

French National Centre for Scientific Research Annual report - 1996

Activities in the scientific departments

Mathematics and Physical science

Nuclear and Particle Physics

Engineering Sciences

Chemical Sciences

Sciences of the Universe

Life Sciences

Humanities and Social Sciences

The scientific departments



In 1996, the departments brought numerous projects to successful completion and launched several new actions. The CNRS is committed to two major goals which concern the entire organization: first, the implementation of a contract policy to reinforce partnerships with the academic world, and secondly, the elaboration, with the aid of the scientific community, of a new scientific programme representing the strategy of the CNRS on the eve of the 21st century.

Mathematics and Physical Science (SPM)

Director:
Catherine Bréchnignac

In 1996, the department concentrated on its priority orientations: supporting the laboratories, strengthening its position in the fields where it plays a leading role, and encouraging interdisciplinary research.

Fostering exchange between mathematicians and physicists

The department centred its activities in mathematics on the priority goals defined several years ago: organizing and structuring the community of mathematicians around several federating projects and research consortia, and encouraging collaboration with other fields. One of the department's internal programmes for 1997 is thus devoted to promoting exchange between mathematicians and physicists. For example, the research project on quantum gravity, conducted under Alain Connes' supervision, should bring new insights on the subject.

In physics, several priorities were also defined among the department's many areas of scientific expertise. One of these concerns basic research on laser-cooled atoms, optics and atomic interferometry and the Bose condensation. In these fields, the French school of research plays a pioneering role in the world, and its leader, Claude Cohen-Tannoudji, was awarded the CNRS's highest prize, the Gold Medal, in 1996.

Spectacular results

Two areas of research have a more technological orientation. These are on the one hand nanophysics, with the Microstructures and microelectronics laboratory, the only laboratory in France able to produce objects 20 to 50 nanometres in size; its aim is to meet the needs of the French community. The other area is that of short pulse lasers. The Applied optics laboratory (CNRS-X-ENSTA) has obtained spectacular results in this field. This laboratory, which works on a European scale, has produced the most intense femtosecond laser beam in the world today, with 35-terawatt power in 25-femtosecond pulses and a 10-hertz repetition rate. A technology transfer process towards the city of Bordeaux is now under way, with a view to creating a living scientific environment around the future "laser Megajoule" project.



••• Interactions with other fields of science

The department actively encourages interdisciplinary research projects. Besides the projects initiated in mathematics, two specific research axes, involving materials science on one hand and the interactions between physics and biology on the other, are emphasized. The department's internal programme on functional materials will focus on fields with highly competent laboratories: wide-gap semiconductors, materials for non-linear optics and glass. In 1997, the physics-biology programme will support laboratories which are already involved in Life Sciences projects.

Nuclear and Particle Physics (PNC)

National institute for
nuclear and particle
physics (IN2P3)

Director:
Claude Détraz

**The four main
areas covered by
the Institute are
the study of
fundamental
particles and of
their interactions,
the study of
nuclear matter, the
analysis of
composite particles
based on their
fundamental
constituents, and
the study of
particles and nuclei
in cosmology and
astrophysics.**

Fundamental particles and their interactions

The energy increase at CERN's LEP (Large Electron-Positron Collider) and the luminosity increase at the HERA (Hadron Elektron Ring Anlage) electron-proton collider in Hamburg have brought significant results, thus enabling us to deepen our knowledge of the standard model, while opening up avenues for further exploration. Furthermore, the first data from the experiments on neutrino physics at CERN and at the Chooz nuclear plant have been registered and demonstrate the high quality of the experimental methods used. In parallel, the IN2P3 research groups are now strongly involved in the construction of the ATLAS, CMS and ALICE detectors at the future LHC (Large Hadron Collider, at CERN) accelerator.

Nuclear matter

Significant results were obtained in experiments conducted in the framework of the "nuclear matter" programme: in the field of hot nuclei, thanks to the data collected by the INDRA detector, and in that of neutron halo nuclei, with the DEMON detector. These two experiments are being carried out at GANIL, where the construction of SPIRAL, a post-accelerator of radioactive nuclei, is also progressing satisfactorily. Experiments in the field of nuclear superdeformation were also successfully completed, using the Eurogam gamma-ray detector which is now undergoing changes and is soon to be transformed into the European detector Euroball. Finally, the NA50 lead beam experiment conducted at CERN led to the observation of phenomena showing evidence of the formation of a quark-gluon plasma.

