EUROPEAN SCIENCE FOUNDATION

SETTING SCIENCE AGENDAS FOR EUROPE

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At a Glance

National funds for research are spent mostly within the borders of the respective countries. The European Commission funds research and networking within the scope of predetermined themes, and applies boundary conditions regarding the criteria for participation. The European Research Council, within Framework 7, funds individual, excellent principal investigators. But it is the European Science Foundation that can respond to eager individual researchers with bright ideas. ESF provides a platform for Europe's scientists to identify the science that needs to be done, the science that is best done across national boundaries, and the researchers' networks that are best suited for international collaboration.

Networks are not, of course, an end in themselves. In several fields, to name a few examples, linguistics, oceanography, atmospheric research and continental geophysics, global collaboration is essential. Even in my own field, cell biology, where the raw material of research is similar everywhere, the challenge is universal and scientists benefit from networks.

Networks provide added value, because their members select each other themselves, appreciate each others' strengths, and understand what they can gain from each other. Their levels of competence are raised because they can complement each others' expertise areas. They can streamline their research, avoid duplication and share their experience, methodologies and data, and profit from each other's infrastructure. And then – every scientist has experienced this – there is something special about a group of enthusiastic individuals. It is a feature of human nature to orient oneself to the intellectual level of the best, which raises the capacity of all. Self-assembled successful networks are invaluable, money cannot buy them.

However, such networks cannot happen of their own accord. A national funding organisation cannot finance international consortia, nor can the European Commission respond to spontaneous proposals from individuals. But ESF can. ESF has the expertise and the machinery to assess the quality of the proposals and confirm the validity of the scientific approach, and the mandate to approach the funding organisations to commit themselves to fund the collaboration. The money stays in individual countries, but we coordinate the networking activities that enable the scientists and scholars to meet, exchange ideas and learn from each other.

This booklet provides you with highlights of the activities of the European Science Foundation.

Professor Marja Makarow,
Chief Executive,
European Science Foundation

Nature's lessons for engineers

What keeps a fruit-fly in the air, or a cockroach on the move? How does a spider spin its web 600 times its own length or sense the slightest movement of air through a single hair on its leg? The answers begin with biological mechanisms measured only in millionths of a millimetre and teams of scientists from Europe and the US have begun to work together to learn from them.

Nanotechnology is – for the moment – barely distinguishable from science fiction but nanoscience at least can frame the most interesting questions, and point to lessons from nature. "The classic is the cockroach," says Patrick Bressler, Head of Unit for the ESF's Physical and Engineering Sciences. "The cockroach can walk around, with a decentralised system controlling each leg. It doesn't have the one central brain that will tell each of its legs how to move. Whereas if engineers were to build such a system, they would work with a central processing unit, and they would produce a whole lot of sensors, and they would be measuring the legs – but it's all very complicated. Existing robots cannot crawl over hills and insects can."

> "Nanotechnology is hyped up. There is a classic saying that people who know about it don't talk about it and those who talk about it know nothing about it."
>
> **Dr. Patrick Bressler,**
> *Head of the Physical and Engineering Sciences.*

So in June 2008 the ESF staged a workshop in Sicily of 35 European researchers and 20 from the US National Science Foundation to contemplate the marvels of biological actuators and sensors. How, exactly, do creatures fly? What sensors do birds and insects need to measure their position, wind speed, roll and pitch? The questions come from biology, but the answers must be unravelled by mathematics, systems modelling, and engineering.

"Aeroplanes are built with rigid wings. There are no animals with rigid wings. They all adapt and move, so there is a lot to learn. Animals have had a couple of billion years of evolutionary improvement to come up with those solutions, so you can learn a lot from them," says Dr. Bressler. "But engineers can fine-tune and optimise the system much better than nature would, because nature would not build a fly just to fly, but also to reproduce, to drink, to suck up water, whatever it needs to do to be a live animal, so that it is a compromise of all these tasks. Engineers can build an aeroplane with one sole task: to fly, to carry a payload, whatever."

The challenge that began at the ESF's biologically-inspired sensors and actuators workshop is to bring together communities from different disciplines and forge new ways of thinking, and new technologies, by combining lessons from nature with nanoscience, the fundamental understanding of processes at the molecular level. Bressler is cautious about claims for nanotechnology. "Nanotechnology is hyped up," he says "There is a saying that people who know about it, don't know how to talk about it, and those who do talk about it know nothing about it. I hate to use the word nanorobot because it conjures up images from science fiction. But when you structure certain molecules to have specific functional pathways, you have produced nanomachines, or nanorobots. To combine this with biologically-inspired engineering is exciting new science. It is unknown territory, and so it evokes fear and public distrust. But ESF's role is to help scientists avoid publicity traps by encouraging clear and open debate, and to foster these emerging sciences on an international, or at least a European, scale."

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Who do you think you are

Descartes defined his consciousness by saying: “I think, therefore I am,” but left a number of questions unresolved. The biggest of these, the nature of consciousness itself, is to be re-examined by a collaboration of European and American neuroscientists, philosophers and psychologists, with a little additional help from children, macaque monkeys and some brain-scanning equipment.

The collaboration is called Consciousness in a Natural and Cultural Context. “It’s about consciousness; it’s about the sense of who you are as a self, and about who you are as an agent, as someone who is acting,” says Dr. Eva Hoogland, Programme Co-ordinator for the Humanities Unit. “These things seem to be self-evident, but you can easily trick people.”

She cites the rubber hand illusion. “I rub your hand with a little soft thing, only you cannot see your hand, because it is behind a screen. What you can see is a rubber hand, like a doll’s, which is being stroked at the same time. The volunteers in the experiment experience the rubber hand as their own, as the visual information is combined with the touch information.” Such experiences have been confirmed by brain scans of premotor cortex activity. “It raises not only neurological questions on how our brains constitute reality, but also more subtle philosophical issues regarding human identity and awareness,” she says.

