

THE CANDIDATES RESPOND



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France's presidential elections are taking place at a time of deep debate over the French research community's standing and prospects. To further the debate, *Nature's* **Declan Butler** submitted a list of questions on research issues to the three leading candidates. Their full responses, in both French and English, are on our website. Here we present extracts:

Is French science in decline and, if so, why? How much will you invest in science, when and on what priorities?

Nicolas Sarkozy: It's true that we've had various warning signs over the past few years that the relative position of French science in the world is being eroded. France nonetheless maintains expertise of the highest international level in many disciplines, in particular in mathematics, physics and engineering. I note too that France exports its scientific expertise abroad, even if I regret the fact that many of our young scientists increasingly choose to leave the country because they no

longer feel they can succeed at home.

Research and higher education will be at the forefront of my priorities. Although this will be realized in the shape of more resources — €4 billion [US\$5.4 billion] extra for research, and €5 billion for higher education — it will also involve deep reforms in the way the system works. Reform without resources would be as fruitless as resources without reform.

I want to favour powerful and autonomous universities, which will be reinstated at the core of our research effort, and to reinforce a culture of scientific evaluation by promoting competitive grants. I would also note that the reshaping

and restructuring of the Saclay plateau will be a major presidential initiative. This site is unique in Europe in its enormous concentration of centres of education and research, but there is scope for it to be exploited yet further.

Ségolène Royal: I don't think it's fair to speak of a decline, because France still has great assets and renowned university researchers, for example in mathematics. But for years, France has not really made research or the universities a top priority. The recruitment drive launched by Lionel Jospin was stopped when the conservatives returned to power; budgets have stagnated, PhD students and young scientists have been neglected, and the research system has been made more complex. France has fallen from 5th to 11th place among OECD countries in terms of science spending. I want to turn that situation around by making higher education, research and innovation top spending priorities, with a 10% budget increase each year for five years.

François Bayrou: It's not so much that French science is in decline, but rather that other countries, including the United States, Japan, the nations of northern Europe and, more recently, China, have constantly increased investment in research over the years. For too long, research budgets in France have stagnated. Despite this situation, French scientists still rank among

Who's who

Nicolas Sarkozy (pictured centre) is head of the right-of-centre UMP party, which was founded by outgoing president Jacques Chirac. He has served as both finance minister and minister of the interior.

Ségolène Royal (pictured left) is the Socialist Party candidate. A member of the National Assembly, she is president of the Poitou-Charentes region in the west of France.

François Bayrou (pictured right) is the head of a small centrist party, the UDF. He was minister for education in two right-wing governments during the 1990s, and has been a member of the European Parliament.

There are also nine other candidates, including **Jean-Marie Le Pen** of the National Front, **Dominique Voynet** of the Greens, **Olivier Besancenot** of

the Revolutionary Communists, **Philippe de Villiers** of the traditionalist and eurosceptic Movement for France, and anti-globalization campaigner **José Bové**.

The two candidates who get the most votes in the first round of the elections, which in metropolitan France will be held on 22 April, will proceed to a run-off election on the first weekend in May.

Issues and initials

A guide to what the candidates and scientists are talking about.

ANR A national research-funding agency founded in 2005. Previously, most research funding in France had been via block grants to specific research agencies.

Ariane Europe's family of space launch vehicles, built by a consortium led by French industry and a source of great French pride.

'Competitiveness clusters' A 2005 interministerial initiative to link companies, research and education centres.

CNRS France, and Europe's, largest basic-research organization

EPR European pressurized reactor, a new type of nuclear plant designed by Areva — a French engineering company in which Germany's Siemens has a large stake — and the French electricity utility Electricité de France.

Galileo An EU/European Space Agency programme of positioning satellites that would rival or complement (take your pick) the American Global Positioning System.

GMES Global monitoring for environment and security, a joint EU/European Space Agency programme with some military ramifications.

GMOs Genetically modified organisms. A source of considerable unease in parts of rural France, and a sore point with minor presidential candidate José Bové.

Grandes Ecoles The actually quite small schools that form the élite branch of French higher education, producing just a few thousand graduates every year; almost every school in the system is focused on a single speciality.

