSTITUT DE FRANCE  
Académie des sciences

## With the Académie des Sciences in 2015

Encouraging the Scientific Community

Promoting Science Teaching

Transmitting Knowledge

Fostering International Collaboration

Performing the Role of an Expert and Advisor



The year 2015 saw an upsurge in the public sessions organized by the Académie des Sciences. These sessions are traditionally held on Tuesday afternoons in the Great Hall of Sessions of the Institut de France. The number and diversity of these events reveal how dynamic science is and how important a role the Académie plays in imparting scientific knowledge as it progresses. It would be excessive to name all these sessions; it is worth noting, yet, that such issues as the Ebola epidemic, energy transition, the security of computer systems and the evolution of the human species hold the attention of internet users, who may find all the videos of these conferences on the website of the Académie.

Out of an identical concern for the promotion of knowledge, the Académie chose to become more accessible to all its audience through the launch, in July 2015, of its new website. Intuitive navigation has been made easier, articles enriched with meaningful images, the website revamped for the internet users of today, whose attention is relentlessly solicited. In 2015, almost 200,000 unique visitors browsed our website. The arrival of the Académie on the social media platforms – Twitter in 2015, then Facebook and YouTube in 2016 – stems from the very same desire to reach the widest audience, and especially the youngest generation.

The Académie, moreover, carried out numerous actions, thus maintaining its leadership at the international level, particularly drawing on its involvement within the interacademic networks and over 50 cooperation agreements with foreign academies, including the agreement of 29 May 2015 with the Chinese Academy of Engineering. We are also delighted by the installation of the Algerian Academy of Science and Technology on 14 November 2015, the creation of which we had been fostering in recent years. In addition, our Académie continued acting towards sub-Saharan Africa, in particular through the organization of a colloquium on “Chemistry and Natural Resources”, in close cooperation with the young Académie des Sciences et des Arts du Bénin (Academy of Science and Arts of Benin), with which it has close ties.

Finally, the Académie continues playing an advisory role and, as such, may greet the French Prime Minister's decision to create a *Conseil national consultatif pour la biosécurité* (National Advisory Council for Biosafety) in November 2015, a creation the Académie had recommended as early as 2008. Furthermore, it also brought its contribution to the reflection on energy transition and published its report on atmospheric ozone in October 2015.

The culminating point of the year 2015, and the prelude to 2016, occurred on 2 December 2015, when the illustrated book devoted to the Académie was published by the Cherche Midi publishing house: *Une compagnie en son siècle – 350 ans de l'Académie des sciences*. It was a solemn launch, as well as the official opening to the events that would delineate the year 2016 and celebrate the 350<sup>th</sup> anniversary of our Académie. The reader shall find their detailed sequence in the next issue of *One year with the Académie des Sciences*.



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**Jean-François Bach and Catherine Bréchnignac**  
*Secrétaires perpétuels of the Académie des Sciences*

## A Word from the President

As the 350<sup>th</sup> anniversary of the Académie approaches, to be celebrated in 2016, it is worth recalling the role of an academy and its operating principles. As early as 1666, the year of its creation, the Académie was formed by empanelling personalities of high repute in their respective fields. This has remained the hallmark of a founding principle of our institution. An academy should be an assembly of very high level scientists in their own disciplines, thus allowing them to work together on topics whose consideration require strong skills. Interaction between disciplines takes place from the moment it is necessary. The interactions between disciplinary fields should not be passively lived through, as the same old song heard over again, but should take place on a voluntary basis, bringing together one another's skills to venture off into new horizons.

Such a conception is clearly expressed in the very first page of the archives of the Académie: "*On this 22 December 1666, it has been settled in the company that it would meet twice a week, on Wednesdays and Saturdays. [...] On Wednesdays, one shall deal with mathematics, on Saturdays, one shall work on physics. As there is great connection between these two sciences, it has been deemed appropriate that the company did not divide and that all should gather at the assembly on the same days*", end of quote.

What mission is there for an academy of science to fulfil? All is said from the very first page of the history of the Académie des Sciences written by Bernard de Fontenelle. Let me quote: "*The reign of words and expressions has passed, one wants things. One establishes principles that one understands, one follows them, and hence one advances. Authority has ceased to bear more weight than reason, what was received without contradiction because it had been so for a long time is now being re-examined and often rejected*".

Today, many doubt the value of scientific progress. Is this any reason to minimize the role of scientific creation? We do not hold fond memories of the countries that, at some point in their history, tried to get rid of science and scientists. It is always preferable to try science than to maintain ignorance.



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**Bernard Meunier**

*President of the Académie des Sciences*

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# THE ACADÉMIE: ALWAYS IN TUNE WITH ITS TIME

## Adapting to the Evolution of Science

Faced with an unprecedented boom in science and with the birth of new disciplines, the Académie has revamped itself. In the early 2000s, it adopted new statutes that allowed for its membership to increase – it now comprises 258 members, 133 foreign associates and 87 correspondents<sup>1</sup> — — and rejuvenate: at each session of elections, at least 50% of the new members are under 55 years old<sup>2</sup>. In doing so, the Académie thus covers the widest possible array of scientific domains, including the most emerging ones.

### Fifteen New Foreign Associates in 2015

*The statutes of the Académie state that “The Académie is composed of 150 foreign associates at most, chosen among the most eminent foreign scientists (Article 27). The foreign associates contribute to the international reputation of the Académie. They are invited to notify the Académie of the results of their research and, when they are present in Paris, to participate to the fulfilment of the mission of the Académie (Article 28)”.*

In 2015, an *ad-hoc* working group was set up by the Académie, and, based on its conclusions, the *Comité Restreint* (Select Committee) organized a session to elect foreign associates: on this occasion, on 17 November 2015, eminent foreign scientists were proposed by each section, the global list of the Electoral Commission was approved, then the proper election by the *Comité Secret* (Closed-Door Committee) took place. This election was validated by a decree from the President of the French Republic<sup>3</sup>, dated 22 March 2016.

#### Division 1

##### Section of Mathematics

- Maryam Mirzakhani, Iran, professor of mathematics at the University of Stanford (USA), 2014 Fields Medal
- Báo Châu Ngô, Vietnam and France, scientific director of the Vietnam Institute for Advanced Study in Mathematics in Hanoi, 2010 Fields Medal

##### Section of Physics

- Ian Affleck, Canada, professor at the Department of Physics and Astronomy, University of British Columbia, Vancouver
- Fabiola Gianotti, Italy, 2016-2020 director-general of CERN, Geneva

##### Section of Mechanics and Computer Science

- Michael Brady, Great Britain, co-director of the Oxford Cancer Imaging Centre
- Adi Shamir, Israel, professor of computer science at the Weizmann Institute, Rehovot, 2002 Turing award winner, 2012 laureate of the Grande Médaille de l'Académie des Sciences
- Subra Suresh, India and United States, president of the Carnegie Mellon University, Pittsburgh (PA)

##### Section of Earth Sciences and Astronomy

- Véronique Dehan, Belgium, extraordinary professor at UCL (Université Catholique de Louvain)
- Alessandro Morbidelli, Italy, director of the French National Programme for Planetary Science (PNP) at the Côte d'Azur Observatory (OCA), Nice

#### Division 2

##### Section of Chemistry

- Avelino Corma, professor at the Polytechnic University of Valencia, 2011 laureate of the Grande Médaille de l'Académie des Sciences

##### Section of Molecular and Cell Biology

- Hans Clever, Netherlands, former president of the Royal Netherlands Academy of Arts and Sciences, 2013 Breakthrough Prize in Life Sciences
- Svante Pääbo, Sweden, director of the Department of Genetics, Max Planck Institute for Evolutionary Anthropology, Leipzig (Germany)
- Shinya Yamanaka, Japan, director of the Centre for iPS Cell Research and Application (CiRA), Kyoto University, 2012 Nobel Prize in Medicine

##### Section of Integrative Biology

- Sandra Myrna Diaz, Argentina, professor of Community and Ecosystems Ecology at the Department of Biological at the University of Córdoba

##### Section of Human Biology and Medical Sciences

- Max Cooper, United States, professor of immunology at the Emory University, Atlanta

1 As of 31 December 2016

2 On 1 January of the year of their election

3 <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000032287275&categorieLien=id>

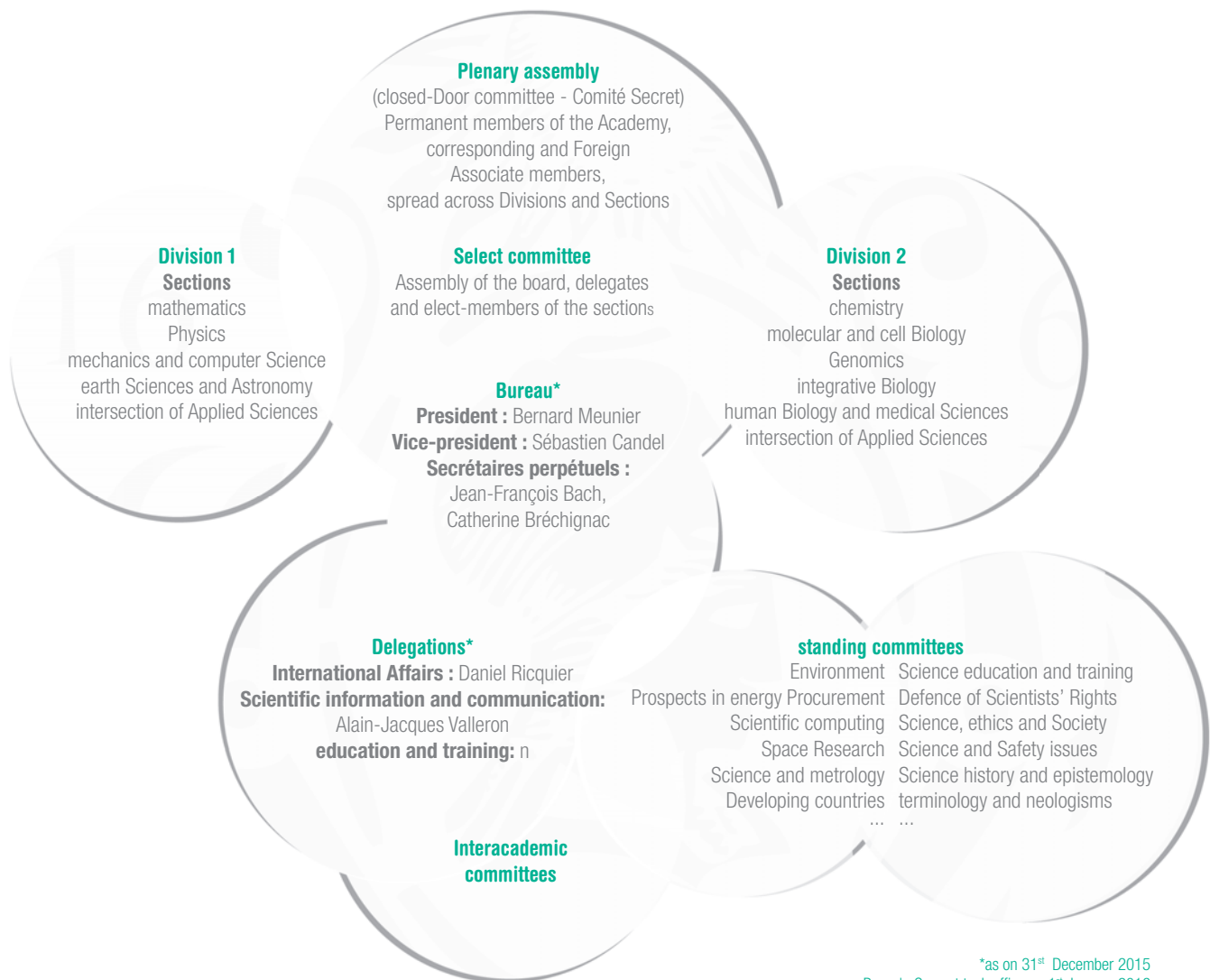
## Five Missions to Foster the Progress of Science

The Académie des Sciences carries out five critical missions:

- encouraging the scientific community;
- promoting science teaching;
- transmitting knowledge;
- fostering international collaboration;
- playing an expert and advisory role.

Its members conduct their work within thematic committees in close interaction with its statutory governing bodies, which all have voting rights.

### Bodies for decision making and reflection



\*as on 31<sup>st</sup> December 2015  
Pascale Cossart took office on 1<sup>st</sup> January 2016

## 2015: One year to Prepare for the 350<sup>th</sup> Anniversary!

On 22 December 1666, Colbert introduced about fifteen savants to King Louis XIV, who bestowed upon them the task of *driving and fostering science for the public good and glory*. In return, he granted them his protection and funded their work.



Présentation des membres de l'Académie des sciences par Colbert à Louis XIV

© Château de Versailles. Dist. RMN. J.M. Manai

### From Louis XIV Onwards

1666 - Birth of the Académie des Sciences de Paris, at the Louvre, at the initiative of Colbert

1699 - Birth of the Académie Royale des Sciences, with statutes granted by the king

1793 - Termination of the three Académies: *Française* (founded in 1635), *Inscriptions et Belles-Lettres* (1663) and *Sciences* (1666)

1795 - Foundation of the *Institut National des Sciences et des Arts*, composed of the three Académies

1805 - Napoleon moves the Institut National des Sciences et des Arts to the premises of the former Collège des Quatre-Nations, on the Quai de Conti in Paris

1816 - The three Académies become independent within the Institut de France. They are joined by the Académie des Beaux-Arts (founded in 1816) and later the Académie des Sciences Morales et Politiques (1832)

Today - The Académie des Sciences is a legal person governed by public law with a particular status under the Research Programme Law of 18 April 2006

Despite the trials and tribulations the instability of power relations brought about over the centuries, the Académie has remained the enlightening institution it already was at the end of the seventeenth century. Still protected by the highest magistrate of the country, namely the President of the French Republic, it has however gained independence: it administers itself independently, under the sole control of the Cour des comptes (French Court of Audit).