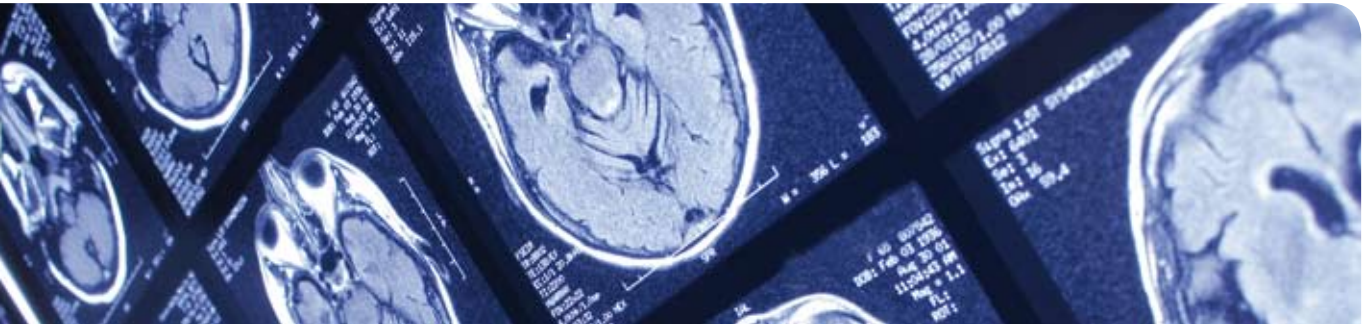
Another experiment in the programme involves a phenomenon called choice blindness. Present a subject with two pictures of faces, and ask for a preference. Then hand the picture to the subject and ask why it had been the choice. “You come up with all kinds of reasons: because she has lovely hair, or her eyes are so beautiful. But the trick is that I gave you the wrong picture. I gave you the one you did not choose. Still, you can come up with all those reasons why you preferred that picture.”

> “It’s about consciousness; it’s about the sense of who you are as a self, and about who you are as an agent, as someone who is acting.”
>
> **Dr. Eva Hoogland,**
> *Programme Co-ordinator for the Cognitive Sciences.*

Experiments like these raise questions about the nature of self, and the nature of control. “It has got to do with who I feel I am; it has also got to do with the actor, but sometimes I feel that the one who is acting is not me. So who am I?” asks Dr. Hoogland.

Philosophers have been asking such questions for two millennia. Neuroscientists have been asking such questions for 20 years. A cross-disciplinary approach to such ancient questions could pay dividends. Nobody expects a straightforward answer to the puzzle of consciousness. But scientists working with different disciplines might certainly frame some interesting new questions. “I hope the answer will be that this is indeed the right approach: bringing experimental people together with conceptual philosophy,” says Dr. Hoogland. “If we can get evidence for that, I will be very happy.”

www.esf.org/human



The shape of things to come

Europe is taking a new shape, and European scientists aim to watch it happen. They plan to measure Scandinavia on the way up and the Anatolian plateau on the way down, the shifting of the sediments in the Danube basin and the steady rise of the Alps. They want the big picture, and they want to catch the changes as they happen, from the tip of Spain to the Urals. They want to watch Mediterranean basin as it shrinks, and the mountains of Norway – once crushed by the glaciers of the last Ice Age – rebound towards the heavens.

TOPO-EUROPE is a concerted attempt to observe a continent that is going places, in very slow motion. The detailed and increasingly meticulous observation of geological change in Europe began in the late 18th century: what is new is that for the first time, the attempt is now concerted across a whole continent. Teams of researchers who had been mapping change in the Iberian peninsula or the Rhine valley or the Greek islands have just agreed to pool their data, their resources and their methodologies to complete a picture not just on their own territories but on the continent as a whole.

The programme will harness seismic and satellite data, sedimentary studies, oil company observations and rock corings to create a study of Europe in depth – all the way through the rigid crust to the viscous mantle on which the continent rides, like a biscuit on a dish of treacle – and over time as the tectonic plates beneath the continental crust edge across the globe.

"The processes are incredibly slow but they are using all kinds of satellite tools and GPS, and with laser-based measurements you can actually see the continents move; you can resolve movements of a centimetre or so a year," says Dr. Kai Rankenburg, Co-ordinator of the research programme for ESF's Life, Earth and Environmental Sciences Unit. "We know exactly, today, how the plates are moving but the construction of the past is a different story."

One of the many projects fitted into the jigsaw puzzle of co-operative research is called Source-Sink: geologists would like to trace the journey of a particle of rock from the mountainside from which it was first dislodged by rain or frost, all the way to the ocean. "This will give you an idea how topography not only is created, but how it is eroded with time," says Dr. Rankenburg. "How do you trace a grain of sand from the Himalayas to the ocean?"

The big question behind TOPO-EUROPE is a simple one: how do the contours of the continent affect wind, currents, rainfall, glaciation and snowfall, with the additional hazards of avalanche and landslide, and the intermittent impact of earthquake and volcanic eruption? The research could save lives, protect property, influence planning decisions, and even answer the question of whether Europe is getting smaller or bigger. The immediate outcome, however, is likely to be decided not by slow tectonic movements, or by barely perceptible topographical uplift or erosion, but by the direction of future climate. "Two thirds of the world is water," says

Kai Rankenburg. “If the glaciers are melting, Europe will get a lot smaller.”

TOPO-EUROPE will identify which parts of Europe are subsiding, which are rising, and can pinpoint the most vulnerable coastlines with great precision. But over longer periods – geologists and geophysicists tend to think in tens of millions of years – the future remains uncertain. Geophysicists have long known about isostasy, the natural process in which the mountains subside as the viscous mantle far below gives way, like a mattress under a sleeper, or bounces up again as a weight is removed. But the granite uplands of Scandinavia, once crushed by the weight of huge glaciers during the ice ages, are among the few places in the world where they can study isostatic responses directly. The broad Rhine valley between Strasbourg and Mulhouse in France is an enduring reminder of an east-west rift in ancient Europe that began suddenly, and equally suddenly came to a mysterious halt: the sediments that slowly filled the fissure may reveal some unexpected secrets.

