

The Centre Scientifique de Monaco

More than 50
years of research
excellence in the
Principality

Created in May 1960 at the initiative of Prince Rainier III, the CSM is a scientific autonomous public organization of the Principality responsible for developing scientific research. It is currently grouped into three Departments: marine biology, polar biology and biomedicine.

A multidisciplinary approach to advance
knowledge of biodiversity, environmental
management and health



Department of MARINE Biology

This department includes CSM's "historic" teams which study coral ecosystems from gene to human societies:

- Physiology and Biochemistry Team,
- Ecophysiology and Ecology Team
- Environmental Economics Team



Department of BIOMEDECINE

Linking fundamental research and applied clinical research, the department includes:

- Translational research teams, that link the results of fundamental research to clinical services
- A research funding agency for the development of clinical research in the Principality
- An observatory for the use of cord blood in the treatment of sickle cell disease.



Department of POLAR Biology

Recently established under the mantle of a CNRS European Associated Laboratory with the University of Strasbourg, this department investigates penguins as an indicator of changes in polar ecosystems.



Gouvernement Princier
PRINCIPAUTÉ DE MONACO



www.centrescientifique.mc



Department of Marine Biology

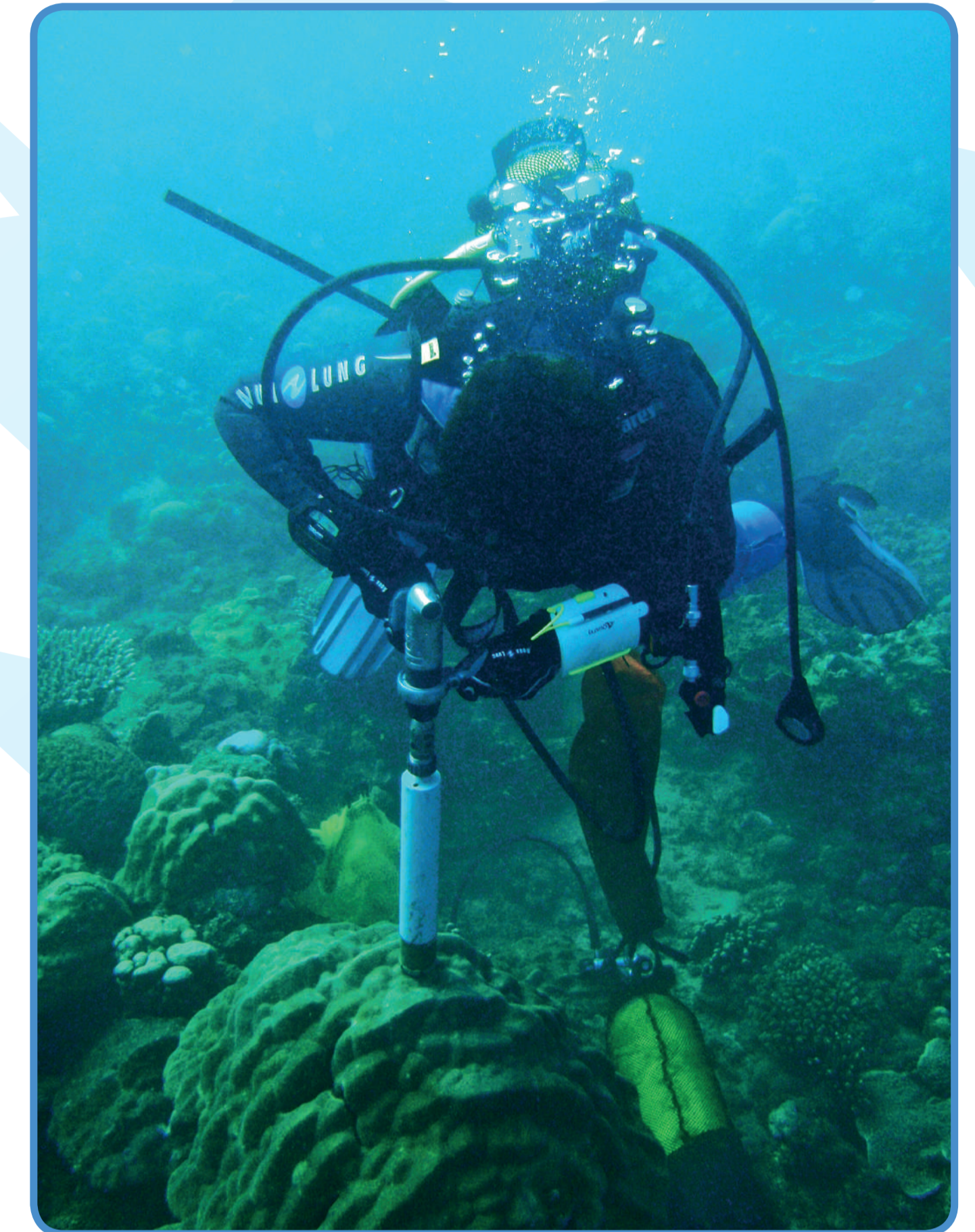
From Coral Reefs to Genes

Coral reefs are ecosystems rich in biodiversity that protect coastlines from erosion.