Hadron physics

Experiments have begun at the Grenoble ESRF (European Synchrotron Radiation Facility) ring, thanks to the development of the GRAAL back scattered photon beam; these experiments will make it possible to study spin effects in the photoproduction of composite particles. Experiments have also started at the Thomas Jefferson National Accelerator Facility (TJNAF) in Virginia, in the United States; these are aimed at improving our knowledge of the structure of the proton and of simple atomic nuclei. At the Saturne accelerator in Saclay, research has been conducted to evaluate the influence of the nuclear environment on the particles' properties.

Particle astrophysics

In this area, the IN2P3 has concentrated on three main topics: first, the Virgo gravitational-wave detection project which is in progress near Pisa, Italy. IN2P3 laboratories are building a large ultra-high vacuum facility

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Interdisciplinary projects

Work in progress also includes interdisciplinary projects involving biology, nuclear chemistry, materials physics and theoretical physics. Two important events for 1996 deserve to be highlighted: the engagement of IN2P3 in research on nuclear waste transmutation has resulted in an agreement between the CNRS, the Atomic Energy Commission (CEA) and *Electricité de France* (EDF) in the framework of a Groupement de Recherche (GDR - research group) called Gedeon; secondly, thanks to the development of a new line for the detection of heavy long-lived isotopes at the Tandatron facility in Gif-sur-Yvette, new avenues for research are being opened in the fields of environment as well as in the Life and Earth Sciences.

Engineering Sciences (SPI)

Director:
Jean-Jacques
Gagnepain

In 1996, the engineering sciences department expanded its partnerships with the industrial world and launched several international cooperation projects in the field of optics and industrial applications of power lasers.

Promoting new partnerships

This year was particularly fruitful in new partnerships with the industrial world: the PROSETIA programme on membrane-separation process engineering, the research programme "Contact, metal, tool, lubricant" involving the Engineering, Physics and Mathematics, Chemistry departments, and two industrial firms.

As far as international activities are concerned, several projects were launched this year: the public interest group, bringing together the CNRS, the French Atomic Energy Commission, the Department of Defense, and the *Fraunhofer Institut für Lasertechnik* in Aachen, on the industrial uses of power lasers; the European Associated Laboratory "High power laser science", which brings together the Laboratory for the Use of Intense Lasers (LULI) and the Rutherford Appleton Laboratory, and aims at coordinating access to large European lasers; also, in the field of optics, the LOADS project with the Georgia Institute of Technology in Atlanta.

Certain priority research goals were reinforced thanks to new specifically targeted actions. Thus, the department's active role in the field of telecommunications was underscored by the creation of a new research group and through the continuation of the MIRIHADÉ project. In the Operational Safety field, a joint CNRS-Department of Research-Department of Defense action was launched to study complex, reactive and safe systems control.

Research and innovation

1996 was also devoted to the preparation of the Consortium which had been announced at the end of 1995, during the department's twentieth anniversary celebration. The Consortium on Research and Innovation for Enterprises (CRIE) brings together the CNRS, the French Atomic Energy Commission, ONERA, CEMAGREF, INRA, the network of industrial technological centres, the association of independent industrial research and development companies (ASIRDI), represented by the Bertin company and the INRIA. Its aim is to coordinate means and actions in the fields of engineering and technological research in order to promote and accelerate innovation in enterprises. The CRIE creation process will be completed in 1997.

Chemical Sciences (SC)

Director:
Paul Rigny
(until July 1996)
followed by
Jean-Claude Bernier

The department emphasized its orientations by rationalizing its research potential. This process involved a great deal of reorganization: new teams were created, cooperation projects through laboratory networks were expanded, the three-party contracting policy with universities was pursued, and many new partnerships with the industrial world, both at the regional and the international levels, were launched.

Improving our research potential

Several original actions carried out by our department illustrate our desire to enhance our research capacity: the activities of the newly-constructed Institute of Surface and Interface Chemistry in Mulhouse centre on such essential themes as adhesion, tribology, interfaces and dispersed mediums, refractory composite materials; the creation in Montpellier of the Structure and Dynamics of Molecular and Solid Systems Laboratory; the setting up of the biology-physics-chemistry laboratory at the Institut Curie; the growing importance of the Versailles Solids and Microporous Chemistry Laboratory. The three-party (CNRS-University-Ministry) contracting policy established with universities has also led to the reorganization of research units.