Other evidence will ultimately be destroyed by the invisible forces that shape the planet. The African tectonic plate is pushing against Europe, heating the rocks under Mt Etna, Stromboli and Vesuvius, and buckling the crust to the north. Geologists long ago identified the suture in the Alps where two geological entities collide, and two completely different strata of rock push against each other. Along that line, they boast, they can stand with one foot in Europe, another in Africa. In the eastern Mediterranean, island arcs formed long ago as the debris of profound and still uncertain subterranean processes.

“The Alps are still rising. The Mediterranean that we see now is a remnant of a much larger ocean called Tethys. It is now closed and will eventually be gone,” says Dr. Rankenburg. “It is just a matter of time, and then there will be no more beaches.”

> “Two thirds of the world is water. If the glaciers are melting, Europe will get a lot smaller.”
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> **Dr. Kai Rankenburg,**
> ***Programme Co-ordinator for the Life, Earth and Environmental Sciences Unit.***

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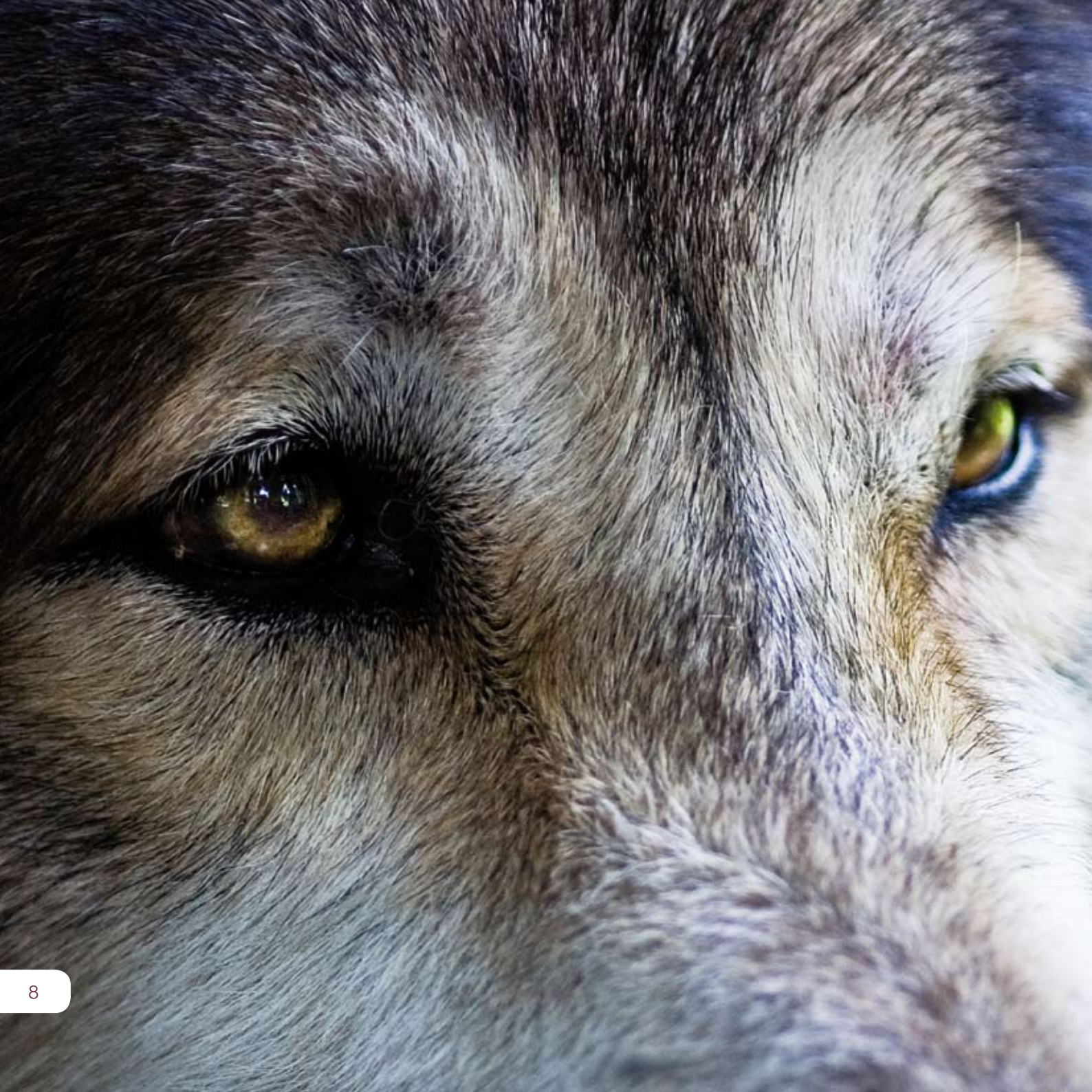

A thought for another species

Keep a close eye upon your dog, because it is certainly watching you. Hounds and poodles and lapdogs alike show signs of being able to read their owner's intentions. This is called social cognition. Humans have it, and dogs may share it because dogs and humans have co-evolved for more than 10,000 years.

But wolves that hunt in packs also need to anticipate each other's moves. So perhaps this mysterious talent existed long before the first wolf tagged along behind a group of Palaeolithic humans during the last Ice Age. To answer such questions, researchers from 11 nations have joined forces to compare social cognition in humans, animals and even automata – robots need a rudimentary awareness too – in an ESF research networking programme called CompCog. This is short for Evolution of Social Cognition: comparisons and integration across a wide range of human and non-human animal species.

"It is an unusual project for us to fund in the social sciences because researchers working on animal cognition were sitting around the table: all kinds of people, working with horses, with wolves, and with dogs, planning to compare this with human cognition. It was truly interdisciplinary," says Dr. Frank Kuhn, ESF Co-ordinator for the Social Sciences.