INRA The national agricultural research organization.

INSERM The national medical research organization.

PhD Doctorates are a hot-button issue in France, where a PhD was until recently not recognized as a professional qualification (it still isn't under French law), and a poor cousin of a diploma from a Grande Ecole.

PRES Research and higher-education hubs. New entities intended to bring together nearby universities, hospitals and public and private research organizations, created by the 2006 law on research.

Saclay A site outside Paris that is home to the Soleil synchrotron, ten research organizations and ten higher-education centres including three Grandes Ecoles.

the best in many disciplines, in particular in mathematics, and in certain fields in physics, chemistry, biology, social sciences and the environment. It is now urgent to invest in emerging disciplines. I propose that France reinvest in research, with a 5% budget increase in real terms every year for ten years.

Is French science beyond reform?

Mme Royal: The real question is: which reforms does French science need? It's our misfortune that successive right-wing governments have failed to make research a priority. It was opposition to the impoverishment of the university and its decline that brought students out on to the streets in 1986 and 1995, and scientists in 2004.

M. Bayrou: That's not fair to French research. I am very conscious of its willingness to get beyond the deadlock in which it finds itself. Research must first be reinstated as a priority on the political agenda; leading French politicians must make that their personal duty.

M. Sarkozy: No, French science is not unreformable! I think it has never been more ripe for reform. Growing awareness of the state of research is spurring demand for change. Lecturers and researchers are faced with globalization and international competition, just as everyone else is. Travelling a lot in their jobs, they are able to make comparisons.

The leadership of France's industries and government is dominated by graduates not from universities, but from the Grandes Ecoles. How would you reconcile the parts of this dual system so as to recognize the value of PhD scientists?

M. Bayrou: Rather than pitting the different educational routes against each other, I prefer policies that diminish the differences between them. For example, we might extend the existing bridges between universities and the Grandes Ecoles, such as reorientation classes, to deserving students in all courses at the master's or PhD level; or it might be possible for the Grandes Ecoles and universities to set up common curricula.

M. Sarkozy: Research students will come into their own when French universities finally have available the finances and the autonomy they need to be centres of excellence — something that is already the case for courses in law, medicine and economics.

Research needs to play a bigger role at the Grandes Ecoles, and the best university students should be able to switch to those courses. Universities and Grandes Ecoles that are close

to each other should have joint campuses with shared services. Universities could benefit from the Grandes Ecoles' business know-how, and the access their students enjoy to highly responsible jobs. I want PhD students to be able to access opportunities beyond the areas of research and education.

Mme Royal: I have pledged to have the PhD recognized both in the civil service and in the private sector. It is also necessary to bring the various parts of the higher-education system closer together, and to establish routes for moving between the Grandes Ecoles and the universities. That will be a role for the PRES, which will stimulate interaction and synergy between universities, Grandes Ecoles and research organizations.

How would you modernize France's universities?

M. Sarkozy: As of the day after the elections, I will be ready to launch a major reform of French universities designed to give them much more autonomy. This will include powers to recruit, to fix salaries, to decide how they organize themselves, to build endowments and to diversify their funding sources. I will also rebuild the way that they are governed, restructuring their executive boards and the ways they choose their presidents.

M. Bayrou: After a massive increase in student numbers over the past two decades, enrolment has now stabilized, and this makes it possible to envisage a new phase of long-term development. The universities suffer three ills: the absence of recognition of the PhD, lack of funding and a poorly adapted governance structure. We need to reach spending-per-student levels equal to or more than the average of OECD countries, continue the rapprochement with the Grandes Ecoles that has now begun, and make changes in the ways the universities are run.

Mme Royal: I favour a rational, optimal use of resources based on evaluation; this means we must provide favourable working conditions for all researchers. If we supported only a small proportion of researchers it would mean that we would be paying the others without benefiting from their potential. That would be absurd.

State planning created France's powerful aerospace, nuclear and transport industries, but is 'innovation by decree' possible for fast-moving sectors such as biotechnology and information technology?