## An illustrated Book to Celebrate 350 Years of Science!

In this 232-page work, produced throughout 2015 and presented before the Académie des Sciences on 2 December 2015, the Académie recounts its own scientific and political history, drawing the topical portrait of an institution with a reaffirmed role and redefined missions –of an Académie des Sciences able to weave new relations on the international side and fully restore its position in a scientific world echoing the major challenges of our century.



Pascal Griset and Florence Greffe. *Une compagnie en son siècle – 350 ans de l'Académie des sciences*. Foreword by Jean-François Bach and Catherine Bréchnignac. Collection Beaux Livres, Cherche-Midi Eds, 2015.



The younger reader may also take interest in a small work dedicated to the Académie, produced in 2015 by the publishing house Nane Éditions in partnership with the Académie on the occasion of its 350<sup>th</sup> anniversary.

Marianne Leclère. *L'Académie des sciences*. Collection du citoyen/Institutions, Nane Éd, 2016.



## ENCOURAGING THE SCIENTIFIC COMMUNITY



The Académie des Sciences carries out actions to support scientific research. It thus holds scientific colloquia and sessions on various themes in order to promote exchanges at the highest level. Moreover, it honours the best scientists by awarding them prizes for their work. Lastly, it publishes the review *Les Comptes Rendus de l'Académie des Sciences*, a set of seven series, with the aim of contributing to the dissemination of knowledge within the international community.

## Colloquia by and for the Scientific Community

Confronting knowledge and skills is crucial to scientific progress. Boosted by its multidisciplinary approach and close connections with the forces of research, both in France and abroad, the Académie des Sciences holds every year a series of scientific meetings focused on research fields that delve into the boundaries of knowledge.

### Conference Debates



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#### **Research on the Ebola Virus**

From the beginning of 2014, West Africa was the scene of a new epidemic of Ebola fever, which, due to its quick dissemination and its severity, raised a global alert. This session organized by the Académie des Sciences, aimed at taking stock of the clinical aspects of the disease, modelling work applied to this epidemic, and specific characteristics related to the nature of the virus at the origin of the epidemic, the Ebola Zaire strain, which emerged in West Africa (“*Les recherches sur le virus Ebola*”, 13 January 2015<sup>4</sup>).

#### **Translational Research**

Based on examples of research conducted in such various medical fields as neurology, cardiology, oncology, immunology or addictology, the Académie, during this session, “*La recherche translationnelle*”, considered the pitfalls of passing from the stage of discoveries in biology to that of possible innovations in human therapeutics (17 March 2015<sup>5</sup>).

#### **The Security of Computer Systems: Myths, Reality and Prospects**

The security of computer systems concerns every one of us, from the citizens in their daily lives to the whole State, as it must now defend itself against many-sided attacks. The conference “*Sécurité des systèmes informatiques: mythes, réalités et perspectives*” looked back on these various issues and showed what answer scientific progress could provide, from the software development breakthroughs that followed recent results in cryptology, to progress achieved in the security of large computer systems (24 March 2015<sup>6</sup>).

#### **Twenty Years of Research on Exoplanets**

Twenty years after the discovery of the first extrasolar planet – 51 Pegasi b – by Michel Mayor et Didier Queloz, 2 000 exoplanets have thus far been discovered. During this session organized by the Académie des Sciences, stock was taken of the methods that may be used to detect exoplanets, study their formations and the dynamic of the systems that house them, and search for signatures of life in their atmospheres (“*Vingt ans de recherches sur les exoplanètes*”, 31 March 2015<sup>7</sup>).



© dracozlat - Fotolia

4 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/les-recherches-sur-le-virus-ebola.html>

5 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/la-recherche-translationnelle-de-la-decouverte-biologique-a-l-innovation-therapeutique-humaine-un-transfert-difficile-et-perilleux.html>

6 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/securite-des-systemes-informatiques-mythes-realites-et-perspectives.html>

7 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/vingt-ans-de-recherches-sur-les-exoplanetes.html>

### **Surfaces Beside Themselves**

For a little more than a century, mathematicians have been interested in surfaces that are far less smooth than those that were described and studied when geometry began, more than 2 000 years ago. Origami, smooth fractals, Brownian random surfaces, "rough" surfaces revealed part of their hidden treasure at this session proposed by the Académie ("*Les surfaces dans tous leurs états*", 7 April 2015<sup>8</sup>).

### **Chemistry and Solar Energy**

It is considered that, as fossil fuel will dry up, a shortfall of 14TW may occur by 2050. Solar energy raises high hopes for tomorrow's energy production. During this session, the promising contributions of chemistry to this great question were discussed, on the first hand with regard to the capture of solar energy and its transformation into electricity or chemical fuel: very advanced projects were presented, using hybrid systems of microbes and artificial leaves or photosystems that artificially reproduce the principle of photosynthesis. The other major challenge is the storage of these renewable forms of energy. This session discussed the different existing types of mega-batteries and presented new approaches that use the development of photo-ionic cells to allow solar energy to be directly converted into electricity ("*Chimie et énergie solaire*", 5 May 2015<sup>9</sup>).



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### **Allostery and Rational Drug Design**

Pharmacology has long been based on the search for molecules that compete with the natural substrate of the target protein – for example a receptor – for binding to one same fixed site, the active site. As this session of the Académie des Sciences showed, the strategy is now to use the allosteric properties of the receptors and to develop compounds that target allosteric sites, either directly binding to them (by agonist or antagonist actions), or playing modulatory roles, whether positive or negative, on the allosteric transition ("*Allostérie et conception rationnelle de médicament*", 30 June 2015<sup>10</sup>).

### **Gnomons and Sundials Throughout the Ages**



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The next robot sent on Mars by NASA is to use a gnomon to determine the geographic north of the planet. How come these millennia-old objects, whose principle is to stand up to light and cast shadows, remain relevant for future research? How did they cross the centuries and how did scholars, located pretty much everywhere on the planet, make the most of their potentials? Such are the questions that the Académie addressed during this session ("*Gnomons et cadrans solaires à travers les âges*", 16 July 2015<sup>11</sup>).

8 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/lisses-ondulees-froissees-ou-rugueuses-les-surfaces-dans-tous-leurs-etats.html>

9 <http://www.academie-sciences.fr/fr/Colloques/chimie-et-energie-solaire.html>

10 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/allosterie-et-conception-rationnelle-de-medicament.html>

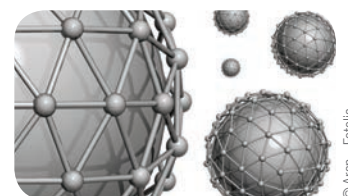
11 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/gnomons-et-cadrans-solaires-a-travers-les-ages.html>

## Climate Modelling

The evolution of climate – related to the accumulation of greenhouse gases – and energy transition are most complex issues and raise many difficulties. They are the focus of an ongoing reflection at the Académie des Sciences. This conference takes stock of research on climate modelling, from the geological past to the centuries to come (“*Modélisation des climats: du passé géologique aux siècles futurs*”, 22 September 2015<sup>12</sup>).

## New Materials

The properties of defects in crystals, new nanoparticle-based "glues", electronic properties of transition metal oxides – all these topics were discussed at this conference organized by the Académie des Sciences (3 November 2015<sup>13</sup>).



## Quantum Entanglement

During this conference on *Quantum Teleportation, Entanglement, and Einstein's Question "What is Light?"*, Anton Zeilinger, a foreign associate member of the Académie des sciences, reviewed the phenomenon of quantum entanglement and its possible applications (17 November 2015<sup>14</sup>).

## Partner Sessions and Colloquia



### Drug Safety

Drug safety involves a growing number of preclinical tests and pharmacovigilance studies, which has an impact on the time and cost of drug development. How may the development of new methods, such as the *-omics* or *in silico* approaches, prove useful? How may rare effects, of the immuno-allergic type, be predicted? What is the acceptable risk of adverse effects occurring, balanced against therapeutic benefit? All these issues were considered during this interacademic conference (“*La sécurité des médicaments*”, 20 January 2015<sup>15</sup>).

*Académie des Sciences-Académie Nationale de Médecine Joint Session*

### Determination of Sex

Sexual differentiation, most of the time genetically determined, may, with some animal or plant species, be determined by environmental (temperature) or social (population size) variables. This interacademic session provided the opportunity to clarify the molecular mechanisms at work in sexual differentiation in humans, animals and plants, mechanisms that are the focus of intense research (“*Détermination du sexe*”, 21 January 2015<sup>16</sup>).

*Académie des Sciences-Académie d'Agriculture de France Joint Session*

12 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/modelisation-des-climats-du-passe-geologique-aux-siecles-futurs.html>

13 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/nouveaux-materiaux.html>

14 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/quantum-teleportation-entanglement-and-einstein-s-question-what-is-light.html>

15 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communauté-scientifique/la-securite-des-medicaments.html>

16 [http://www.academie-sciences.fr/pdf/conf/interacad\\_210115.pdf](http://www.academie-sciences.fr/pdf/conf/interacad_210115.pdf)



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### **Sexual Dimorphism**

Each cell of our organs bears the signature of our sex (XX or XY sex chromosomes). The session discussed first the fundamental aspects of sexual dimorphism – "What benefits did evolution provide to sexual beings?" – and then its clinical aspects – "What are the specific mechanisms, whether genetic, hormonal or epigenetic, which may explain differences in vulnerability to a number of pathologies, in particular in the case of oncology and psychiatry?" The session also discussed differences in medical care for men and women, using the example of cardiovascular diseases. It concluded on the training needs of health professionals ("*Dimorphisme sexuel*", 1 December 2015<sup>17</sup>).

*Académie des Sciences-Académie Nationale de Médecine Joint Session*

### **Photography**

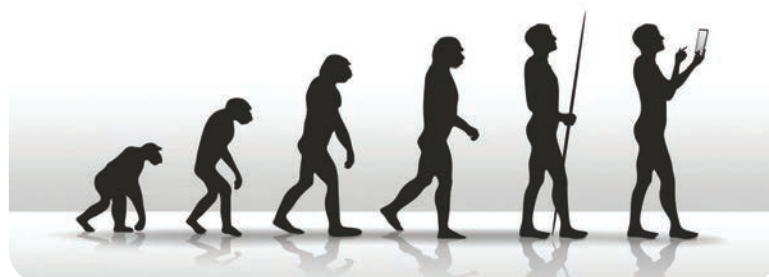
The year 2015 marked the 250<sup>th</sup> anniversary of Nicephore Niepce's birth. The session first recalled the "multiple inventions of photography". It also highlighted the role of science in the progress of photography, whether regarding the chemistry of silver photography or, more recently, algorithmics and computer science. The session also, and particularly through the description of the physiology of the eye and the process of visual perception, insisted that while "a camera looks, the eye sees". This joint session with the Académie des Beaux-Arts, finally, was an opportunity to confront scientific experiments and those carried out by photographers and painters ("*Colloque sur la photographie*", 15 December 2015<sup>18</sup>).

*Académie des Sciences-Académie des Beaux-Arts Joint Session*

## **National and International Colloquia**

### **Human Evolution: from Genes to Culture**

To know the human being implies to consider as much their biology as their culture. Few meetings have provided such an opportunity, unlike the delectable humanist debates that flourished in the eighteenth century. This partitioning may be required for the sake of documentation but the transversal perspective brings something else. This symposium aimed at grasping human nature through its various components, which are often too much separated from one another ("*L'évolution humaine: des gènes à la culture*", 12-13 May 2015<sup>19</sup>).



© Fierfels - Fotolia

17 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/dimorphisme-sexuel.html>

18 <http://www.academie-sciences.fr/fr/Seances-publiques/la-photographie.html>

19 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communaute-scientifique/l-evolution-humaine-des-genes-a-la-culture-1.html>

## ***In search of Time***

This session on the theme of time gathered scientists from very different disciplines: it provided the opportunity to confront different notions of time: the definition of time according to the Phoenicians, biological time within various species, and time on the scales of humankind, the history of life, and Earth (“A la recherche du temps”, 19 May 2015<sup>20</sup>).

## ***Evidence-Based Public Policy***

How may the scientific approach be used as a basis to optimize public decision? The conference first recalled the experience of medicine, which, in fifty years, has passed from decisions made on the advice of masters and experts, to the search for rigorous demonstration based on randomized therapeutic trials. It then showed how such approaches now extend to many other fields, particularly education, but also criminology, agriculture or the care of disadvantaged populations (“*La décision publique fondée sur la recherche de preuves*”, 11 September 2015<sup>21</sup>).



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## ***Transgenerational Epigenetics***

A growing number of studies now point to the responsibility of modifications in gene expression, rather than to the sole gene sequences, to explain phenotypic variations between individuals – variations which are, moreover, transmissible to their offspring. The mechanisms underlying such transgenerational epigenetics was at the heart of this international colloquium held by the French Académie des Sciences (“*Can Epigenetics Explain Transgenerational Transmission of Acquired Traits?*”, 8 December 2015<sup>22</sup>).

