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science. The flora inventory, coordinated by botanist Santiago Castroviejo, will continue for at least another ten years. So far more than a hundred new species have been discovered.

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**Malen Ruíz de Elvira is the science correspondent of *El País*.**

## science in spain commentary

# Spain breeds good science in lean times

Malen Ruiz de Elvira

The politics of Spanish science can be rather depressing, as various articles in this supplement show. But despite this, good science is being done, particularly in recent years, by many groups and individual scientists who are at the forefront of their disciplines and move with ease in the international arena.

Spain's relative lack of interest in science is usually explained by its culture's traditional disregard for scientific work. Spanish culture has tended to favour the arts exclusively, and this is certainly part of the reason for the disastrous state of R&D in the private sector.

There are, even now, relatively few scientists in the public sector in Spain compared with other European countries. They are not very well organized, do not influence decision taking and are, for the most part, socially irrelevant. So it is not surprising that governments remain unconvinced — despite their public claims to the contrary — of the need for putting more money into science, even though the late 1980s showed that Spanish science flourishes with only a minimum of nourishment.

The Spanish tendency towards individualism has also been used to explain the difficulties in building strong groups and schools, despite the abundance of brilliant individuals. Many of the best have, of course, ended up abroad. An exception to this tendency is the school of molecular biology, which is still the strongest area of Spanish science. It descends partly from Severo Ochoa, who won a Nobel prize in 1959, and was the last Spanish-born scientist to achieve such a feat. Two prestigious veterans of this school, Antonio García Bellido (development genetics) and Margarita Salas (virology), are still working at the Centre for Molecular Biology in Madrid.

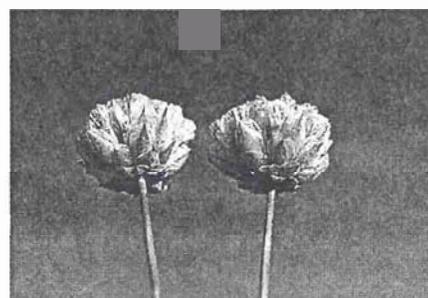
Some of the school's new generation of outstanding scientists have remained in basic science, such as Ginés Morata (developmental genetics) and Esteban Domingo (virology). Others work in biotechnology, such as Víctor de Lorenzo from the National Centre for Biotechnology, who leads a strong group in bio-remediation (the use of genetically engineered bacteria to help clear up pollution). Immunology, plant biology and virology all have their own distinguished specialists.

A special case is the so-called 'Spanish cancer school' in the United States, a group of scientists who have worked there for many

years. They include Mariano Barbacid, Angel Pellicer, Joan Massagué, Carlos Cordon and Eugenio Santos, to name but a few.

That so many brilliant scientists were not able to find in Spain the intellectual and economic atmosphere they needed to return — in the 1970s or later — is a sad story. Now, at least three of them — Barbacid, Santos and Pellicer — have accepted offers to return to Spain, and there is hope that they will provide leadership and increased funding (see p. 10).

Spanish science has in recent years seen an explosion in palaeontology, spurred by the magnificent discoveries in Atapuerca (in the province of Burgos). An important group of specialists in many different areas has gathered around this, led by Juan Luis Arsuaga (Universidad Complutense), Eudald Carbonell (Universidad Rovira i Virgili) and José María Bermúdez de Castro



(National Museum of Natural Sciences). Bones of the first known Europeans, some 800,000 years old, and a wealth of 300,000-year-old bones have been excavated here since the late 1980s.

These bones, with artefacts found nearby, are being meticulously studied by young and enthusiastic scientists, along with the bio-environment in which they were found. The project is one of the most important suc-

## CSIC president César Nombela

*Alison Abbott talks to César Nombela, a professor of microbiology at the Complutense University in Madrid, who was appointed president of the Consejo Superior de Investigaciones Científicas (CSIC), Spain's national research council, after the new government took office in 1996. CSIC runs 105 institutes which employ 2,000 permanent scientists.*

### What role does CSIC play in Spain's overall scientific effort?

CSIC is essential to Spanish science. CSIC scientists make up just 6 per cent of the total scientific community but they are an important example of how competitive research should be conducted. This is demonstrated by the fact that the participation of CSIC scientists in the European Union's Framework programmes of

research is growing exponentially. According to bibliometric analyses, Spain contributes 2.2 per cent of the world's science, of which CSIC scientists perform 20 per cent. The government appreciates our importance and has increased our budget by 6 per cent this year.