Our aim for the coming years is to improve the quality of our research tools and to create and develop research networks in the aim of reaching common goals. The creation of the microcharacterization centre at the Nantes Materials Institute, the development of the Aquitaine-Matériaux platform which caters to the needs of laboratories and enterprises, the inauguration of the high temperature nuclear magnetic resonance facility in Orléans, the creation in Pau of an analytical chemistry and environment network linking several French cities, are a proof of this determination. Finally, the CNRS-MENESR-Belstein project has made it possible for laboratories to gain access to organic synthesis data bases.

Promoting partnerships

Our department is very actively developing its partnerships with the industrial and academic worlds. Thus, two new joint laboratories were created: one was set up together with Rhône-Poulenc and Princeton University on the Cranbury site and is working in the field of complex fluids (surface-active agents and water-soluble polymers); the other, set up with Elf-Atochem in the polymer field, studies heterogeneous macromolecular systems. Furthermore, the cooperation of our laboratories with the pharmaceutical company Eli Lilly was finalized thanks to a joint agreement between Eli Lilly, the CNRS and the Louis Pasteur University in Strasbourg. The cooperation with Rhône-Poulenc was also matched by the creation of a CNRS-Rhône-Poulenc fund which will finance two specific research topics: combinatorial chemistry and stimutable polymers.

An international outlook

Our international activities included two Franco-British workshops on electroactive polymers and on the environment, the creation of a European Laboratory Association between the Dynamic and Structural Selectivity Studies Laboratory (CNRS-Joseph Fourier University in Grenoble) and the Organic Chemistry and Physical Organic Chemistry Laboratories (université libre de Bruxelles-FNRS).

Finally, together with various European organizations and institutions working in the field of chemistry, we have completed the AllChemE forecast report, "Chemistry: Europe and the Future", which follows up on a common declaration of intentions. Our department also encourages the creation of networks within the framework of the COST-chemistry programme.



Sciences of the Universe (SDU)

National Institute for
the sciences of the
universe (INSU)

Director:
Michel Aubry
(until November 1996),
followed by
Jean-François Minster

**In the framework
of the CNRS'
global orientation
plan, 1996 saw
important scientific
breakthroughs and
new developments
in various areas of
research.**

Astronomy and astrophysics

The THEMIS solar telescope and the EISCAT radar were both completed in 1995 and inaugurated in 1996. Other highlights of the year were the decision to launch the interferometry programme of the European Southern Observatory's Very Large Telescope, the installation of adaptive optics on the Canada-France-Hawaii 3.6 m telescope and the spectacular results of the ISO and SOHO space observatories.

However, 1996 saw the failure, at the launching stage, of the Cluster and Mars space missions. We are now analysing the consequences of these failures and examining what possible measures could be taken by the concerned communities to avoid such problems in the future.

Three new programmes have been elaborated in the framework of the CNRS's new programme policy for 1997. They involve both astronomers and astrophysicists and their themes are Earth movements (the FOMTE programme), cosmology (National Cosmology programme), the heliosphere and the environment of the earth (SHET programme).

Earth sciences

In solid earth sciences, the main events were the first use of the $^{177}\text{Lu}/^{177}\text{Hf}$ chronometer, thanks to the magnetic sector and Inductively Coupled Source mass spectrometer of the *Ecole normale supérieure de Lyon*, the identification and mapping of the magma chamber under the Vesuvius and the discovery of the surprisingly early development of proboscidean mammals after the great dinosaur extinction at the end of the Cretaceous period.

In fluid earth sciences, the Espresso experiment (Experiment for Regional Sources and Sinks of Oxydants) in the Central African Republic aimed at quantifying the flows of trace compounds emitted by anthropic sources (combustions) and biogenic sources (vegetation, soil) in intertropical zones and at evaluating their impact on the atmosphere.

The Earth sciences organized workshops to define the department's future orientations for the next four years, the high point of this work being a colloquium which took place in Poitiers on March 3 and 4, 1996. Several strong thematic orientations were thus outlined. Integrated into the overall CNRS scientific plan, these objectives will be pursued thanks to the new programmes on soils and erosion (the PROSE programme), on interactions between the earth's layers (Programme "Dynamics of earth transfers"), and on geomaterials.