M. Bayrou: Research is not in itself innovation, but it can and should contribute to it. There are several ways of promoting this. Researchers



The incoming French president will need to clarify the country's role in space exploration (right) as well as wrestle with emotive issues such as stem-cell therapies.

contribute to our growth and our competitiveness by taking interest in their work's potential for wealth creation. To attract talent, I propose that for researchers living in France, royalties from patents should be exempt from income tax. I want to reinforce technology-transfer departments in our research institutes — a few hundred million euros could have a substantial impact — to help the birth and development of innovative enterprises.

Mme Royal: Innovation has stagnated because fundamental research has not been supported. The proactive policies of the 1960s led to the development of the space, aeronautics and nuclear-power industries. The 'breakdown' in biotechnology — despite the fact that French labs were at the forefront of sequencing the human genome in the early 1990s — stems from a glaring lack of support for the life sciences a decade ago.

M. Sarkozy: The competitiveness clusters that I established in my different positions in government are still very young. But an initial appraisal is rather encouraging. I would emphasize that they represent a relatively innovative approach, at least by French standards. As you say in Great Britain it is a bottom-up, and not top-down, approach.

It is, above all, the quality of research and the dynamism of the ways in which it is disseminated that determine our potential for innovation — not just financial incentives. But let's be pragmatic; everywhere in the world, from

emerging economies to developed and ostensibly free-market countries, the state intervenes to encourage innovation, and to build and reinforce the industrial and technological sectors of the future.

What cuts in greenhouse-gas emissions would you commit France to and how would you attain them? What should be agreed post-Kyoto?

Mme Royal: I am committed to a 75% reduction in our greenhouse-gas emissions by 2050. I'm setting out an ambitious policy because I'm convinced that climate change is the major challenge of the twenty-first century. So I advocate saving energy in the building and transport sectors, developing renewable energy (solar, wind, biomass and geothermal) and promoting research into carbon capture and storage, electricity storage, hydrogen, intelligent electricity grids and new fuels created through hydrolysis of biomass.

M. Sarkozy: I am proud to be able to say that France made a visionary choice in committing itself several decades ago to developing its nuclear-power programme. Just think, the carbon emissions saved by France using nuclear-power stations rather than fossil fuels are equivalent to those of all Europe's cars. Of course, we have also made scientific and technological priorities of research on renewable energy and more energy-efficient means of production and transport.

As a market of 500 million people, Europe

should make greater efforts to encourage its large commercial partners — in particular the United States, China and Canada — to play according to the planet's own rules. Countries that behave like stowaways hitching a free ride, making no effort to reduce their emissions, should not continue to benefit from the competitive industrial advantage this gives them. To compensate for this we must tax products from countries that make no effort to reduce emissions after 2012, even if this means modifying World Trade Organization rules.

M. Bayrou: I will fulfil the European commitment to a target of generating 20% of our energy from renewable sources. But we need to do even more, through saving energy and new technologies — for example, the construction sector already has the know-how to erect zero-emission buildings. That will create local jobs.

Would you maintain nuclear power's current 75% share of French electricity generation? And how will you tackle France's accumulating nuclear waste?

M. Sarkozy: The nuclear sector is of absolute strategic importance, as well as of industrial and technological excellence. France is one of the rare countries to have mastered the nuclear-fuel cycle in its entirety. France will continue to nurture its comparative advantage here by modernizing its nuclear fleet and know-how. That's why we have committed to a series of third-generation reactors, the EPR, and a research programme into fourth-generation reactors.

Mme Royal: I will pay particular attention to guaranteeing that the storage of nuclear waste is reversible. Parliament will decide in ten years time which options should be retained for long-term management of nuclear waste.

I think that the current government took the decision to go ahead with the EPR without adequate analysis or debate. No impact assessment was presented to parliament, and no effort was made to create real diversification in our energy mix. We cannot set our country's energy future in stone without an in-depth debate, not just on the EPR but on the entire issue.

M. Bayrou: The EPR project will be maintained. But we need a scientific assessment of it. The renewal of our existing fleet of reactors hinges on this project, and a decision this important for our energy policy cannot be taken on the sly. There must be as wide and democratic a debate as possible.