> "We want to try and find the basis of social cognitive skills: that is the purpose of this network. It is absolutely fundamental for us to understand where we sit as humans within it all, in order to understand animals from a more compassionate point of view."
>
> **Professor Daniel Mills,**
> *Department of Biological Sciences,*
> *University of Lincoln.*

One member of the CompCog network is Professor Daniel Mills of the University of Lincoln, who suspects that some conditions that psychiatrists call behavioural disorders may have their beginnings in normal behaviour, taken to an extreme form. He learns from dogs, especially those that have become too dependent on human company. "If you take a traditional line like Labradors, and then start selecting them to be better pets – because people want dogs that will be more affectionate – you actually move the whole population. Even if you shift the mean by a couple of percentage points, there is a much larger increase in the extreme of over-attachment. You end up with dogs that cannot cope without human contact and become extremely distressed," he says.

"However, just because dogs behave in human-like ways doesn't mean they do it using human-like mechanisms and that is the fundamental issue that needs to be addressed."

His research could deliver fresh understanding of some human psychiatric conditions: it could certainly pay off in a more compassionate approach to animal suffering. The argument is that humans, like dogs, wolves and horses, have been shaped by the evolutionary biology, and humans share some of their social cognition with other animals. "We have to stop thinking that humans are the ultimate in everything. We are just part of biology."

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Europe beneath the waves

It occupies an area far greater than the European mainland; its biology is a puzzle, its management is a challenge, and its terrain is more mysterious than the surface of Mars. The cold, deep sea off the European coasts has been crossed by Phoenicians, Greeks, Romans, Vikings and the great navigators of Spain, Portugal, England, Holland and France.

But the ocean remains almost entirely unknown territory, and scientists, maritime agencies, fishermen, shipping lines, oil companies, research councils, national authorities and the European Commission are to come together to make a systematic and sustained study of that other Europe, the one beneath the waves. The European Commission has taken up the challenge to create EMODNET – the European Marine Observation and Data Network – in the frame of the Integrated Marine Policy for Europe; in a complementary development the ESF Marine Board presented to European and national decision makers its perspectives on what EMODNET should look like in a Vision Document (September 2008) on the art of the possible: of the political, technical and scientific co-operation required to understand the global ocean system, to explore the oceans and seas that surround Europe, and to monitor the changes in the coastal waters of the continents.

"You have to look at the oceans as a cosmos and we probably know less about the oceans than we know about space, because, even if it is very far away, you can look into space with even better instruments. But to find out what is going on in the deep ocean, in the absolute dark, that is another matter," says Lars Horn, chairman of the ESF's Marine Board and one of the directors of the Research Council of Norway. "It is extremely costly and extremely complicated and we need to know what is going on there."

Scientists, European Commission representatives and a huge network of other marine and maritime interests have begun to work towards the creation of a permanent European central bank of vast and disparate collections of data, assembled over decades and in some cases over more than a century, by individual scientists, enthusiasts, agencies and businesses. These data involve observations over time of plankton blooms, algal growths, water temperatures, salinity, pressure, pollution, wave heights, fish catches and other marine, maritime and meteorological phenomena.

Assembling this data into a coherent framework is a fundamental first step in planning new economic activities on the sea and in monitoring ecosystem health. As a result many valuable data are now inaccessible because of how, why and by whom they were collected and how and where they are now held. These datasets need to be

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unlocked and made easily accessible so that such records of change over time could begin to answer questions as yet undreamed-of.

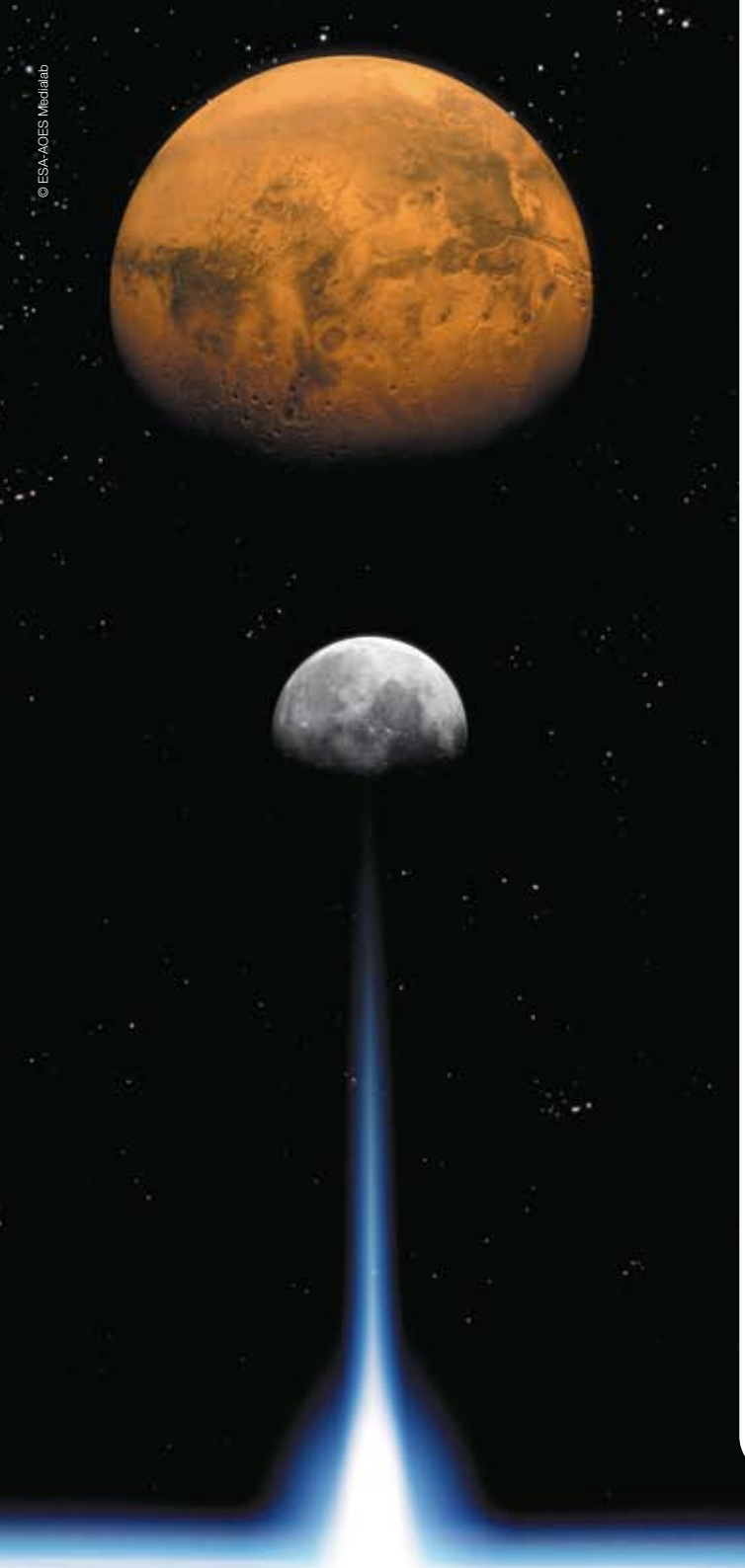
With a common pool of information, through EMODNET European marine scientists will have a basis for more systematic study of the waters that wash the European shores: the Black Sea and the Mediterranean, the Atlantic south of the Azores, the coasts of Britain and Ireland, the partly land-locked North Sea, the completely enclosed Baltic and the north Atlantic almost all the way to the Arctic. They will study the impact of the sediments, nutrients and pollutants that wash from the estuaries of Europe's great rivers; they will measure changes in temperature and water chemistry and current, they will observe the shifts in the communities of creatures of the continental shelf. Scientists know enough to be acutely aware that they need to know more, much more to adress matters such as climate and weather, safety at sea and along the coast, fisheries, offshore activities, management of the seas.