## **When Members of the Académie Pay Tribute to Their Predecessors...**

- Tribute to François Jacob (1920-2013): the Académie des Sciences and Académie Française, of both of which François Jacob was a member, have devoted a joint session to the life and work of this great researcher, 1965 Nobel Prize in Physiology/Medicine, honorary professor at the Collège de France and the Institut Pasteur, through five lectures, as so many facets of his personality (27 January 2015<sup>23</sup>);
- ARN Day, a tribute to Marianne Grunberg-Manago (1921-2013): a former president of the Académie des Sciences, Marianne Grunberg-Manago discovered the polynucleotide phosphorylase, which is responsible for the synthesis of the polyribonucleotides that constitute RNA. The objective of this day was to illustrate the growing place RNA is taking in all fields of biology (bacterial virulence, parental fingerprints in humans, etc.) (10 February 2015<sup>24</sup>);
- Recent extensions of the work of Anatole Abragam (1914-2011): during this session, the speakers retraced the work and personality of this pioneer of NMR (nuclear magnetic resonance), and presented the recent progress of this discipline that was directly derived from the theories he developed (14 April 2015<sup>25</sup>).

20 <http://www.academie-sciences.fr/fr/Colloques/a-la-recherche-du-temps.html>

21 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/la-decision-publique-fondee-sur-la-recherche-de-preuves-evidence-based-policy.html>

22 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/l-epigenetique.html>

23 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communauté-scientifique/hommage-a-francois-jacob.html>

24 <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communauté-scientifique/journee-arn-en-hommage-a-marianne-grunberg-manago.html>

25 <http://www.academie-sciences.fr/fr/Colloques/conference-sur-la-rmn-prolongement-oeuvre-anatole-abragam.html>

## Awards and Medals

Thanks to the generosity of private donors, state organisations and enterprises, the Académie des Sciences awards nearly 80 prizes every year, in basic or applied research fields. Laureates are selected within a regulatory framework that ensures there is no conflict of interest. The juries for prizes that amount to less than €7,500 – so-called Thematic Prizes – are composed of the members of the relevant sections. The Grand Prizes, which exceed €15,000, fall within the province of ad hoc juries that include members from different sections and, should the need occur, personalities from outside the Académie. In 2015, 29 Grand Prizes, of a total amount of €1,006,450, and 36 Thematic Prizes, amounting to €156,585 in all, have been awarded by the Académie des Sciences. These prizes have been awarded to the laureates during two solemn sessions under the Cupola of the Institut de France on 13 October and 24 November 2015<sup>26</sup>.

### Émile Jungfleisch Award

Amounting €120,000 € (two thirds being for the work of the laureate's team), this award is presented every two years to reward a researcher working in a French laboratory in the field of organic chemistry or biochemistry.

#### 🏆 2015 Laureate:



- Pierre-Jean Corringer, research director at CNRS (National Center for Scientific Research), head of the Channel Receptors unit of the Institut Pasteur, Paris.

### Lamonica Prizes

Awarded since 2009, each of the two Académie des Sciences-Fondation pour la Recherche Biomédicale-PCL Lamonica Prizes in neurology (€100,000) and oncology (€60,000) is awarded to a French or foreign scientist working in a French laboratory. Part of the funding is to be used by the laureate, the rest of it enabling him/her to fund his/her research.

#### 🏆 2015 Laureates



- *Neurology*: Pier-Vincenzo Piazza, director of the Magendie Neurocenter in Bordeaux;



- *Oncology*: Jean-Baptiste Michel, emeritus research director at Inserm.

26 [http://www.academie-sciences.fr/pdf/documentation/prix2015/plaquette\\_2015.pdf](http://www.academie-sciences.fr/pdf/documentation/prix2015/plaquette_2015.pdf)

## Prize Ampère de l'Électricité de France

This prize (€50,000 €), created in 1975 by Électricité de France to celebrate the 200<sup>th</sup> anniversary of André-Marie Ampère's birth, rewards basic or applied research work conducted in a French laboratory in the field of mathematics or physics.

### 🏆 2015 Laureate:



- Michel Fliess, CNRS emeritus research director at the Laboratoire d'Informatique de l'École polytechnique (Laboratory of Informatics of the École polytechnique, LIX), Palaiseau.

## The Fondation Ramsay Générale de Santé Prize for Cell Therapy and Regenerative Medicine

The Fondation Ramsay Générale de Santé and the Académie des Sciences have been awarding a prize since 2012 to reward scientific excellence in the field of tissue regeneration. Amounting to a sum of €100,000 (one part for the laureates, the rest for the work of their teams), the prize rewards basic research, aiming to foster the expansion of scientific knowledge, as well as translational and clinical research, in order to encourage the fast transfer of knowledge into applications for diagnosis and therapy.

### 🏆 2015 Laureates



- *Basic Research*: Pierre Savatier, research director at Inserm, Stem Cell and Brain Research Institute (SBRI), Bron;



- *Clinical and Translational Research*: José Cohen, director of the Mondor Biomedical Research Institute (Institut Mondor de Recherche Biomédicale, IMRB), Créteil.

## Institut de France Awards

In the field of science, the great annual awards of the Institut de France – the Del Duca, Louis D, Lefoulon-Delalande, NRJ, Allianz/Institut de France, Victor Noury, Danièle Hermann prizes – are granted by decision of or on a proposal from the Académie des Sciences.

The most important of these are the most eminent scientific awards of the Louis D. Foundation (€750,000) and the Simone and Cino Del Duca Foundation (€300,000). In both cases, a part of the grant is for the scientific team leader, while the other is intended to fund the work of the research team, including the recruitment of French or foreign post-doctoral researchers.

### 🏆 2015 Laureates



- *Fondation Louis D*: Chris Bowler, CNRS research director at IBENS (Institut de Biologie de l'École Normale Supérieure), and Didier Raoult, director of the Méditerranée Infection institute, Marseille.



- *Fondation Simone et Cino Del Duca*: Guy Perrin, astronomer at the Paris Observatory LESIA, and Patrice Hello, in charge of the VIRGO team at the Linear Accelerator Laboratory, Orsay.



## Irène Joliot-Curie Prizes

Created in 2001 by the French Ministry of Higher Education and Research and organized in coordination with the EADS corporate Foundation<sup>27</sup> 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, in charge of empanelling the members of the jury who designate the laureates. The Irène Joliot-Curie Prize comprises three categories: Female Scientist of the Year (€40,000), Young Female Scientist (€15,000) and Women in Enterprise (€15,000).

### 🏆 2015 Laureates



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- *Female Scientist of the Year:*  
Leticia Fernanda Cugliandolo, professor at the University Pierre-et-Marie-Curie (UPMC), theoretical physics and high energy laboratory;



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- *Young Female Scientist:*  
Rut Carballido Lopez, research director at INRA (National Institute for Agricultural Research), Food Microbiology for Human Health research unit;



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- *Women in Enterprise:*  
Agnès Bernet, professor at the University Claude-Bernard Lyon 1, director of the scientific council of the simplified joint-stock company Netris-Pharma.

## INRIA-Académie des Sciences Prizes

Since 2013, INRIA (the French National Institute for Computer Science and Applied Mathematics) and the Académie des Sciences jointly single out the laureates of the three following INRIA-Académie des Sciences scientific awards: the Great Prize, Young Researcher Prize (under 40 years old) and Innovation Prize (in partnership with Dassault Systèmes). Such a partnership has given a new impetus to the system of the INRIA Prizes, as it highlights their primary purpose: to promote the contributions and success of the men and women who, within French institutions, whatever their nationalities or affiliations, drive computer science and mathematics forward, thus participating to the development of the digital world.

### 🏆 2015 Laureates



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- *INRIA-Académie des Sciences Great Prize (€25,000 €):*  
Benoît Perthame, director of the Jacques-Louis Lions laboratory, UPMC, Paris;



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- *INRIA-Académie des Sciences-Dassault Systèmes Innovation Prize (€20,000 €):*  
Marc Lavielle, research director at INRIA, Popix research team scientific leader, Saclay;



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- *INRIA-Académie des sciences Young Researcher Prize (€20,000 €):*  
Véronique Cortier, CNRS research director, Loria Laboratory, Vandœuvre-lès-Nancy.

27 Now the Airbus Group corporate Foundation

## For the Younger Researchers in Biology, the AXA-Académie des Sciences Awards

The Académie des Sciences fosters the dynamism and creativity of the younger French researchers. Every year, on the initiative of Académie Member Pascale Cossart, Great Breakthroughs in Biology gives the floor to six young biologists whose discoveries are of major importance, accompanied by their research directors. Speakers are selected by a jury following a national call for applications and each laureate receives a prize (€2,500) from the Axa Research Fund.

On 26 May 2015<sup>28</sup>, this operation celebrated its 10 years of existence with six new young laureates:

- Bérangère Pinan-Lucarré and her research director Jean-Louis Bessereau – University Claude Bernard Lyon 1, CNRS UMR5534, Villeurbanne: *Organiser la synapse et déterminer son identité grâce à la Punctineb* [Organizing the Synapse and Determining its Identity through Punctineb];
- Raphaël Méheust and his research director Sylvain Billiard – Évo-Éco-Paléo unit, University of Lille 1, CNRS UMR8198, Villeneuve d'Ascq: *Contrôle d'une hiérarchie de dominance par des petits ARNs non codants chez Arabidopsis* [Controlling a Dominance Hierarchy Through little Non-coding RNAs in Arabidopsis];
- Aurore Fleurie and her research director Christophe Grangeasse – Bases Moléculaires et Structurales des Systèmes Infectieux, CNRS UMR5086, University of Lyon 1: *Division de la cellule bactérienne: au commencement était une balise moléculaire* [Division of the Cell: in the Beginning was a Molecular Beacon];
- Karim Majzoub and his research director Jean-Luc Imler – Institute for Molecular and Cellular Biology (IBMC), CNRS UPR9022, Strasbourg: *Découverte d'une protéine impliquée dans la traduction sélective: des virus d'insectes à l'hépatite C* [Discovery of a Protein Involved in Selective Translation: from Insect Virus to Hepatitis C];
- Adel Al Jord and his research director Alice Meunier – IBENS (Institut de Biologie de l'Ecole Normale Supérieure), Inserm U1024, CNRS UMR8197, Paris: *De 2 à 100: Comment une cellule amplifie ses centrioles pour nucléer des cils motiles* [From 2 to 100: How a Cell Amplifies its Centrioles to Nucleate its Motile Cilia];
- Mathieu Pinot and his research director Bruno Antony – Institute of Molecular and Cellular Pharmacology (IPMC), CNRS UMR7275, University of Nice, Valbonne: *Voyage au coeur de la biomécanique des Oméga-3* [A Journey to the Heart of Omega-3 Biomechanics].



De gauche à droite : Raphaël Méheust, Aurore Fleurie, Adel Al Jord et Sébastien Candel

© Brigitte Eyermann

## The Comptes Rendus de l'Académie des Sciences

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



This set of seven series spans the whole field of scientific research, as its titles make it obvious: *Mathématique*, *Mécanique*, *Chimie*, *Biologies*, *Geoscience*, *Physique* and *Palevol*. Each series is driven by its editor-in-chief with the assistance of its 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, or other publications such as thematic issues, under the direction of guest editors-in-chief from France or abroad.

Altogether, 630 articles have been published in the 2015 *Comptes Rendus* and 21 thematic issues have come out (2 from the *Mécanique* series, 8 from *Physique*, 5 from the *Chimie* series, 2 from the *Biologies* series, 1 from the *Palevol* series and 3 for the *Geoscience* series).

Until the end of 2015, the *Comptes Rendus de l'Académie des Sciences* were available for hard copy or online subscriptions for individuals (EM Consulte) or groups (ScienceDirect), abstracts being published for open access on the two websites. On 1 January 2016, a new version was launched with free access to the articles emanating from French laboratories. Moreover, the articles published between 1835 and 1995 have been digitized by the *Bibliothèque Nationale de France* and may be accessed through its website [www.gallica.bnf.fr](http://www.gallica.bnf.fr).

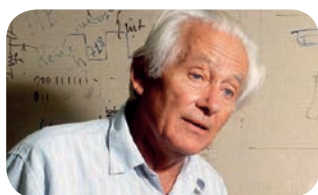
28 <http://www.academie-sciences.fr/fr/Colloques/les-grandes-avancees-francaises-en-biologie-presentees-par-leurs-auteurs-2015.html>

## PROMOTING SCIENCE TEACHING



Learning scientific reasoning skills, gaining access to knowledge and being taught scientific methods – these are essential steps for the citizens of the future to develop critical thinking and for excellence to transmit within the scientific community through time. The Académie des Sciences has a long-standing tradition of advising on these matters: today, it takes action, even on the international level, to strengthen initial and ongoing teacher training, renew science teaching at all school levels and ensure all young people equal opportunity in this field.

The initiatives of the Académie on science teaching are grounded on two pillars of action: the *Delegation for Education and Training*, directed by Académie Member Christian Amatore (until 2016), is in charge of keeping a watch on topical issues of science teaching, all scientific, administrative and legal dimensions being considered; the *Standing Committee for Science Education*, chaired by Académie Member Étienne Ghys (until 2016), delves into the major science education issues the Académie wishes to take hold of, most often with long term vision as a goal. In close cooperation with the Foundation for Scientific Cooperation *La main à la pâte - Pour l'Éducation à la science*<sup>29</sup>, which is chaired by Académie Member Daniel Rouan and of which the Académie is a founding member, the Académie des Sciences continuously promotes, through its initiatives, science teaching at primary and middle school. The Foundation For Scientific Cooperation *La Main à la Pâte - Pour l'Éducation à la Science* was created in 2011 by the Académie des Sciences, Ecole Normale Supérieure (Paris) and Ecole Normale Supérieure de Lyon. It carries out its initiatives in continuity with the hands-on science operation *La main à la pâte*®, launched in 1995 at the initiative of Académie Members Georges Charpak, 1992 Nobel Prize in Physics, Pierre Léna and Yves Quéré.