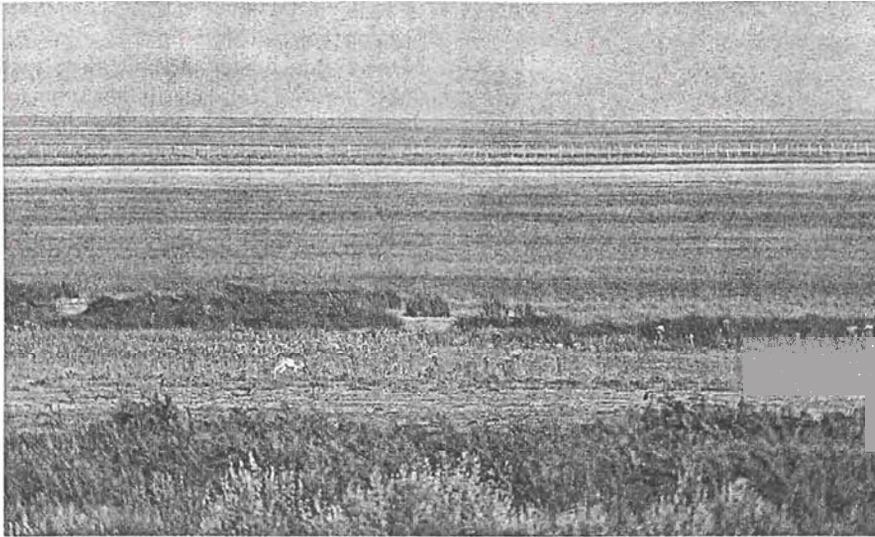
### What are the most exciting scientific prospects for CSIC at the moment?

That is very difficult to say because we are active in so many fields, many of which are important for our country. We are particularly strong in biotechnology, for example. Cutting-edge research is being carried out in molecular biology at institutes in Barcelona and Madrid, but we are also involved in classical biotechnology areas such as the production of olive oil, from agriculture to oil

production technology. Spain was highly successful in the European Commission's most recent call for proposals for its Biotech programme, and half of the contracts with Spanish participation were for CSIC projects.

We also carry out very important ecology research in the Doñana national park, which is top class in many respects. Other important research areas for CSIC that involve basic research with clear applications include chemical catalysis, material sciences, microelectronics and neuroscience. And we also have an important humanities programme: one of our biggest projects is the creation of a dictionary of Greek, which is a very large undertaking.

**Has CSIC reached its critical mass, or is it yet to grow?**



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## in interview

We need to grow. In the 1980s, politicians planned an expansion of the entire Spanish science system. According to this plan, CSIC should double in size. I understand that achieving this in the next few years is now politically unrealistic. I would be satisfied if we were able to maintain steady growth, which is why I have asked for 150 new positions per year.

Growth is important not just for our science but also for our scientists. Around a fifth of our staff are on highly unsatisfactory temporary contracts, and I would like most of them to be integrated into CSIC on a more permanent basis over the next three or four years. I am not talking about tenure, but they should at least be able to work independently on their own projects and have good conditions of employment.

However, in absorbing these young people we need to structure things to achieve the greatest level of efficiency and

productiveness. So they should not be allowed to set up projects that are too distant from their institute's main research interests. There would be a danger that research would become too fragmented and research groups too small, which would work against the aim of achieving true critical mass.

**How can the young scientists' needs for independence be reconciled with the need to avoid fragmentation?**

I am trying to reinforce the role of the institute directors. Previously they did not have enough authority. New directors have been given greater responsibility for coordinating the research of their institutes and developing specific scientific objectives.

**Many basic scientists feel that the scientific priorities set by the government are too industrially orientated.**

**Do you agree?**

I don't think this is the case. A careful examination of the government's national plan [a five-year research programme] and the projects that have been approved indicate the opposite.

The fact is that in Spain academic research is far more highly developed than industrial research. Of course, academics are invited to do what they can to contribute to their country's needs, but without compromising the quality of their research.

I am convinced that this approach is sensible. I was trained in basic research, but I started working in collaboration with the pharmaceutical industry more than ten years ago. This stimulated substantial activity within our research group. We benefited not only from the funding but also from the experience, which allowed us to reinforce our position in the field of the molecular biology of pathogens. Indeed, this area has

become an important subject for pharmaceutical development. My experience has shown me that industrial contact can improve the quality of research, and I believe that scientists must consider how their research can — sooner or later — be useful for our society. This is a trend in many countries, not just Spain.

**How do you respond to the criticism that basic science in Spain has become rather static?**

In science you have to be dynamic. You need to stimulate new fields and new ideas. I must return to my previous points. To be able to be dynamic, we need to expand our whole scientific system. But we also need some structural reforms to allow us to hire scientists on more flexible contracts. The need for this sort of structural reform is actually most acute in the universities.