"Europe is not in good shape generally when it comes to fish stocks. If you look at the North Sea, it has been precarious for a number of years: a sorry situation," says Mr. Horn. "We are also interested in the geological conditions below the sea: corals, high pressure, high-temperature vents that affect the chemistry of the water, and the growth. We are interested in the biological chain, from the smallest things to the mammals, and in who is eating who."

The first challenge is to get research vessel and equipment owners to combine forces and see what they can share. Research ships are very expensive vessels, and many of them are already old. The challenge is to find ways of sharing both the cost and ship-time for scientists. But researchers also need to co-operate to exploit the available data from space-based satellite systems with radar signals that can penetrate the first 30 to 50 metres of the ocean waters; they should also, the ESF's Marine Board argues, co-operate in the use of remote operated submersibles, buoys, sensors and observatories to investigate the oceans – for once the cliché is appropriate – in depth.

"Because of the huge costs of putting people down there we have to have equipment that is both reliable enough and fantastic enough to find out what is going on down there," says Mr. Horn. "If Europe had a small fleet of submersibles, researchers could do an awful lot of work because they could be guided from the surface. You could charge them up, send them down and after a couple of days they could come up again. You would do spot checks, because the area is so large, but you could cover a lot of ground with a few units."

www.esf.org/marineboard



Humanity on the launchpad

Neil Armstrong called his small step on the moon in 1969 “a giant leap for mankind” but what, exactly, would such a leap mean? If astronauts and cosmonauts embarked on the long, perilous journey to Mars, how would horizons widen for humankind as a whole? There is more to space exploration than just rocket science, ESF scientists discovered when they examined the challenge of missions to Mars, the moon or Near-Earth Objects for the European Space Agency.

> “How can you sustain the pace of projects – such as the exploration and colonisation of space – that span 50, 100 years or more? It is completely misaligned with every structure society has, political, societal… That challenge alone, to develop and support institutions that span decades or even centuries, is a mind-blowing concept.”
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> **Dr. Jean-Claude Worms,**
> *Head of the Space Sciences Unit*

“We mobilised a community, we organised a series of workshops, and we came up with some recommendations,” says Dr. Jean-Claude Worms, Head of Space Sciences Unit at the ESF. “The interesting thing is that it triggered, in return, a reflection within ESF, to ask how we could go beyond the rocket science aspect of exploration. How can we launch into the human element? How can we talk about humans exploring the solar system?”

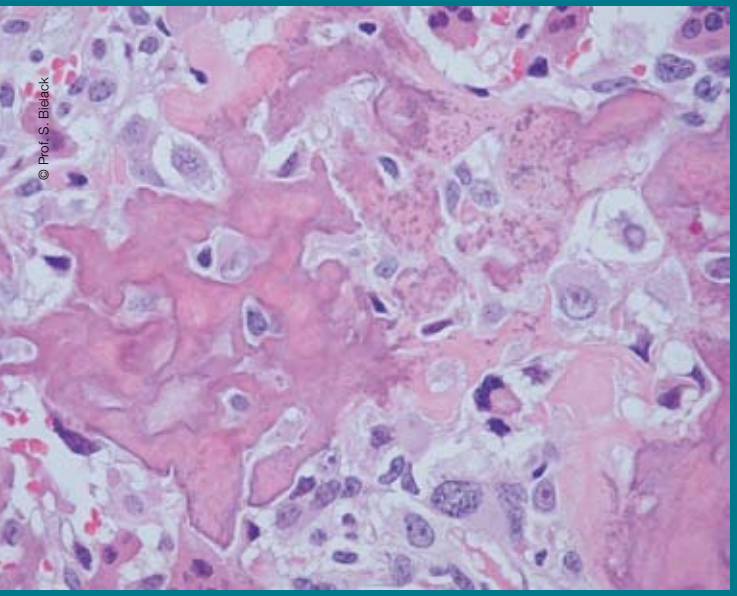
The question is an old one. In Micromegas, Voltaire sent citizens of Sirius and Saturn to search for life on Earth; in The War of the Worlds, HG Wells dreamed of a Martian corporate bid for the blue planet and in 2001: A Space Odyssey, the science fiction author Arthur C Clarke and the film-maker Stanley Kubrick dispatched some unlucky astronauts and a malevolent computer to a strange encounter with an alien intelligence near Jupiter.