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Georges Charpak



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Pierre Léna



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Yves Quéré

Its goals are:

- to actively contribute to the professional development of teachers, particularly through the creation, in major universities, of *Houses for Science to the Benefit of Teachers (Maisons pour la science au service des professeurs)* and the provision of various special teaching resources;
- to nurture networks of pedagogical experimentation, relying on the world of research and on business to develop, assess and disseminate “good practice” in science and technology teaching;
- to be a reference point in France, Europe and over the world in order to support public authorities in the formulation of educational policies conducive to investigation-based science teaching.

### La Main à la Pâte was 20 Years Old !

1995-2015: to celebrate the 20 years of *La Main à la pâte*, the Académie des Sciences organized a special session<sup>30</sup> on 9 June 2015, in the presence of, inter alia, Bruce Alberts, former president of the US National Academy of Sciences, Nicole Belloubet, member of the Conseil constitutionnel (French Constitutional Council), and Florence Robine, general director of School Teaching at the French Ministry of Education. This event provided Yves Quéré with the opportunity to recall the history of *La Main à la Pâte* and pay tribute to Georges Charpak, and Cédric Villani to give a lecture on the “pathemata/mathemata” association, i.e. the relationships suffering (or effort) and learning share with one another.

In 2015, the Foundation *La main à la Pâte - Pour l'Éducation à la Science* also continued acting on the international side, with such notable initiatives as: the organization of the 6<sup>th</sup> edition of the international Seminar on teaching science at the elementary and primary school levels (1 to 6 June 2015); the opening of the *Centre Eurêka* in Lebanon (May 2015) in the presence of Académie Member Pierre Léna; support to the European project *Sustain* and the coordination of the European project *Scientix 2*; the running of the colloquium *Children and Sustainable Development: a Challenge for Education*, co-organized by the Académie des Sciences with the Pontifical Academy of Sciences (Rome, November 2015<sup>31</sup>).

In order to secure the contingent of researchers, engineers and technicians that the country requires, the French education system must take up a double challenge: put science and technology back into the students' minds and boost their appetites for science and technology courses and professions. The Académie des Sciences provides support to this twofold objective through several initiatives that promote science, especially in high schools.



29 <http://www.fondation-lamap.org/>

30 <http://www.academie-sciences.fr/fr/Seances-publiques/celebration-des-20-ans-de-la-main-a-la-pate.html>

31 [http://www.fondation-lamap.org/sites/default/files/upload/media/fondation/page\\_103\\_RA/RA2015\\_web.pdf](http://www.fondation-lamap.org/sites/default/files/upload/media/fondation/page_103_RA/RA2015_web.pdf)

## Conferences Intended for High School Students

Since 2006, high school students from Paris are invited by the Académie des Sciences on the occasion of the Fête de la Science [Science Festival] to hear a conference held by one of its members. Given the success of these meetings, specially organized for the pupils, the Académie and the Rectorat de Paris [National Education local Authority of Paris] have jointly decided to increase meeting opportunities, with, from 2014, two additional conferences proposed during the Semaine des Mathématiques [Maths Week] and Semaine du Développement Durable [Sustainable Development Week]. Each of these conferences gathers a little more than 150 high school students. Given the public for which they were prepared, these conferences, filmed and available for consultation on the website of the Académie, are a useful collection of resources for a wide audience.

### The Earth, Atmosphere, Oceans: New Challenges for the Mathematicians

The mathematical models used in oceanography show that coastal geometry has a global impact on marine currents. In particular, they predict an intensification of the western edge currents observed for example off the coast of Florida. From a simplified model, it was shown that mathematical analysis allows such non local effects to be captured.

*A conference by Laure Saint-Raymond on the occasion of the Semaine des Mathématiques [Maths Week] (20 March 2015<sup>32</sup>).*



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### How to Live with No Fossil Fuel: The roles of Chemistry and Batteries



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Following a description of the current energy situation, its evolution and its consequences for the planet, issues related to the storage of renewable energy were raised, and the latest breakthroughs in the field of electrochemical storage were presented – which massively rely upon chemistry – including Li-ion batteries, in order to facilitate the deployment of clean vehicles as well as network applications.

*A conference by Jean-Marie Tarascon on the occasion of the Semaine du Développement Durable [Sustainable Development Week] (3 April 2015<sup>33</sup>).*

32 <http://www.academie-sciences.fr/fr/Seances-publiques/terre-atmosphere-oceans-de-nouveaux-defis-pour-les-mathematiciens.html>

33 <http://www.academie-sciences.fr/fr/Seances-publiques/comment-vivre-sans-energies-fossiles-le-role-de-la-chimie-et-des-batteries.html>

## The Ocean as Observed from Space

From space, it is now possible to measure the temperature, salinity and surface currents of the oceans, their chlorophyll concentration – and thus the biological activity of surface waters –, how their masses increase due to the melting of continental ice, how the water level rises in connection with global warming, and to map even the topography of the seabed. This presentation drew on a few examples to show what incredible progress has been achieved in the last decades in our knowledge of the ocean.

*A conference by Anny Cazenave on the occasion of the Fête de la science [Science Festival] (13 October 2015<sup>34</sup>).*



© robert - Fotolia

### Scholarships for Deserving Students

Awarded by the Académie des sciences since 1991, the Rogissart scholarships are aimed at rewarding high school students for their outstanding achievements in their education and who were born or have at least one parent born in the Department of the Ardennes, of which Jean Rogissart, their founder, was a native. The Rectorat of Reims provides support for the laureate selection process, in such a way that every high school of the Department of the Ardennes may enter one or more candidates.

Each scholarship amounts to €6,000 in all, paid in six times during two successive scholar years at the university (as an example, a 2015 scholarship laureate receiving €1,000 in 2014 would receive €3,000 in 2016 and €2,000 in 2017).

### Colloquia on Science Education

#### The future of Science Education for Children in a Changing World

For twenty years, converging international initiatives have led to the implementation in many countries of science education methods based on investigation, often in the form of pilot projects, but sometimes also on a larger scale. Based on their experiences, educators and scientists were invited to join the eminent members of the International Committee of the Foundation *La main à la pâte - Pour l'Éducation à la science* to reflect on the future of natural sciences and mathematics education. (10 June 2015<sup>35</sup>).

#### Scientific Pathways from Three Years Before A-Levels to Three Years After

At the initiative of the Délégation à l'éducation et à la formation (Delegation for Education and Training), the Académie brought together a group of political decision makers, high-ranking civil servants, academicians and teachers in secondary and higher education, to revolve around the “expert witness” Alain Boissinot, chief education officer and former general director of school education at the French Ministry of National Education, and reflect on scientific pathways from three years before A-Levels to three years after. The colloquium was organized around three themes: *Les contenus en discussion: le projet des formations scientifiques* [Discussing Content: the Projects behind Scientific Training Programmes] - *L'architecture des formations* [The Architecture of Training Programmes] - *Parcours de formation: orientations et réorientations vers de nouveaux parcours en science* [Training Programmes: Orientations and Reorientations Towards New Pathways to Science] (25-26 November 2015).

<sup>34</sup> <http://www.academie-sciences.fr/fr/Seances-publiques/l-ocean-observe-depuis-l-espace.html>

<sup>35</sup> [http://www.fondation-lamap.org/fr/programme\\_colloque](http://www.fondation-lamap.org/fr/programme_colloque)

## Museums with Educational Purposes

### Louis Pasteur's House



© Catherine Brechignac

Owned by the Académie des Sciences since 1991, the house of Louis Pasteur (1822-1895) in Arbois, which received the label *Maisons des illustres* [Houses of the Illustrious] from the Ministry of Culture and Communications in 2011, is open for visits all year long and hosts events, particularly intended for school audiences. In 2013, the Académie des Sciences created, with the Conseil général du Jura [Departmental Council of Jura] and the communes of Arbois and Dole, the Établissement public de coopération culturelle [Public Institution for Cultural Cooperation, EPCC] *Terre de Louis Pasteur*. Pasteur's house in Arbois, which is a central part of it, has been at the disposal of this EPCC since 2014.

As for the Académie des Sciences, it refocused its educational scope on Louis Pasteur's historic vineyard, *le Clos de Rosières*, located near Arbois. On 8 April 2015, in association with the wine producer Henri Maire, who has been making wine from these vines for more than 70 years, the Académie held a charity wine auction with bottles from the *Clos*. The raised funds were donated to the research programme<sup>36</sup> on vine wood diseases, especially the esca, which affect almost 13% of the French vineyard.

### Louis Pasteur “Memory of the World”

Because of the importance of Louis Pasteur's bequest for science and medicine, the Académie des Sciences and Bibliothèque Nationale de France (BnF) filed an application for the inscription of his archives in the *Memory of the World* Programme created in 1992 by UNESCO. In October 2015, success was there: Louis Pasteur's archives were officially inscribed among the documentary heritage of *Memory of the World*. The archives held by the Académie des Sciences have been digitized and are entirely accessible on the website of the Académie<sup>37</sup>.



© O.T. Hendaye - P. Laplace

### Abbadia Castle Observatory

Antoine d'Abbadie (1810-1897) was an explorer, geographer, linguist and astronomer. His castle was built by Viollet-le-Duc up above Hendaye, in the Department of Pyrénées-Atlantiques, between 1864 and 1884. It was then bequeathed by its owner to the Académie des Sciences, of which he was a member, and now hosts an astronomical observatory, which has remained operational until 1976. A listed historic monument, the castle has been the object of a vast restoration programme from 1997 to 2008. Benefitting from the label *Maisons des illustres* since 2011, it is now managed by the Hendaye Tourist Information Centre, according to the terms of a service concession arrangement.

<sup>36</sup> <http://universalisme.fr/pasteur/programme/pasteur-dans-sa-vigne/>

<sup>37</sup> <http://acsciences.mnesys-portail.fr/>

## Ry-Chazerat Estate

Adolphe Godin de Lépinay (1821 -1888) is the often unknown designer of the Panama Canal as it was finally built after the failure of the operation led by Ferdinand de Lesseps. An engineer from the *École des Ponts et Chaussées*, he was also behind the maps of many railway lines in France and Algeria. He bequeathed his Ry-Chazerat manor house and lands, located in the commune of Journet, in the Vienne Department to the Académie. An application for the *Maisons des illustres* label is underway.

Since 2013, there is a partnership framework-convention between the Académie des Sciences, Conseil Général de la Vienne [Council of the Vienne Department] and communes of Journet and Montmorillon. It is in this specific context that the Académie des Sciences:

- showcases its publications every year at the Salon du Livre de Montmorillon [Montmorillon Book Fair];
- is considering the possibility of setting up a centre where high school and college students may learn of the challenges of modern and reasoned agriculture – which seeks the right balance between high productivity and respect for ecosystems;
- plans to reorganize the Ry-Chazerat mansion to host scientists awarded the *Villa Ry-Chazerat Prize (Prix de la villa Ry-Chazerat)* and thus make it possible for them to stay there, dedicated to the writing of scientific educational works.



© DNF



## TRANSMITTING KNOWLEDGE

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The scientific community owes society explanations and knowledge sharing. As part of its mission, the Académie des Sciences is committed to disseminating the scientific culture and, in this context, organizes public session meetings, at which great scientific problems are presented. The *Delegation for Scientific Information and Communications*, directed by Académie Member Alain-Jacques Valleron, fosters communications at the Académie through its website and its involvement in the main social media platforms, in media relations, in the biannual *Lettre de l'Académie des Sciences*, in meetings with the youth and in twinning arrangements between researchers, members of the Académie and members of the Parliament.

## Public Sessions, Civic Culture

The unprecedented technological rise the world has been experiencing since the middle of the last century complexifies society's relations to 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 to conferences presented by the great figures of science, to provide topical knowledge on major science themes bearing strong societal repercussions.

### Deep Cerebral Stimulation: Where Are We Coming from, Where Are We, Where Are We Going to?



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High Frequency Electrical Stimulation (HFES) has now become an indication for the treatment of Parkinsonian symptoms, whether severe or poorly responding to drug therapy. But HFES has also other indications, especially in mental disorders, thus allowing for the field of “psychosurgery” to be reopened. During his lecture, Académie Member Alim-Louis Benabid unveiled the latest results of his research on HFES, whose goal is now not only to treat the symptoms of a disease but also to develop neuroprotective and curative therapies (3 March 2015<sup>38</sup>).

### From Carbon Dioxide to Hydrocarbons: a Salutary Reversal

The increase in CO<sub>2</sub> caused by the combustion of oil, gas and coal is a major environmental issue. Now it is possible - though difficult – to convert carbon dioxide into carbon molecules, through the formation of carbon-hydrogen and carbon-carbon bonds that are rich in energy: CO<sub>2</sub> then becomes a molecule of interest, convertible into fuel. In his lecture, Académie Member Marc Fontecave took stock of the issues of CO<sub>2</sub> capture and sequestration, its current use in industry, and finally the emerging CO<sub>2</sub> recovery technologies (16 June 2015<sup>39</sup>).