A demonstration project should be launched rapidly to prove that after temporary storage, the volume and radioactivity of waste can be reduced to low levels. This is necessary to reassure the many men and women in France, and worldwide, who have doubts about this form of energy because of the risks still associated with it.

What are your priorities for space?

Mme Royal: France is a major space power, having developed, with its European partners, the high-quality Ariane launchers. I think that the high costs of manned space flight mean that such ventures should be carried out in international programmes. The launch of Earth-observation satellites is, of course, a priority.

M. Bayrou: The emphasis should also be on fundamental research and exploration of the Universe, a field in which France and Europe are proficient, and then on GMES and on the Galileo navigation system. For Europe to carry sufficient weight, should it aim for the Moon or even farther, perhaps going it alone? Should it support the International Space Station? This all demands reflection.

M. Sarkozy: The Galileo project has become bogged down in national quarrels that are petty compared with the stakes on the table, and breaking the current deadlock is a matter of urgency.

I'm keen on greater European cooperation in space. France should be ready to make the extra effort to lead the way, if needs be, as it has done in the past. The main goal must be to maintain and reinforce our basic civil, military and scientific skills. If, after that, we can together develop more ambitious manned flight and planetary-exploration missions, then why not?

What will be your policy on genetically modified crops? Would you change existing laws on embryonic stem-cell research?

M. Bayrou: What has happened with GMOs is symptomatic of the lack of democratic consultation on major topics in France. Such a debate would have helped to bring out the citizens' expectations, and to provide directions for research, so as to allow the downstream use of the technology in a way that was regulated and acceptable. We must therefore organize this now, with input from independent

scientists. In the meantime, I am in favour of an immediate moratorium on GMOs.

M. Sarkozy: I want research to continue on GMOs as, among other things, that is the only way to improve our knowledge of the potential risks to human health and biodiversity. Unless we can be highly certain that they are harmless, I am less enthusiastic about their industrialization and marketing.

As for research on embryonic stem cells, with the creation of the Agency of Biomedicine in 2005, researchers can now submit research projects for review. I'm delighted that projects that have been favourably reviewed can thus develop in our country within a clear and evolving framework. I think it's indispensable that research also continues to develop in this area.

Mme Royal: I am in favour of a moratorium on open-field cultivation of GMOs and of having a public debate on this question, which is of interest to all citizens.

Research on human stem cells should be permitted provided that they are obtained after informed consent, they come from embryos that are no longer part of any fertility treatments and the proposed protocol has been rigorously examined. We must revise the legal framework to reconcile ethical principles and scientific progress. ■

For fuller answers, and for questions on the street protests of 2004, nuclear deterrence, the CNRS, EU science and the common agricultural policy, visit our website at <http://tinyurl.com/23fwj5>. See also Editorial, page 831.

Let science speak for itself

You've heard what the presidential candidates think the challenges facing science in France are. *Nature* also canvassed opinion across the French research spectrum: from young researchers to reformers and industrialists. **Declan Butler** reports.

Pierre Chambon

Biologist at the Institute of Genetics and Molecular and Cellular Biology in Illkirch near Strasbourg, of which he was formerly director.

The common assertion that French research is doing badly is untrue; it's doing badly in some sectors, with life sciences the main concern. The French research system hasn't been organized in 40 years. There's duplication in biology across the CNRS, INSERM, INRA and the

universities that's damaging competitiveness. We need a single life-sciences agency, plus perhaps a second for more applied work, to bring together the best life scientists and give them the means to do top-quality research.

Biotech companies and universities compete for the best scientists worldwide. But France's civil-service pay scales mean that a biologist earns the same as a sociologist or anthropologist. This makes it impossible to attract the world's best biologists, but life sciences in France cannot survive on French researchers alone.

In France, most scientists start and finish their careers in the same organization, whether this is a research agency or a university. There are two separate corps of scientists, some teaching and researching, some doing only research. This is inefficient, because you want less effective researchers doing more teaching, and the best researchers doing less, according to their success in winning grants. For this to work, we need to have just a single corps of researchers, all attached to universities, with the research agencies transformed into research councils.