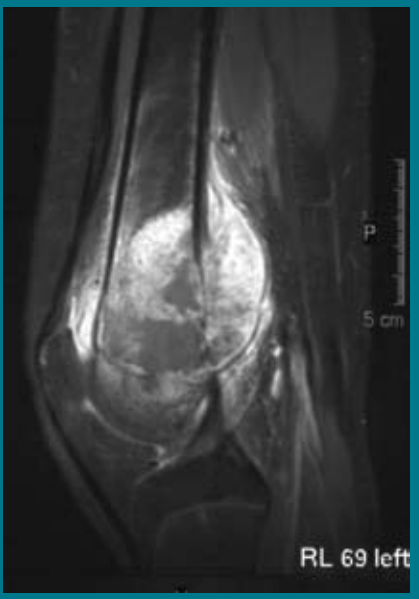
But this time, it is different: humans are planning a return to the moon, and a giant leap towards Mars, and the search has begun for habitable planets around distant star systems. The ESF scientists began working with ESA to see what the social sciences, the life sciences and the humanities could offer, and then prepared an international conference on humans in outer space, called Interdisciplinary Odysseys.

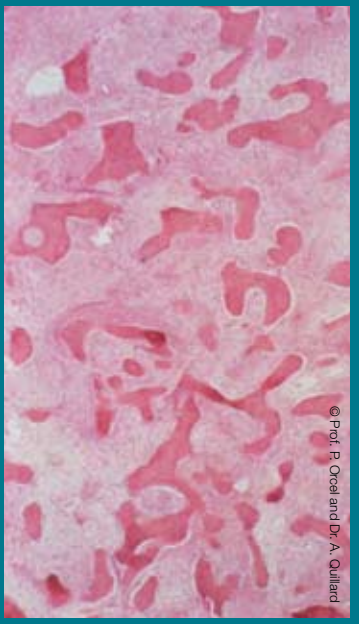
"We have had so many interesting ideas: cosmic perspective and social and political case for human space exploration; ethical distribution of risks and benefits in connection with space exploration; what happens to religious faith if we find extraterrestrial life; will that shatter the religious beliefs of people down on earth or will it just be business as usual?" says Dr. Worms.

"There are more down to earth topics to be discussed in the social sciences, such as the legal aspects. You go to the moon, you start to establish bases. What is the legal basis for that? You have colonies, what happens with the law there? Who deals with what? Who is in charge? If people are born there, will that create a paradigm shift in civilisation? Will these places become specific branches of human society that will develop on their own? There are many, many ideas out there.

www.esf.org/essc



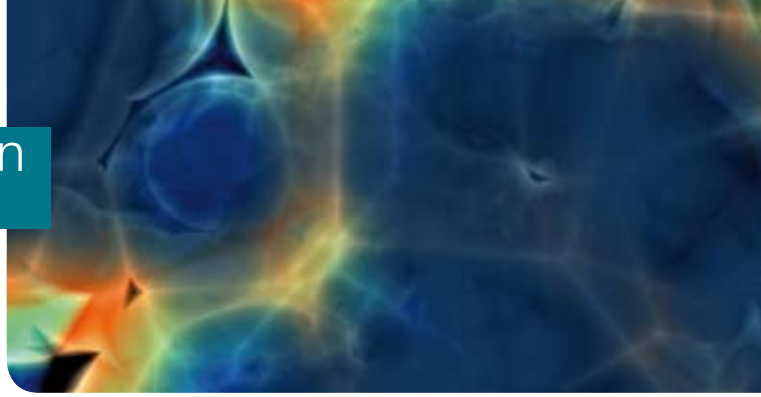




Top: Osteosarcoma of the left knee visualized by histological section and Magnetic Resonance Imaging (MRI).

Bottom: Fibrious dysplasia of the femur before and after a 4-years bisphophonates treatment, and histological section.

Why overcome the burden of pan-European trials?



Osteosarcoma is a rare and potentially lethal form of bone cancer in children and adolescents. Fibrous dysplasia is even rarer.

Rarity is part of the problem: the more patients with a chance of survival, the greater the likelihood that pharmaceutical companies will put money into clinical trials of new treatments. In the sorry economics of suffering and death, osteosarcoma and fibrous dysplasia are known as orphan diseases[1], partly because no wealthy pharmaceutical company wants to "adopt" them, and partly because the incidence is so rare that there are too few patients in any one country for tests that will produce statistically reliable results. Through a collaborative programme launched by the ESF, academic, researchers from across the continent have joined forces to launch two pan-European clinical trials. One, called *Euramos*, is supported by the Osteosarcoma group, and more than 1,000 patients have been recruited so far in 200 clinical centres in 13 European countries as well as the U.S. and Canada. The second, called *Profidys*, is aimed at recruiting 160 patients at 11 centres in five European countries.

> "It was only because of a little money that ESF Member Organisations put towards this research that Professors Stefan Bielack and Philippe Orcel could network, and meet to decide how they could develop the respective clinical trials."
>
> **Dr. Carole Moquin-Pattey,**
> *Head of the Medical Sciences Unit*

"The principal investigators of these two clinical trials had to face a changing regulatory situation, a lack of common funding, the access to drugs, everything was a problem, and it was only because of a little money that ESF Member Organisations put towards this research that Professors Stefan Bielack and Philippe Orcel could network, and meet to decide how they could develop their respective clinical trials," says Dr. Carole Moquin-Pattey, Head of the Medical Sciences Unit at ESF.

For every million people, there are five or six cases of osteosarcoma a year. Surgery is the standard treatment, but the clinical trials are aimed to investigate whether a new therapeutic approach with a course of chemiotherapy increases the chances of survival and decreases the damaging side effects. To produce reliable results there is a need to recruit the adequate number of patients in the trial.

Euramos will ultimately involve 1400 patients. Fibrous dysplasia is a very rare disease with no known cure, but the Profidys partnership hopes to enlist at least 160 patients, many of them children, to provide reliable data about the safety, efficacy and tolerability of treatments to reduce the pain. The pan-European clinical trials collaboration is a mandatory to offer fresh hope to thousands of families.