© Frenia - Fotolia

38 <http://www.academie-sciences.fr/fr/Seances-publiques/la-stimulation-cerebrale-profonde-d-ou-partons-nous-ou-en-sommes-nous-ou-allons-nous.html>

39 <http://www.academie-sciences.fr/fr/Seances-publiques/du-co2-aux-hydrocarbures-un-renversement-salutaire.html>

## Information Resources Specifically Designed for the Public

In the course of 2015, the Académie des Sciences intensified its initiatives to provide direct scientific information to the general public. Thus, the “resources<sup>40</sup>” section, placed under the editorial responsibility of the Standing Committee for Science History and Epistemology, has benefitted from many contributions of members of the Académie.

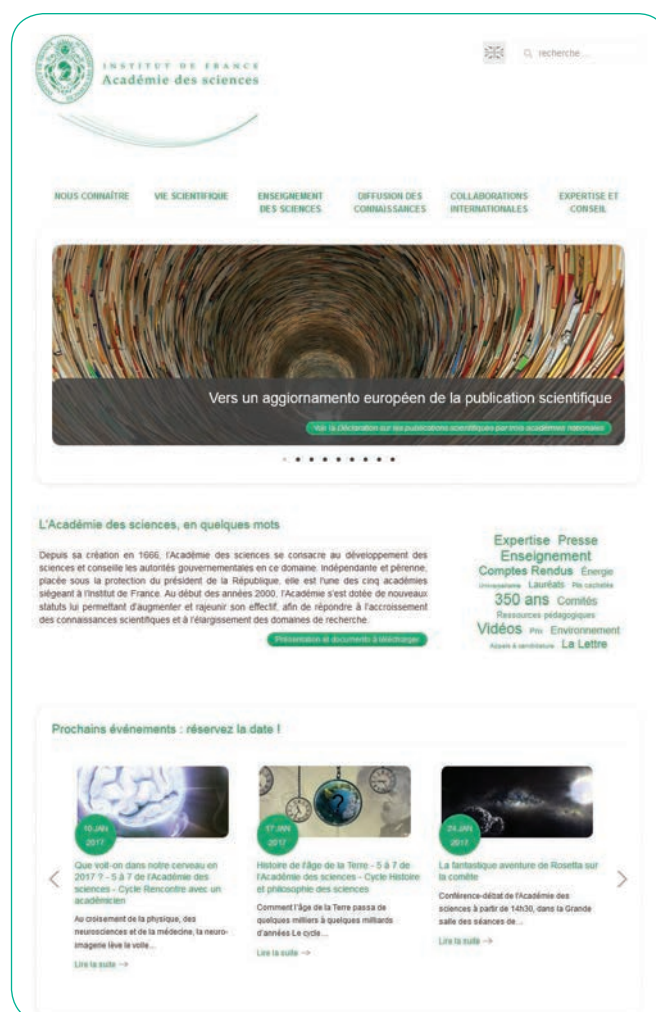
### A New Website for the Académie

On 7 July 2015, the Académie des Sciences launched a new website<sup>41</sup>, which was totally redesigned to provide all its audiences with an easier access to information. For the Académie, the main challenges of web strategy were addressing mobility, improving the visual impact of information, and capturing the attention of website visitors.

Indeed, the new interfaces now adapt to each digital device – computer, smartphone, tablet -, events are lavishly illustrated and ergonomics has been revisited to provide more user-friendly and direct access to information.

As for browsing, it is now carried out:

- from the main menu, which presents the sections of the website, built around the five missions of the Academy as redefined in 2012 – *Encouraging the scientific community; Promoting science teaching; Transmitting knowledge; Fostering international collaboration; Playing an expert and advisory role*—and the section *About Us*, which, in particular, introduces all the members of the Académie des Sciences and provides access to the main presentation documents of the Académie available for download;
- through the search engine, which is particularly efficient for intuitively accessing information;
- via dedicated frames on the home page: news header, keyword cloud with direct links to the *Press Releases* and *Videos* sections, such as, for example, a frame dedicated to the *Most recently published articles*, etc.;
- in the articles themselves: linked one to the other, they provide for a thematic and gradual discovery of the website.



Moreover, new functionalities are now available: information sharing from the website to social media platforms, RSS feed subscription, online registration to conferences and colloquia, etc.

In 2015, the website of the Académie attracted 182,025 unique visitors, with 15,439,826 hits and 1,269,512 read pages.

Finally, the Académie sends out a monthly e-letter to over 14,000 subscribers, mostly scientists or institutional readers, in order to alert or remind them of the most important news of the Académie. Registration is open to all internet users who would like to receive it, and may be carried out from the home page of the website.

40 <http://www.academie-sciences.fr/fr/Promouvoir-l-enseignement-des-sciences/ressources-pedagogiques.html>

41 <http://www.academie-sciences.fr/fr/>

## The Académie des Sciences is on Twitter

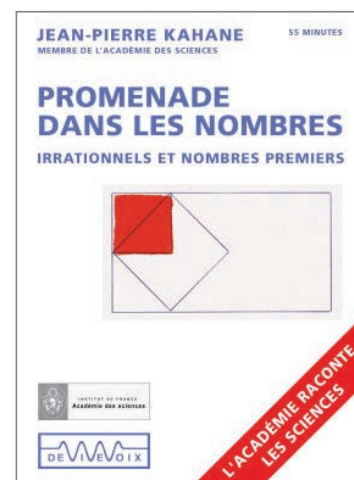
Since 2014, the Académie des Sciences is on Twitter. Through this media platform, it disseminates information to subscribers on its conferences and advice notes, such as its advice notes on climate change and prospects for energy research (best Tweet of November 2015) and on research funding and young researchers' career difficulties (best Tweet of June 2015).



## The Lettre de l'Académie des sciences



The *Lettre de l'Académie des sciences* is a biannual journal sent out to more than 2,000 free subscribers and open to download on the website of the Académie. The feature of the 35/36 double issue was focused on light, as a tribute to UNESCO's choice of devoting the year 2015 to it. Member of the Académie Christian Bordé, who coordinated this feature, chose to address this topic from an original perspective: *light as a means for exploring the fringes of space and time: the infinitely small, infinitely large, infinitely short and infinitely sustainable*. The *Lettre* is foremost aimed at providing the non-scientific public with a knowledge review in a given field, place within a historical perspective.



In 2010, the Académie concluded a partnership with the publisher *De vive voix* to launch an audio book series for the general public, "L'Académie raconte les sciences"<sup>42</sup>, where its members share their passion for their disciplines. In 2015, *Promenade dans les nombres* by Jean-Pierre Kahane and *Henri Poincaré* by Cédric Villani, joined the list of about fifteen titles already published.

The Académie des Sciences also keeps a presentation brochure<sup>43</sup> of its missions and activities at the disposal of its partners and the interested public, which was translated into English, Spanish and Chinese.

42 <http://www.academie-sciences.fr/fr/L-Academie-raconte-les-sciences/l-academie-raconte-les-sciences.html>

43 <http://www.academie-sciences.fr/fr/Documents-a-telecharger/documents-de-presentation.html>

## Adding Value to a Scientific Heritage

### Historical archives

The Académie des Sciences holds archives dating to its creation and continuously expands 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 stand as one of the main conservation institutions where today's research in science history commences.

In 2015, 915 documents were communicated, 319 workshops held upon request, 208 readers greeted and guided in the Reading Room and 154 historical research projects carried out for a third party. Fifteen letters from Cuvier to Duméril, two letters from la Condamine and the catalogue of Dutrochet's library have moreover entered into the archives.

The sealed deposit procedure<sup>44</sup> at the Académie allows researchers or inventors to secure the date in time of their scientific discoveries or process inventions. The *Standing Commission for Sealed Deposits (Commission des plis cachetés)* unsealed 328 envelopes in 2015, and 27 expert reports were requested. 37 envelopes were deposited during this period (including 9 authors submitting 2 envelopes), and 2 were returned to their authors. The year 2015 was also the year the database of sealed envelopes was achieved and set up.

### Committees Dedicated to Great Scientists

#### Lavoisier Committee

The Académie des Sciences holds the vast majority of the archives of the founder of modern chemistry, as entrusted by his heirs with a view to have the works of Lavoisier (*Oeuvres de Lavoisier*) published. Since Volume 7 of Lavoisier's correspondence (*Correspondance*) was published in 2012, the eponymous committee has been in charge of creating general tables for the *Oeuvres* and *Correspondance* and preparing several hundred letters more (Volume 8) that are being dated, transcribed and annotated.



#### D'Alembert Committee and ENCCRE project

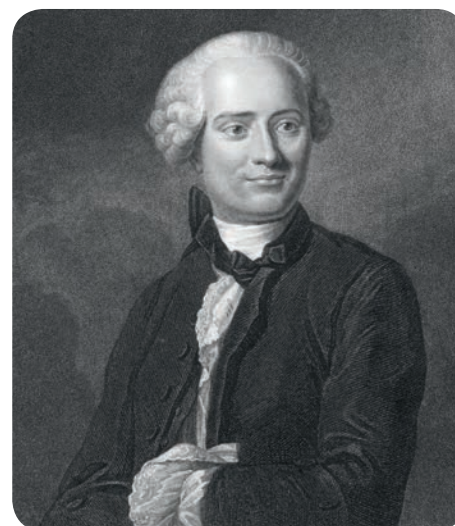
The mission of the Comité d'Alembert<sup>45</sup> of the Académie des Sciences, chaired by Académie Member Jean-Pierre Kahane, is to lead the publication and dissemination of the complete work of Jean Le Rond d'Alembert (1717-1783), in the form of five book series, each focused on one of the scientist's activities:

- Series I: *Traité et mémoires de mathématiques* [Mathematical Treaties and Memoirs], 11 volumes planned (3 already published);
- Series II: *L'Encyclopédie* [The Encyclopaedia]. D'Alembert's contribution to the Encyclopaedia amounts to a dozen of printed volumes. A digital critical edition of the whole of the Encyclopaedia is in progress, within the ENCCRE project; on completion, it shall replace the current printed Series II Edition;
- Series III: *Opuscules mathématiques* [Mathematical Opuscules], 11 volumes planned (2 volumes already published);
- Series IV: *Écrits philosophiques, historiques et littéraires* [Philosophical, historical and literary written work], 10 volumes planned (1 already published);
- Series V: *Correspondance générale* [General Correspondence], 11 volumes planned (2 already published). Volume V/2 was published at the end of 2015. These 115 letters pertain to D'Alembert's private life, his institutional life (his relationships with the Academies of Paris and Berlin) and thematic parts: general mechanics, fluid mechanics, pure mathematics, celestial mechanics, music, and the beginning of his personal investment in the Encyclopédie.

<sup>44</sup> <http://www.academie-sciences.fr/fr/Transmettre-les-connaissances/les-plis-cachetes.html>

<sup>45</sup> <http://dalembert.academie-sciences.fr/>

Moreover, the Comité d'Alembert is setting up the first critical and digital edition of L'Encyclopédie, in collaborative mode, which will replace the printed Series II. This is the ENCCRE project<sup>46</sup>, whose construction began in 2012 and will culminate in autumn 2017 with the launch of the dual interface: aimed, on the one hand, at the general public and, on the other, at researchers. Designed through an unparalleled dynamic process, this ambitious project should contribute to the advancement of computer research, catalyzing the development of new interfaces. It motivated several teams in France and Japan, and about a hundred reviewers in all. The 75,000 articles and 2,000 plates of this gigantic work have been digitized and are being exploited.



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## The Académie des Sciences and Key Opinion Informers

### The Académie in the Media



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In 2015, with over 3,000 releases all media combined, the Académie des Sciences continued building its reputation in the classical media and initiated its presence in the social media. Its members regularly received press coverage, and so did the researchers awarded by the Académie or taking part in its conferences. The latter were widely announced in the press: "Gnomons et cadrans solaires" in *Le Monde* and on *France 2*, "La recherche du temps" in *La Croix*, *Le Point*, "L'évolution humaine, des gènes à la culture" in *Sciences et avenir*, etc.

In 2015, for the first time, the number of articles published on the internet (49% of the total number recorded) was higher than that of print media articles (43%). The large amount of copy from the news agency *AFP* (*Agence France-Presse*) contributed to such overtaking, and so did the many articles posted on national daily, weekly and monthly websites, as well as the creation, or growing audience, of professional websites, whether mainstream or specialized. The radio (more than 5% of the notifications quoting the institution) often gives the floor to the members of the Académie and pays tribute to those winning awards (May 2015 interview on *France Culture* of Joël Lebowitz, 2014 Grande Médaille of the Académie). Television (2.4% of all releases), especially *France 3 Regions*, remains faithful to the solemn ceremonies of awards or those welcoming new members under the cupola of the Institute.

46 <http://enccre.academie-sciences.fr/>

## The press Echoed the Académie's Advice Notes on Climate or Energy

The year 2015 was marked, for the Académie des Sciences as well, by significant priority given to the climate and energy transition, as the COP21 meeting was held in Paris in December. The Academy's advice note on energy transition, adopted on 6 January 2015, had many echoes in the major press (*Défi*, *Les Echos*, *Le Figaro*, etc.), and so did the proposals of the four French and German Academies of Sciences and Technology calling for closer cooperation between their two countries (July 2015). Its advice note on climate change and the transformation of the energy system (*Changement climatique et transformation du système énergétique*, 3 November 2015) and its support to MicroCarb, the French initiative space mission aimed at continuously measuring atmospheric CO<sub>2</sub> concentration (8 December 2015) received media coverage, especially from *AFP*.