Life Sciences (SDV)

Director:

Pierre Tambourin

The department pursued its research activities along the lines defined in the 1994-96 plan, by actively encouraging projects involving collaboration both with other CNRS departments and with outside partners.

Six main orientations

The main orientations for 1996 were the following: structural biology, pharmacology, enzymology; cell biology and signalling, development; genomes (structure, function, regulation); integrative biology (physiological functions and neurosciences); microbiology, virology, parasitology; ecosystems, population, biodiversity.

The department invested considerable means in developing these areas of research with the hiring of 69 researchers, the reorganization of 30 research units, the creation of 11 new laboratories or research teams and the launching of 10 thematic and regional projects. Additional support was thus brought to the structural biology and pharmacology research centres in Paris, Strasbourg and Marseilles, the human genetics and genetic transformation research centres in Montpellier and Orléans, the cognitive sciences Institute in Lyons and the Institute for sciences of taste and eating behaviour in Dijon. The setting up of the Lille Biology Institute went through its second phase: the first research teams settled in and a joint CNRS/university research unit and a federating institute were created. In the "ecosystems, population, biodiversity" field, ten new researchers were hired and the joint project (with the Sciences of the Universe department) to build the Armorican Research Centre on the Environment (CAREN) in Rennes, Brittany is making due progress.

Significant achievements

Among the most important achievements of the department this year, one should mention the launching of the CNRS "computers and genomes" programme, the completion of the expert report on "Diesel fuel and health", the creation of eight new international scientific cooperation programmes (PICS) and of a new European Laboratory Association (LEA), as well as the following publications: *Images de la recherche française en biologie végétale* (French research on plant biology)", *30 ans de recherche au département des sciences de la vie du CNRS* (30 years of research in the CNRS Life Sciences department), which publicize the major scientific breakthroughs made in 1994 and 1995 by the research units supported by the department. Many actions were devoted to developing data processing tools for biological research, promoting the use of large equipment, and to setting up, on an experimental basis, an interdisciplinary CNRS committee in charge of carrying out expert reports. The department was also intent on reinforcing interdepartmental projects, fostering both partnerships with the industrial world and international cooperation, and organizing scientific information campaigns.

Humanities and Social Sciences (SHS)

Director:
André Kaspi

1996 was a year of change within the department. Its main objective remains the restructuring of research in the humanities and social sciences. Major emphasis was laid on the "maisons de la recherche" (research institutes) and the specialized programmes, on networked computing facilities, libraries, international relations, and the publicizing of research findings.

"Maisons de la recherche"

The "*maisons de la recherche*" programme (four jointly-managed research units and two federations, created in 1996) addresses five of the department's most crucial concerns: stimulating research, increasing communication efforts, improving results, sharing the burden of costly investments (libraries, media centres, computer servers, special equipment, complex software) and optimizing means.

Furthermore, in the framework of the contract policy with universities and ministries, certain operational structures were merged .

A new specialized programme

Despite budgetary constraints, a new thematic SHS-AIDS programme was set up in collaboration with the Ministry of National Education, Higher Education and Research (MENESR) and the National Aids Research Agency (ANRS). An invitation to tender gave rise to fifty-seven projects, among which twenty-six were selected and financed by ANRS and MENESR grants.

Interlinked computer facilities

In the humanities and social sciences, computer networks linking together the department's various disciplines play an important role in structuring the research environment. Thanks to the creation of special thematic expertise centres, means and know-how concerning state-of-the-art information technologies can be optimized and shared. These centres are an asset for our department's policy of continuing education and job optimization.

Modernizing libraries

Researchers spend a considerable amount of time in libraries, and their importance for our department is comparable to that of large-scale scientific equipment for others. For this reason, libraries must be modernized by setting up data bases which can be consulted on the Web (Collective Catalog of Works). A coherent purchasing policy is also necessary, and the grouping of libraries should be encouraged.

International cooperation

The department's international cooperation projects focused on four geographical areas: the Middle East, the Far East, North America and the European Union.

New projects were initiated: a second joint research unit was set up with the Ministry of Foreign Affairs, agreements with the Universities of Chicago and Boston are being negotiated, and five international scientific cooperation programmes were launched.

Publicizing research findings

Publicizing research findings is an important part of our department's activities: it involves organizing colloquia and publications by CNRS Editions, and establishing relationships with the business world through close collaboration with the National Association for the Interdisciplinary Publicizing of Social Sciences Research in Enterprises (ANVIE).