Based on these experiences, the European Medical Research Coucils (EMRC), the medical sciences unit at the ESF has launched a comprehensive foresight study aimed at addressing the issues raised by investigator-driven clinical trials. "The conclusions of the report will be published in January 2009" says Dr. Moquin-Pattey. "Orphan diseases have no interest for the large pharmaceutical concerns and this is really the role of the academic sponsor. So this has been done with a lot of energy and strong commitment from the researchers and we need to make it easier for the next round."

www.esf.org/emrc

[1] In Europe a rare disease affects less than one in 2,000 people

From pack ice to ocean crust

Aurora Borealis could be Europe's first ship. She has yet to exist, but one day she could slide down the launch slipway, with the dreams and hopes of thousands of oceanographers. Aurora Borealis is to be the world's first truly international ship. She will also be a technological wonder: powerful enough to smash through thick sea ice, and steady enough to withstand ice drift as she drills 1,000 metres into the ocean floor far below.

Tropical and temperate oceans have remained more or less tropical and temperate for most of the planet's history. But when climate has changed, the first and fastest regions to react have been the waters around the poles. So deep in the seasonal layers of mud and increasingly impacted sediment in the Arctic basin is a record of climatic change. A series of cores from these sediments could yield detailed information about the advance and retreat of the glaciers, the shifts in ocean currents, and the changes in the biosphere above.

> "This icebreaker should be able to operate on its own without any other support, and go on very long missions, operating in the polar night, putting submersibles under the ice."
>
> **Dr. Paul Egerton,**
> *Head of the ESF Polar Board*

“From its first development, this has been quite a special ship, because it will be able to drill in the deep Arctic Ocean,” says Dr. Paul Egerton, Head of the ESF Polar Board. “We have all heard about reductions in the ice cover in the summer time but in the winter the ice cover is still very severe – and we need to know about processes that go on in the winter time as well.”

So Aurora Borealis will be able to withstand the pressure of floes more than 2.5 metres thick. It will have to stand its ground against occasional icebergs much more massive, because it must stay precisely above its drilling station: if you have a powerful coring instrument down through 4,000 metres of sea and biting 1,000 metres into the ocean floor, there isn’t much room to move. The vessel’s bottom will be equipped with “moon pools” so that scientists can launch remotely operated submarines to study the seabed, and the decks and hull will house state-of-the-art laboratories for meteorologists, glaciologists, biologists, geologists and geophysicists. It will have its own 80 megawatt power station, and it will be able to undertake special missions to the Antarctic as well as the northern polar waters.

Everything about Aurora Borealis is a challenge. A consortium of 15 European partners is wrestling with the problems inherent in an international ship: who will “own” it, who will run it, and how should sea-time be shared between the partner nations? What flag should it fly? At which port should it be registered? “We pushed this for a long time within the ESF Polar Board, we developed the first science plan for the vessel,” says Dr. Egerton.

www.esf.org/epb

How to bring back a memory

Europe's computer scientists have peered into the future and identified a paradox from the past. While computer memory has multiplied exponentially, computer programmers have begun to forget some of their old skills. The consequences could one day be exasperating.

Dr. Patrick Bressler, Head of the Physical and Engineering Sciences Unit, puts the problem simply. Thirty years ago, computer scientists went to computer centres and used huge machines to write very simple algorithms in specially-devised programming languages such as Fortran, to model very complex physical systems. Twenty years ago, the first personal computers began to flood the academic and business markets, and the laptop followed. Moore's law, the aphorism that predicts a doubling of computer power every 18 months, was at work.

"Now, your hotel doorknob processor has more computing power than some of these old computers, and so the whole field of computational science has changed. Computer scientists are not running around with Fortran cards any more. You can do a lot of modelling on your laptop. So what are these university computer centres and national computer centres – the ones that aren't going down the teraflop, gigaflop route, but are providing a service for scientists – what is happening to them? Where do they go?" says Dr. Bressler.

Grid technologies – think of the World Wide Web but with an extra dimension – have begun to link such centres together, giving them unparalleled computing potential. One role of the ESF is to sponsor such "forward looks" but the future of computing is difficult to guess.

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"There are modelling scientists who would be happy to do everything on their notebook, wherever they are, even in cafés: how do they gain additional power, how do they do new science with grid technology?" asks Dr. Bressler. There is another dimension to the challenge: incorporated in the new and highly sophisticated software are sets of old codes and algorithms.

"The trick is that the original parts of the programmes were classically written by PhD students and post-docs who then went on to get new jobs. They might have written the parts in Fortran 77 or Pascal or whatever. People have adapted and copied these into larger, more complex solutions and there is no real maintenance. Take computer code from 20 or 30 years ago: it is not self-evident that people looking at it today will understand what it was and why it was written like that. You will also find people reinventing algorithms and codes that were around in other fields a long time ago," he says. "Where is this today? Where is it going? What will it look like in five or 10 years?

How do you secure the knowledge that has been put into all these programmes and algorithms, how do you maintain it and document it, when people do it for a few years and then get a new job?"

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Witnesses from the frozen North

They number about four million, they live in small communities with distinct ethnicity, tradition, and language, and they are the indigenous peoples of the Far North. In the last 10,000 years, they have evolved ways of life precisely adapted to the harsh, unforgiving, conditions of the circumpolar Arctic: by hunting, fishing, herding reindeer. They are distinguished by their variety – there could be more than 40 separate peoples in northern Russia and Siberia alone – but they are united by the threats of change. Commercial whalers, and fishermen, traders and missionaries began the process of invasion more than two centuries ago, and political pressures of another kind accelerated the changes. Vast areas were colonised by military bases, oilmen, and mining companies from the great cities to the south. Some Northern communities were cut off from their resources, and were forced to move, others fled, many were absorbed into the new settlements that grew up around them. And then – in the last decades – the climate itself began to change, the summer lengthened, and the ice began to retreat, – threatening ancient ways of life.

"This means often enough a depopulation of certain areas, going hand in hand with an urbanisation in other areas and again loss of knowledge about the ways humans, nature and animals interacted, and the spiritual world that was constituted around that interaction," says Dr. Rüdiger Klein, Senior Science Officer in the Humanities Unit of the ESF. "All those changes are rapid, are often brutal and are not recorded by the numbers of ethnographers and other travellers who visited the area in the past."