Several initiatives were particularly emphasized by the press:

- The advice notes of the Académie *La science, école de citoyenneté* and *L'excellence pour tous*, as well as the twentieth anniversary of *La main à la pâte*, while work was being conducted by the Conseil supérieur des programmes (CSP) [Senior Council on Instructional Programmes at the French Minister of National Education]; a debate on the place of science at school, which was continued in the Financial Times and on RFI (*Radio France Internationale*), evoking the new approach, notably in education, of evidence-based public policy, which was the theme of a colloquium (*La décision Publique fondée sur la Recherche de Preuves*) organized by the Academy in September; AEF focused its attention on the discussions of the colloquium on scientific training from three years before to three years after A-Levels;
- The advice note *Le financement de la recherche publique, un chantier urgent* (16 June 2015) received very favorable attention from *AFP*, *Les Echos*, *Le Parisien*, *L'Express*, etc.;
- Pascale Cossart's election as Secrétaire perpétuel of the 2<sup>nd</sup> division in July 2015, with several portraits on the radio and the written press on top, in particular in newspapers from the north of France, of which Pascale Cossart is a native;
- The report of the Académie des sciences *L'évolution de l'ozone atmosphérique - le point en 2015*, presented by Académie Member Marie-Lise Chanin at a press breakfast on 16 October 2015, covered by *AFP*, *L'Opinion*, *Le Figaro*, *France inter*, *Canal plus*, etc.;
- The creation of the Conseil National Consultatif pour la Biosécurité (National Advisory Council for Biosafety), recommended by the Académie and set up on 30 November 2015 (*AFP*, *AEF*, *Les Echos*, *La Tribune*, *Le Parisien*, *Le Figaro*, *Le quotidien du médecin*, *Enjeux*, *Le Point*, *Usine nouvelle*, etc.).
- The launch, on 2 December 2015, of a book devoted to the Académie, *Une compagnie en son siècle*, published by the Cherche-Midi publishing house.



© François Daburon

 Pascale Cossart

## A new Partnership with the Press

Prompted by Académie Member Alain-Jacques Valleron, Delegate for Scientific Information and Communications, a partnership between the Académie des Sciences and the Sunday newspaper *L'Humanité Dimanche* was agreed upon in July 2015: a monthly two-page feature would be written by a member of the Académie on major scientific themes touching on social issues. The first three platforms have been linked, COP21 oblige, to the theme of climate.

## When Scientists and Members of the Parliament converse

Politics and science constantly interact. Yet politicians and scientists acknowledge that they do not know each other well enough although they would have much to learn from sharing information and experience with one another. In 2004, the Académie des sciences, at the impulse of Académie Member Dominique Meyer, and the Office parlementaire des choix scientifiques et technologiques (OPECST) [Parliamentary Office for the Evaluation of Scientific and Technological Options] have thus launched a programme arranging for three persons – one member of the Parliament, one member of the Académie des Sciences and one young researcher – on a voluntary basis, to meet and discover their mutual worlds under exceptional conditions. Such tripartite partnerships take place in three steps:

- members of the Académie and young researchers are greeted into the Parliament (Senate and National Assembly): here, at this initial step organized by the OPECST, the three participants build contacts. Members of the Académie and young researchers are acquainted with the legislative work of the members of the Parliament who introduce them to the role of some standing committees and delegations, as well as to the work of the rapporteurs. They attend a session of questions to the government at the *Assemblée nationale* [French National Assembly] and are given the opportunity to meet the presidents of the committees of the two chambers, as well as representatives from all political groups;
- members of Parliament are welcomed in laboratories: members of parliament discover there the many aspects of research as an occupation, research projects in progress, partnerships, their necessary openness to Europe and the world, and problems related to the management of big laboratories. They visit premises and facilities and talk with staff in order to better understand how researchers lead their daily lives;
- scientists are greeted into electoral constituencies: the scientists discover there how complex local politics are and how multifaceted the duties of members of parliament in the field.

Beyond these three steps of the partnership itself, partners build direct contacts throughout the whole year, which last through time. These sustainable personal contacts do add to the originality and fruitfulness of this programme.

In 2015-2016, the seventh tripartite partnership session began in Parliament on Tuesday 31 March and Wednesday 1 April 2015, gathering 12 groups of three partners each.

### 2015/2016 - 12 trinômes

Académicien	Jeune chercheur	Parlementaire
Jean-Claude André	Julien Boé	Martine Martinel, députée
Alain Boudet	Hua Cassan-Wang	Pierre Médevielle, sénateur
Azzedine Bousseksou et Ghislain de Marsily	Vincent César	Henri Tandonnet, sénateur
Marie-Lise Chanin	Delphy Rodriguez	Jean-François Husson, sénateur
Pascale Cossart	David Ribet	Jean-Yves Caullet, député
Antoine Danchin	Nouara Lhocine	Jean-Pierre Masseret, sénateur
Jean-Marc Égly	Baptiste Bidon	Jean-Sébastien Vialatte, député
Bernard Kloareg	Fabrice Not	Jean-Luc Bleunven, député
Sandra Lavorel	Wilfried Thuiller	Joël Labbé, sénateur et Serge Coronado, député
Pierre Léna	Yann Clénet	Sophie Primas, sénateur
Jacques Livage	Sophie Carencoc	Hervé Pellois, député
Jacques Pouyssegur	Johanna Chiche	François Commeinhes, sénateur



Parlementaires, académiciens et jeunes chercheurs le 1<sup>er</sup> avril 2015, dans la cour d'honneur de l'Assemblée Nationale



## FOSTERING INTERNATIONAL COLLABORATION

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Science is universal and the challenges to take on have, for a great part, worldwide implications. The Académie des Sciences has always enjoyed close scientific relations with other nations, whether in the form of personal relationships between historical figures or specific relationships from one State to another, or through its action within international scientific organizations and other interacademic networks that have been gradually put in place in the course of the twentieth century. It now sustains this cooperative mission within its *Delegation for International Affairs*, under the leadership of Daniel Ricquier, member and vice-president of the Académie.

The many aspects of the Académie's international relations have already been described in details in the document *With the Académie des Sciences in 2013-2014*<sup>47</sup>.

## An advisory Role on a Global Scale



In 2015, the Académie des Sciences brought its support to the French organisations involved in international scientific cooperation:

- meeting of the *Academic Standing Committee for Scientific and Technological International Relations (CARIST)*, created by the Académie in 1983 and chaired by its Delegate for International Affairs: “Mobilité internationale des doctorants et des chercheurs: enjeux de connaissance, d’attractivité et de compétitivité” [The International Flexibility of PhD Candidates and Researchers: Issues of Knowledge, Attractiveness and Competitiveness] (14 January 2015);
- participation to the follow-up meetings of the operation *Frontiers of Science*, Franco-Taiwanese and Franco-Japanese programmes aimed at promoting interdisciplinary dialogue between young researchers.

The Académie also contributed to the preparation of international scientific reports within the international networks of academies of science, including EASAC (*European Academies Science Advisory Council*), IAC (*InterAcademy Council*) and IAP (*InterAcademy Partnership*) et ALLEA (*All European Academies*):

- meeting of the ALLEA Science and Ethics Working Group: Anne Fagot-Largeault, 10-11 March 2015, Berlin;
- IAP Sustainable Energy Workshop: Edouard Brézin, 25-27 June 2015, Amsterdam;
- AEMASE/ALLEA conference on secondary and high school science teaching: Odile Macchi, 12-13 October 2015, Dakar;
- IAP-NASAC Seminar at UNESCO, Science-Policy Dialogue on Climate Change Adaptation and Resilience in Africa: Marie-Lise Chanin, 9 December 2015, UNESCO, Paris (the recommendations of this seminar were presented on 10 December at COP21, at Le Bourget);

Finally, the Académie took part in international expert meetings and contributed to the preparation of joint recommendations:

- *STS Forum*: STS Forum Council meetings, Bernard Meunier, 14-16 January 2015 in Washington and 24 April 2015 in Berlin; STS Forum, Bernard Meunier and Alain-Jacques Valleron, 4-6 October 2015, Kyoto;
- *Inter-Academy Seoul Science Forum* dedicated to Global Cooperation in Science and Technology, lecture by Catherine Bréchnignac, 11-12 November, Seoul;
- Meetings of the G7 academies (Germany, Canada, United States, France, Italy, Japan and the United Kingdom): Bernard Meunier, 23-24 February 2015 and 28-29 April 2015, Berlin, in the presence of Chancellor Angela Merkel. These meetings resulted in a joint statement by the G7 Science Academies<sup>48</sup>.

47 <http://www.academie-sciences.fr/pdf/documentation/RA3/RA3.pdf>

48 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/declarations-communes-des-academies-des-sciences-du-g7-2015.html>

## Bilateral Cooperation Relationships

The action of the Académie des Sciences at the international level also involves bilateral actions, carried out in particular within the scope of more than 50 cooperation agreements signed with its counterparts abroad.

### A New Cooperation Agreement Was Signed



For several years, the Académie des Sciences and the Chinese Academy of Engineering have enjoyed close cooperation, as evidenced by the holding of the Sino-French seminar on urbanization and sustainable development, which was organized in 2014 as part of the 50<sup>th</sup> anniversary of the establishment of diplomatic relations between the French Republic and the People's Republic of China. On 29 May 2015, the Académie des Sciences and the Chinese Academy of Engineering put such cooperation on a long-term footing as they signed an agreement at the Académie des Sciences in Paris at an official ceremony attended by scientists and representatives of French and Chinese organizations.

## Bilateral Meetings

These meetings take various forms: reception of foreign academy members for stays in France, reception of leaders from foreign academies at the Institut, participation of French members of the Académie to foreign academic sessions and, of course, organization of joint colloquia. In 2015, some memorable moments stand out:

- 2<sup>nd</sup> Korean Academy of Science and Technology/French Académie des Sciences Joint Symposium on Fermented foods and Health Benefits, Seoul, 21-22 May 2015;
- China/France/Africa Tripartite Workshop: *Coopération en Matière de Formation Professionnelle et Technologique dans le Continent* [Cooperation on vocational and technological training in the continent], Académie des Sciences, 29 May 2015;
- Colloquium of the Mexican Academy of Sciences and the Académie des Sciences, on the occasion of the Week of Latin America and the Caribbean in France, Académie des Sciences, 2 June 2015<sup>49</sup>;
- 8<sup>th</sup> Franco-Taiwanese Symposium on the following themes: Topological Material, Low-Dimensional and Layered Material and its Future Impact, New Treatment for Cancer: Immunotherapy and beyond, Sustainable and Local Energy Collection, Profiling New Technologies for Social Care, 15-18 June 2015<sup>50</sup>.
- French-Israeli Seminar on the biology of chromatin, "Biologie de la chromatine", Académie des Sciences, 7-8 July 2015;
- Reception at the Académie des Sciences of Tabaré Vázquez, President of the Eastern Republic of Uruguay, who gave a lecture on the challenges of science for global development, "Les défis de la Science au Service du Développement Mondial", 2 November 2015<sup>51</sup>;
- Meeting gathering American and Iranian academy members under the auspices of the Académie, 19-24 October 2015;
- 7<sup>th</sup> Meeting of the Franco-Chinese Steering Committee on Traditional Medicines, on the convergence between the western forms of medicine and traditional Chinese medicine, "Convergence des Médecines Occidentales et de la Médecine Traditionnelle Chinoise", Académie des sciences, 9 November 2015;



49 <http://www.academie-sciences.fr/fr/Actions-interacademiques/colloque-franco-mexicain.html>

50 [http://www.academie-sciences.fr/pdf/conf/colloque\\_070715.pdf](http://www.academie-sciences.fr/pdf/conf/colloque_070715.pdf)

51 <http://www.academie-sciences.fr/fr/l-academie-a-l-honneur-d-accueillir-le-president-de-la-republique-orientale-de-l-uruguay.html>

## The Creation of the Algerian Academy of Science and Technology

The year 2015 saw the achievement of the project of setting up an academy of science and technology in Algeria. The Académie des Sciences brought its support to the leaders of the project at all stages of its implementation, including the drafting of the statutes of the future academy and the empanelling of the international jury in charge of selecting the scientists called to be the founding nucleus of the future academy.

Following the publication on 10 March 2015 of the Presidential Decree establishing the Algerian Academy, a jury composed of members from several academies throughout the world, chaired by Catherine Bréchnignac, Secrétaire perpétuel of the Académie and delegate ambassador for science, technology and innovation, convened from 5 to 7 June 2015 in Algiers. Its work resulted in the selection of the first 46 members (six of which were from the diaspora) of the Algerian Academy of Science and Technology, officially established on 14 November 2015 in Algiers under the auspices of the Algerian Minister of Higher Education and Research.

## International Scientific Prizes



### **Descartes-Huygens Prize**

Created in 1995 at the Hague by the French and Dutch governments, this prize is alternately allocated in the fields of science of matter, life sciences and human and social science. Awarded under the auspices of the French Académie des Sciences and the Royal Netherlands Academy of Arts and Sciences, it rewards every year two researchers of international level, one being French

and the other Dutch, both actively contributing to bilateral scientific cooperation. Amounting to €46,000 (€23,000 for each party), this prize is especially intended to fund the laureate's stay as an invited researcher in the other country.

- 2015 Laureates (life sciences): Benoît Viollet, codirector of the "Energy and Iron Sensing in Physiopathology" team, Institut Cochin, Paris, and Joost Gribnau, director of the Department of developmental biology, Erasmus Medical Center, Rotterdam.

### **Gay-Lussac Humboldt Prize**

Two prizes of €60,000 each are awarded every year to internationally renowned scientists working in Germany, whose applications are submitted by the French partners with whom they develop or plan to develop cooperation. The Académie des Sciences assists the Ministry of Higher Education and Research by empanelling the jury. Conversely, the Alexander von Humboldt Foundation awards the Gay-Lussac Humboldt Prize to scientists working in France and intending to carry out long-term research projects in cooperation with their colleagues in Germany.



- 2015 German laureates: Markus Antonietti, director of the Max Planck Institute of Colloids and Interfaces in Potsdam, and Stephan Schlemmer, head of the Laboratory Astrophysics Group of the University of Cologne.

### **Franco-Taiwanese Scientific Great Prize**

Created by the Franco-Taiwanese Science Foundation, created between the Académie des Sciences and the National Science Council of Taiwan on 10 February 2003, this Prize is awarded every year to French or Taiwanese researchers for their contributions to scientific research projects of interest to both sides. The laureates should commit themselves to catalyzing scientific exchanges between both sides, which may organize conferences and colloquia in this view. The Prize amounts to €38,200.



🏆 2015 Laureates: Monique Combescot, Paris Institute of Nanoscience, Université Pierre et Marie Curie (UPMC), Paris, and Yia-Chung Chang, Academia Sinica Research Center for Applied Sciences, Taipei.

### **Franco-Chinese Prize**

Amounting to €15,000, this prize was created by the Académie des Sciences on the occasion of the 50<sup>th</sup> anniversary of the resumption of Franco-Chinese diplomatic relations.



🏆 2015 Laureates: Zhong Qun Tian, codirector of the nano-biology international laboratory XiamENS, Paris, and Xi Li, professor at Shanghai University.

### **French-American Richard 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 US National Academy of Sciences. Alternately bestowed to a French and an American researcher, it is endowed with \$50,000, plus \$20,000 to cover the laureate's potential stay in a laboratory of the other country.

🏆 2015 Laureate: Hopi Hoekstra, researcher at *Howard Hughes Medical Institute*, for his work on the genetic mechanisms of behavioural adaptation during evolution.



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## Actions Targeting Development

### **COPEP: Contemplating Franco-African Cooperation**

From 13 to 16 April 2015, the Standing Committee for Developing Countries of the Académie des Sciences (Comité Pays en développement, or Coped) held an important pan-African/pan-European colloquium in Cotonou, in partnership with the Académie Nationale des Sciences, Arts et Lettres du Bénin (National Academy of Sciences, Arts and Letters of Benin) on chemistry and natural resources, "*Chimie et Ressources Naturelles*".

Chemistry plays indeed a key role in the study and recovery of plant, animal and mineral natural resources. It makes it possible to extract, characterize and have at our disposal substances of interest for health, agriculture, industry and energy. Chemistry also allows us to reproduce or modify the synthesis of natural molecules and thus prepare for the future of natural resource exploration, Africa being particularly rich in natural resources. Finally, chemistry, as an experimental science discipline, because of its structuring, unifying and integrating nature, is an excellent educational model for training future scientists. Countries in Africa in general, and sub-Saharan countries in particular, as well as Madagascar, have many natural resources; yet chemistry there only plays an important role when plant resource recovery is concerned. It was based on such findings that this major colloquium on chemistry and natural resources was held<sup>52</sup>.

### **Putting knowledge to work for development: GID**



The Interacademic Group for Development (*Groupe Interacadémique pour le Développement*, or GID) was created in 2007 by ten academies of Southern Europe and the African continent, including the Académie des Sciences. It is committed to boosting a true codevelopment Euro-African programme<sup>53</sup>. In order to reach this goal, GID is backed up by two important networks of academies, whose creation it did bring about: GID-EMAN (the Euro Mediterranean Academic Network) et GID-ESAN (the Euro-Sub-Saharan Academic Network).

The 7<sup>th</sup> Parmenides conference, which was held from 17 to 19 March 2015 in Dubrovnik. Its theme was "Common Heritage and Technologies: Enhancement of heritage, a Key to Development", featuring three sub-themes: "Natural Heritage: its Value for Development"; "Geological and Archaeological Heritages"; "Common heritage and Urbanization". At the end of the forum, François Guinot, President of the GID, recommended the idea of organizing "Science, Trade and Society Seminars" (*Séminaires Sciences, Métiers et Sociétés*) for those working in such fields, particularly for the preservation and restoration of heritage elements." This forum was part of a series of actions, including the regional seminar-workshop on "Technology for Research on the Cultural Heritage of the Western Mediterranean, its Protection and valorization" held by the Hassan II Academy of Science and Technology of Morocco, 2-4 March 2015.



As for sub-Saharan Africa, GID:

- maintained its support to the GID-WHEP initiatives: organization of the seminar "*Anthropologie des pratiques sanitaires et des catégories affectives pratiques pluridisciplinaires face à des problèmes de santé*" [Anthropology of health practices and multidisciplinary practical affective categories addressing health issues], 19-21 May 2015, Marseilles; on 17 June 2015, meeting at the University Cheik Anta Diop UCAD in Dakar on the ENSPEDIA project lead by Yannick Jaffré and his team, "*Maladie vécue et qualité des soins en pédiatrie: ce que disent les enfants, approche pluridisciplinaire entre sciences sociales et sciences médicales*" [The experience of disease and quality of paediatric care: what the children say, a multidisciplinary approach combining the social and medical sciences];
- prepared the first African Forum on Science and Technology for Development (FastDev), in consultation with the academies of Morocco, Benin, Senegal, Burkina Faso and with support from the Network of African Science Academies (NASAC) – the forum will be held in February 2016 and focus on "The Employment of Young People: the Necessary Co-construction of Training Courses and Enterprises".

52 <http://www.academie-sciences.fr/fr/Codeveloppement/coped.html>

53 <http://g-i-d.org/>

## PERFORMING THE ROLE OF AN EXPERT AND ADVISOR

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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 the role of an advisor, as indicated in Article 3 of its statutes. Its members' scientific excellence, its multidisciplinary approach and its global outlook now allow it to play a key role as an expert. In order to do so, the Académie sets up Committees and Working groups, which are the cornerstones of its activity as they compose reports, advice notes or recommendations –as many decision aid tools available for public consultation.

## Experts Committees: to Reflect and Propose

Thanks to its members, top-level scientists representing all disciplines and fields of research, the Académie des Sciences may look into any modern issue in which science plays 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 and debates prepared by members of the Académie, and to which external experts are invited when deemed useful, reports, advice notes or recommendations are drafted, presented to decision makers and made available for consultation to all citizens browsing the website of the Académie des Sciences.

The missions of the Committees of the Académie des Sciences have been detailed in *One Year with the Académie des Sciences -2012*<sup>54</sup>.

## Environmental Sciences

The *Standing Committee for Environmental Sciences (Comité des Sciences de l'Environnement)*, which is behind many reports of the Académie des Sciences since its creation in 1990, focused its activity on three topics:



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- Atmospheric ozone: it was decided to conduct another short study on ozone, in order to update the 1993 and 1998 reports (respectively *Ozone troposphérique* [Tropospheric Ozone] and *Ozone stratosphérique* [Stratospheric Ozone]), whose scientific contents remain solid but which should be updated with the most recent data. The work *L'évolution de l'ozone atmosphérique - Le point en 2015* [The Evolution of Atmospheric Ozone – A 2015 Overview] was released on 16 October 2015 and was the subject of a press meeting<sup>55</sup>;
- The MicroCarb satellite project: the *Standing Committee for Environmental Sciences* joined up with the *Standing Committee for Space Research (Comité de la Recherche Spatiale)* to produce a joint advice note on 1 December 2015 promoting the MicroCarb space mission project of CNES, the National Centre for Space Studies (Centre National d'Etudes Spatiales)<sup>56</sup>;
- Biodiversity: the Committee has undertaken important work on the adaptation mechanisms of biodiversity to climate change and their limitations. Eventually, more than twenty explanatory sheets will be released by 2017.

## Space Research

The *Standing Committee for Space Research* joined up with the *Standing Committee for Environmental Sciences* to produce a joint advice note promoting the MicroCarb space mission project of the Centre National d'Etudes Spatiales (National Centre for Space Studies, CNES). This satellite is designed to produce useful data to understand the carbon cycle and how ecosystems behave in response to the anthropic perturbation of atmospheric CO<sub>2</sub> levels. Such questions are of high scientific and societal priority, for MicroCarb is a preparation for the future operational missions that will monitor all carbon fluxes. This advice note was adopted by the Académie des Sciences on 1 December 2015.



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Having the ears of the public authorities, the *Standing Committee for Space Research* of the Académie des Sciences forcefully stands as a focal point for reflection and proposals to reach the French and European policy arenas.

54 [http://www.academie-sciences.fr/pdf/documentation/RA2\\_sources/projet/RA\\_2012.pdf](http://www.academie-sciences.fr/pdf/documentation/RA2_sources/projet/RA_2012.pdf)

55 <http://www.academie-sciences.fr/pdf/rapport/ozone0615.pdf>

56 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/avis-du-comite-des-sciences-de-l-environnement-et-du-comite-de-la-recherche-spatiale-sur-le-projet-de-mission-du-cnes-microcarb.html>



## Energy Prospects

In 2015, the *Comité de Prospective en Energie (Standing Committee for Prospects in Energy Procurement)* has issued three detailed advice notes:



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- an advice note on energy transition, “Avis sur la transition énergétique”, released on 21 January 2015<sup>57</sup>;
- a joint statement on the Energy Transition in France and Germany, by the four French and German national academies (Académie des Sciences, Académie des Technologies, Nationale Akademie der Wissenschaften Leopoldina, Deutsche Akademie der Technikwissenschaften Acatech), released in English on 10 July 2015<sup>58</sup>;
- an advice note on climate change and the transformation of the energy system, within the framework of the COP21 preparation, released on 3 November 2015<sup>59</sup>.

The Committee also interviewed several personalities with an expertise in the field of energy:

- Dominique Grand, ex-CEA Grenoble, on “The Energy Transition and Electricity Mix: Can Renewable Forms of Energy Compensate for Nuclear Power Phase-Out?”;
- David Marchal, Networks and Renewable Energy Service of ADEME (French Environment and Energy Management Agency), on “A 100% Renewable Electricity Mix? Analyses and Optimisations”;
- Michel Combarous, corresponding member of the Académie des Sciences, “On Some Medium- and Long-Term Trends in (Wind, Photovoltaic, Nuclear) Energy”.

The Committee continues to constantly reflect on the energy transition and conducts hearings to deepen its knowledge of issues related to networks, storage, energy efficiency and various plausible scenarios.

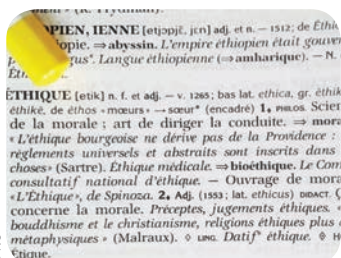
## Science and Biosafety

Following the recommendations of the Académie's report *Les menaces biologiques. Biosécurité et responsabilité des scientifiques* [Biological Threats: Biosafety and the Responsibility of Scientists] published in 2008, the Prime Minister decided to set up a National Advisory Council on Biosafety (Conseil National Consultatif pour la Biosécurité, CNCB), the establishment of which it entrusted to the General Secretariat for Defence and National Security (Secrétariat Général de la Défense et de la Sécurité Nationale, SGDSN). The installation of this Committee took place at the Académie des Sciences on 26 November 2015<sup>60</sup>.



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## Science, Ethics and Society



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In 2015, The *Comité Science, Ethique et Société (Standing Committee for Science, Ethics and Society)* continued to substantively reflect on the issues related to scientific integrity at large, the ethics of scientific publication and the internal deontological rules at the Académie.

On all these issues, it had particular exchanges with Dr. Hervé Maisonneuve, author of the blog *Rédaction médicale et scientifique* on medical and scientific writing, and with Jean-Pierre Kahane and Jean-Pierre Changeux on the role of the French National Consultative Ethics Committee for Health and Life Sciences (Comité consultatif national d'éthique pour les sciences de la vie et de la santé).

Moreover, the Committee started to look into artificial intelligence, its definition, its societal consequences and the ethical implications of its fast-paced development. Anne Fagot-Largeault, president of the Committee, spread the work of the ALLEA (*All European Academies*) Ethics Committee, of which she is also a member.

57 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/avis-sur-la-transition-energetique.html>

58 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/la-transition-energetique-en-france-et-en-allemande.html>

59 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/avis-de-l-academie-des-sciences-sur-changement-climatique-et-transformation-du-systeme-energetique.html>

60 <http://www.academie-sciences.fr/fr/Communiquees-de-presse/communique-de-presse-mise-en-place-du-conseil-national-consultatif-pour-la-biosécurité.html>

## Defending the Men of Science

In 2015, the *Comité de défense des hommes de sciences* (Standing Committee for the Defence of Scientists' Rights, CODHOS) took action for about ten members scientific or medical staff who were victims of rights violations, and was most pleased to hear that six persons were released: Xue Feng, Chinese a geologist, Ebrahim al-Demistani, a Bahraini nurse, Mahmoud Badavam, a Baha'i Iranian engineer and professor of physics, Ramin Zibaie, Baha'i Iranian a psychologist and dean of university, Kamran Rahimian, a Baha'i-Iranian psychologist and advisor, and Carlos Nuno Castel-Ranco, a Mozambican economist. The Committee also expressed its concern regarding the adoption of a very restrictive bill on statistics in Tanzania<sup>61</sup>.