Now many anthropologists, archaeologists and social scientists have united in a massive programme to work with – the emphasis is on with – the native peoples of the North to tell their story, to explore the pressures they face, and to maintain their identity in a changing world. BOREAS is an ESF co-operative research programme that links more than 40 groups of scientists, from Europe, Canada, the U.S. and Russia.

Would this project not have happened without ESF?

"Yes, that I can answer easily, without any immodesty, because that is what the researchers tell us."

Dr. Rüdiger Klein,
Senior Science Officer, the Humanities Unit

Researchers study patterns of migration and movement; and they examine the changes in the world-view of the peoples of the Arctic with time. Indigenous communities in Russia, for instance, shared a highly developed shamanistic tradition; in the course of a century they were exposed successively to Russian Orthodox christianity, the Marxist-Leninist dialectic and most recently to Protestant evangelism of western missions. "The programme title is actually 'Histories from the North', so a strong element is making local traditions, artefacts, and narratives speak to the academic and wider public, says Dr. Klein. "That is the paradox: you have a wide variety of peoples and languages and traditions but there are elements of a common challenge, ecologically speaking in terms of the traditional environmental knowledge, and in terms of the rapid changes that those areas are subjected to."

The programme – which will run to 2010 – is a race against time. Is it fair to say that this research would not have happened at all without ESF? "Yes, that I can answer easily without any immodesty involved, because that is what the researchers tell us, and that I have no reason to doubt," says Dr. Klein. "This is a first of its kind."

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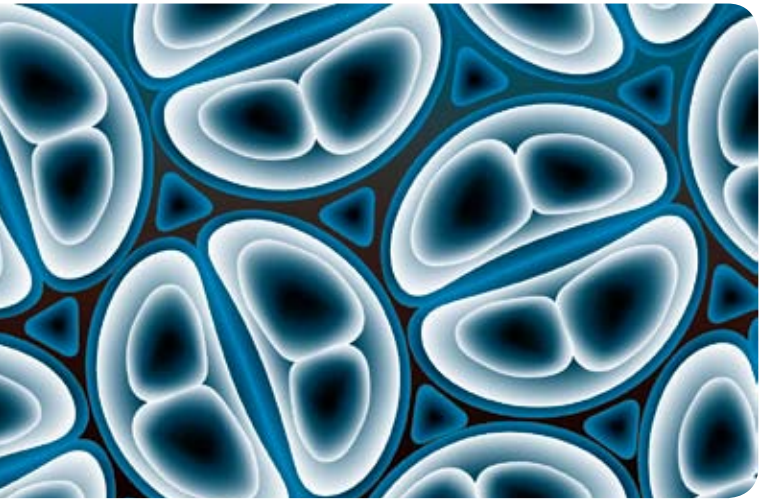

Q & A

What is the mission of the ESF?

The ESF provides a common platform for its Member Organisations in order to:

- Advance European research
- Explore new directions for research at the European level

Through its activities, the ESF serves the needs of the European research community in a global context.

How does ESF fulfill its mission?

To fulfill its mission, ESF uses strategic instruments like for instance Forward Looks where scientific experts analyse the state of the art of their research field. They predict its needs what concerns education, doctoral training, funding, collaborations and infrastructure over the next 5-10 years, and provide recommendations to the national decision makers as well as the European Commission.

Who are the ESF's Member Organisations?

ESF's Member Organisations are presently 80 research funding organisations, academies and learned societies from 30 European countries.

Is the ESF a funding agency?

ESF can best be described as a networking organisation for its Member Organisations (MOs), who themselves are often funding agencies. ESF's funding is provided by its Member Organisations. The research community benefits from the ESF through its various instruments and activities, designed to bring European researchers together to network and share their knowledge for the benefit of European research. For participants within these activities, there may be small grants available for travel etc. Thus, ESF is not a funding organisation.

Does the ESF conduct research?

The ESF does not conduct research but instead facilitates others, especially researchers affiliated with its Member Organisations, in opening new horizons in science or pushing forward existing boundaries. It promotes and facilitates pan-European collaborative and comparative efforts with a particular emphasis on interdisciplinary research. ESF does not duplicate efforts and does not undertake projects which can best be conducted at the national level.

To collaborate and participate in ESF's programmes, do I need to be associated with an ESF Membership Organisation?

Generally, you need to be eligible to apply to an ESF Member Organisation before you can be an applicant to ESF. Other researchers, including those from outside Europe, may be included, and even supported, in some of the instruments once they are launched, notably in Conferences and Exploratory Workshops. Researchers with funding to participate provided by their national (or other) funding organisation, from anywhere in the world, are usually welcome to participate in ESF activities.

What differentiates ESF from other science organisations in Europe?

- **Independence:** ESF is not tied to a national government or policy arm, and is therefore free to make decisions on scientific grounds only.
- **Expertise:** ESF has built up a high degree of expertise since its foundation in 1974 in the management of international networking and research and in the formulation of international research strategy. It has developed state of the art peer review processes. The science management staff are experienced individuals often on rotation from Member Organisations "Customer surveys" indicate ESF's style of managing its activities to be well appreciated by participants.
- **Science policy arm:** ESF's Strategic Plan outlines the vision of becoming a leading European research policy generator. This is accomplished through scientific committees, research activities, and through special instruments such as Forward Looks and Science Policy Briefings.
- **Full coverage of scientific disciplines:** No other European organisation has a similar breadth, covering natural, medical and engineering sciences, social sciences and humanities.

How do I get in touch with the ESF?

You can either call our offices in Strasbourg on **+33 (0)3 88 76 71 00** or find the person in the field you are interested in on our Contacts page **www.esf.org/contacts**. You can also find more information about the ESF on **www.esf.org**.

The European Science Foundation (ESF) provides a platform for its Member Organisations to advance European research and explore new directions for research at the European level.
Established in 1974 as an independent non-governmental organisation, the ESF currently serves 80 Member Organisations across 30 countries.

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