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## History of Science and Epistemology

The Standing Committee for Science History and Epistemology of the Académie (*Comité histoire des sciences et épistémologie*) is chaired by Claude Debru. In 2015, it completed the publication of the colloquium *Les scientifiques et l'épistémologie: la rationalité scientifique aujourd'hui* (2014) [*Scientists and Epistemology: Scientific Rationality Today*] (2014) and prepared the programme for a new colloquium devoted to causality in the biological and medical sciences. The committee also co-organized with the Académie des Inscriptions et Belles Lettres and the Comité National d'Histoire et de Philosophie des Sciences (French National Committee for Science History and Philosophy) a session on gnomons and sundials, "*Gnomons et cadrans solaires à travers les âges*" (which was held on 16 June 2015). Finally, the committee continued to set up – under the editorial responsibility of Evariste Sanchez-Palencia – an Education Resources section on the Académie's website, "*Ressources Pédagogiques*". This section gathers contributions from members of the Académie on the history of science and the scientific method, and recommends books and websites. The committee increased its interaction with foreign academies, notably the Leopoldina through a joint project on the 1914-1918 war. Finally, throughout the year, the committee contributed to the preparation of the 350<sup>th</sup> anniversary of the Académie des Sciences in 2016, particularly with the organization of the "5 à 7" [After-Hour Sessions of the Académie], which were open to the public and specially dedicated to the history of science.

## Advice Notes and Reports

### Advice Note on the energy transition



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Energy transition was the focus of a bill discussed in the Sénat [French Senate] from 10 to 13 February 2015. The Académie des Sciences supports the objectives of reducing the consumption of fossil carbon energy consumption and using energy more efficiently. It notes however that the measures proposed for such transition and their timetable deserve a critical eye. The advice note adopted on 6 January 2015<sup>62</sup> was based on a study undertaken by the *Comité de prospective en énergie* (Standing Committee for Prospects in Energy Procurement) in June 2013 and on hearings and reflections conducted in various settings.

61 <http://www.academie-sciences.fr/pdf/comite/codhos15.pdf>

62 <http://www.academie-sciences.fr/fr/Espace-presse/communiqu-e-de-presse-avis-sur-la-transition-energetique-contribution-de-l-academie-des-sciences-au-debat-sur-le-projet-de-loi.html>

## Letter about the European Union Research Policy

This letter was co-signed by the German, French and English academies and sent on 2 March 2015<sup>63</sup> to Jean-Claude Juncker, president of the European Commission.

## Science: a school for citizenship

This letter was sent on 10 March 2015<sup>64</sup> to Najat Vallaud-Belkacem, minister of National Education, Higher Education and Research.

## G7 Science Academies' Statement 2015



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Greeted in Berlin by the German Academy of Sciences Leopoldina (Leopoldina Nationale Akademie der Wissenschaften) on 28 and 29 April 2015, the academies of science from the countries of the G7 (Germany, Canada, the United States, France, Italy, Japan and the United Kingdom) have jointly defined the key issues on which the action of their respective governments should be urgently focused<sup>65</sup>:

- infectious diseases and antimicrobial resistance: threats and necessary actions;
- neglected tropical diseases;
- future of the ocean: impact of human activities on marine systems.

## Joint Statement on Animal Experimentation

19 May 2015 Statement by the Académie Nationale de Médecine, Académie des Sciences, Académie nationale de pharmacie and Académie vétérinaire de France<sup>66</sup> in reply to the European Citizen's Initiative (ECI) calling for an end to all animal experimentation in Europe.

## Excellence for All

In this advice note released on 27 May 2015<sup>67</sup>, the Académie des Sciences considers that the instructional programme covering the elementary and middle school grades, as proposed by the Conseil supérieur des programmes (CSP) [French Senior Council on Instructional Programmes] to the French Minister of National Education, Higher Education and Research are not satisfactory, for structural reasons.

63 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/lettre-sur-la-politique-de-recherche-de-l-union-europeenne.html>

64 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/la-science-ecole-de-citoyennete.html>

65 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/declarations-communes-des-academies-des-sciences-du-g7-2015.html>

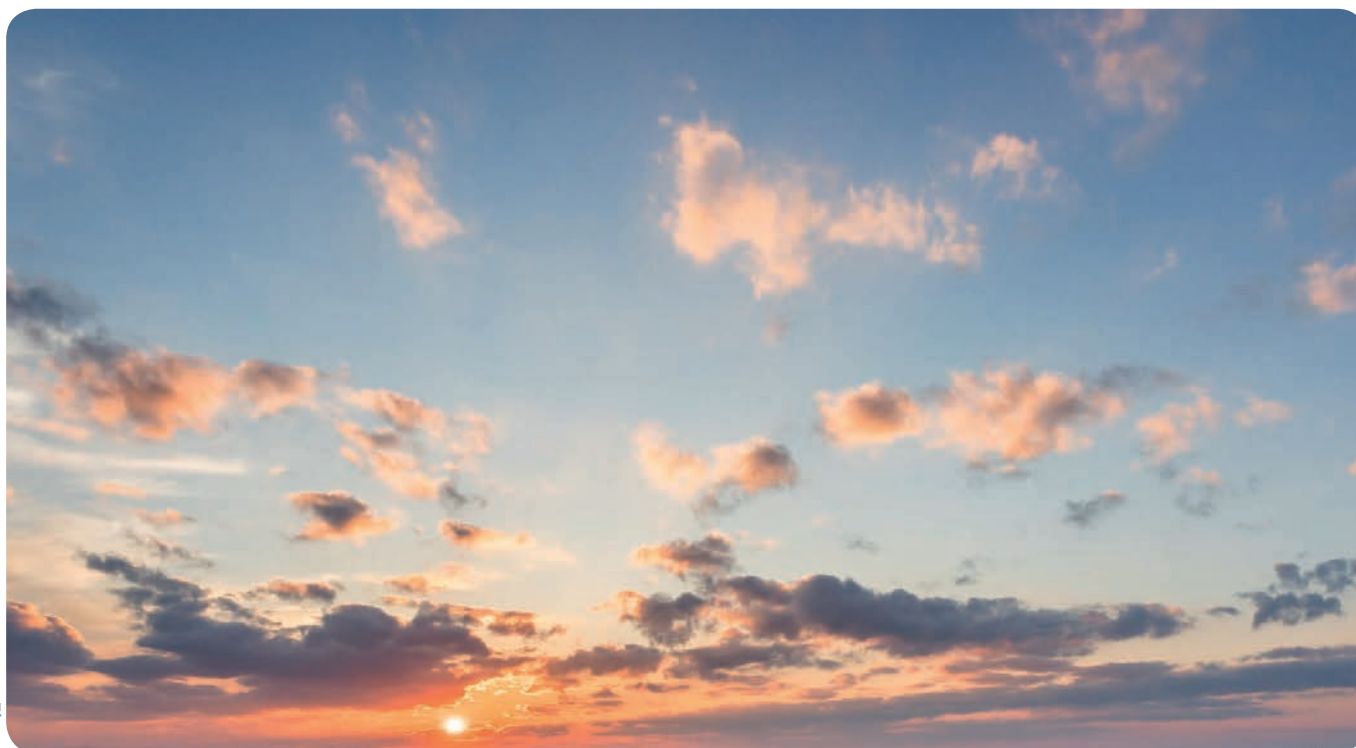
66 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/declaration-commune-sur-l-experimentation-animale.html>

67 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/l-excellence-pour-tous.html>

## Public Research Funding: an urgent task

After expressing two opinions on the financing of public research in France in December 2013 and October 2014, the Academy of Sciences remains, in this advice note published on 16 June 2015, very concerned about the need to preserve the high level of research of our country<sup>68</sup>.

## Energy Transition in France and Germany



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On 10 July 2015, the French and German National Academies of Science and Technology - *Nationale Akademie der Wissenschaften Leopoldina, acatech - Deutsche Akademie der Technikwissenschaften, Académie des Sciences et Académie des Technologies* – released the results of their joint reflection on the issue of energy transition<sup>69</sup>. During the press conference held to introduce their joint statement, Susanne Wasum-Rainer, German ambassador to France, reiterated her support for this initiative and called on decision-makers to take action: “Bilateral research projects often prefigure large-scale actions at the European level and can improve the competitiveness of the European industry. While this joint declaration sets priorities for our future cooperation, it also stresses the need to grant additional funding to energy research and development in Germany and France. The French and German governments should act now”<sup>70</sup>.

68 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/le-financement-de-la-recherche-publique-un-chantier-urgent.html>

69 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/la-transition-energetique-en-france-et-en-allemande.html>

70 Les projets bilatéraux de recherche préfigurent souvent des actions de grande ampleur au niveau européen, et sont à même d'améliorer la compétitivité de l'industrie européenne. Si cette déclaration conjointe définit des priorités pour notre coopération future, elle souligne également la nécessité d'octroyer des crédits supplémentaires à la recherche et développement sur l'énergie en Allemagne et en France. Aux gouvernements français et allemand d'agir maintenant." [Our translation.]

## L'évolution de l'ozone atmosphérique – Le point en 2015

Ed. Lavoisier Tec&Doc. October 2015



This report<sup>71</sup> is devoted to the state of observations and research on atmospheric ozone. It updates the data presented in two previous reports of the Académie des Sciences, whose scientific content remains valid: *Ozone et propriétés oxydantes de la troposphère* (Lavoisier, 1993) and *L'ozone stratosphérique* (Lavoisier, 1998).

The report provides an update on the evolution of tropospheric ozone (lowest atmospheric layer), whose increase is detrimental to health and vegetation, and stratospheric ozone, which made apparent the first signs of anthropogenic change in the environment and whose destruction caused fear that the ultraviolet solar flux on the planet might harmfully increase.

Ozone involves two distinct and seemingly contradictory subproblems: there is too much ozone in some areas of the troposphere (especially near the cities) and not enough in some areas of the stratosphere (particularly above the Antarctic). The report highlights these distinct phenomena, which should not be confused with each other, as their potential remedies are not of the same nature.

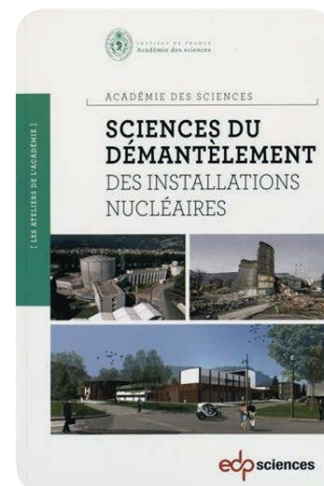
The problem of ozone equilibrium in the atmosphere and that of climate are *a priori* different. However, the state of a constituent in the atmosphere is influenced by the characteristics of the environment; an interaction between the two problems is therefore inevitable. Such various interactions are presented in the report.

## Sciences du démantèlement des installations nucléaires

Éd. EDP Sciences – Collection Les ateliers de l'Académie. November 2015

In France, nine nuclear power reactors are being dismantled. Of the 58 nuclear power reactors operating, 48 should reach the end of their lives before 2050. This situation is common to the industrialized nations that exploit nuclear energy: there are 75 in the European Union and 29 in the United States.

These dismantling sites share specific features that distinguish them from other demolition sites: radioactive materials are present, the radiation, ingestion or accidental inhalation of which may be dangerous. Specific techniques, devices and processes have been developed, and the French teams have built a scientific and technical expertise of international reputation. The Académie des Sciences organized a seminar on these issues, during which all aspects of the disciplines concerned were discussed: the characterization of radioactivity sources, radioprotection, logistics, physicochemistry, continuous mechanics, calculation codes, robotics, returns on experience, training, horizon scanning and serious accident reports. The book *Sciences du démantèlement des installations nucléaires*<sup>72</sup> [The Science of Nuclear Installation Dismantlement] provides an account of these workshops and an overview of the requirements and conditions needed for dismantlement to be implemented. It takes an inventory of the key scientific phenomena, describes current research projects and identifies those that should be carried out for the sites under consideration to be released for unrestricted use while ensuring the protection of workers and the public for the present time and the future.



71 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/l-evolution-de-l-ozone-atmospherique-le-point-en-2015.html>

72 <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/sciences-du-demanterement-des-installations-nucleaires.html>

## Climate Change and the Transformation of the Energy System

This advice note, dated 3 November 2015<sup>73</sup>, takes stock of the reflections conducted within the Académie des Sciences since its previous opinion on climate change in 2010, to the conclusions of which it provides a confirmation at a distance. This followed from a long process carried out within internal working groups of the Académie, which relied, when deemed necessary, on external experts, and on two conferences that presented the state of knowledge regarding climate data (16 December 2014<sup>74</sup>) and models (22 September 2015<sup>75</sup>).

### Advice Note on the MicroCarb Project

In this advice note prepared by its *Standing Committee for Environmental Sciences* and *Standing Committee for Space Research* and adopted on 1 December 2015<sup>76</sup>, the Académie recommends the academic agencies and the relevant ministries to launch the MicroCarb mission of CNES as soon as possible, aimed at measuring atmospheric CO<sub>2</sub> from space.



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<sup>73</sup> <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/avis-de-l-academie-des-sciences-sur-changement-climatique-et-transformation-du-systeme-energetique.html>

<sup>74</sup> <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats-par-et-pour-la-communauté-scientifique/observation-du-systeme-climatique-en-permanente-evolution-mecanismes-physiques-et-chimiques-en-jeu.html>

<sup>75</sup> <http://www.academie-sciences.fr/fr/Colloques-conferences-et-debats/modelisation-des-climats-du-passe-geologique-aux-siecles-futurs.html>

<sup>76</sup> <http://www.academie-sciences.fr/fr/Rapports-ouvrages-avis-et-recommandations-de-l-Academie/avis-du-comite-des-sciences-de-l-environnement-et-du-comite-de-la-recherche-spatiale-sur-le-projet-de-mission-du-cnes-microcarb.html>





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