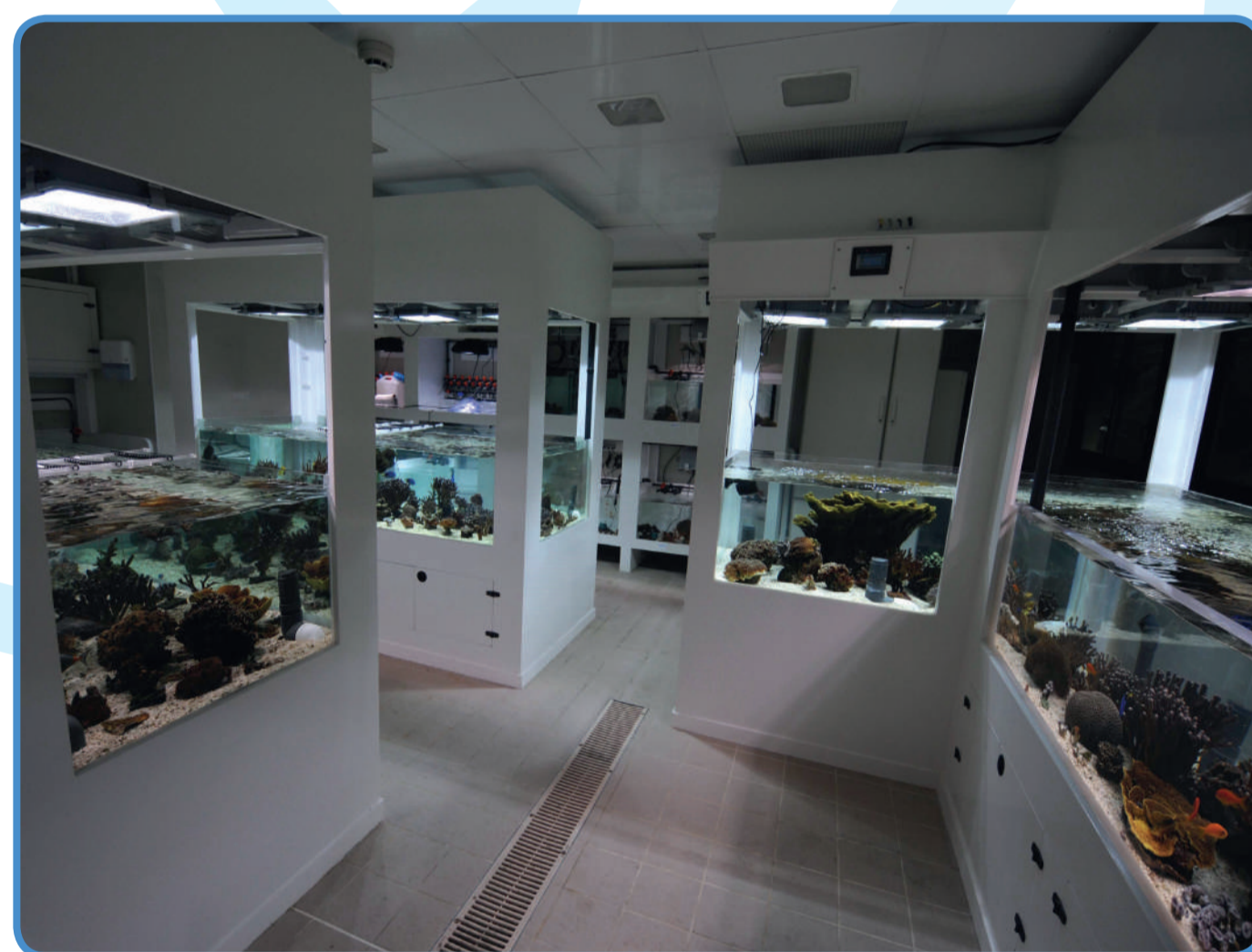
Research in the field

A team of technicians and researchers trained in field sampling, collect various marine invertebrates including tropical corals, gorgonians and deep sea corals.



From the field to the laboratory

The Centre Scientifique de Monaco has grown corals under controlled aquarium conditions for more than 25 years, establishing one of the world's most important coral cultures kept for scientific purposes. Corals at CSM are multiplied by asexual reproduction.



Experiments and analyses carried out in the laboratory

The Centre Scientifique de Monaco is renowned for its expertise in the study of symbiotic relationships between animals and photosynthetic microalgae and also biomineralization / calcification of the coral skeleton.

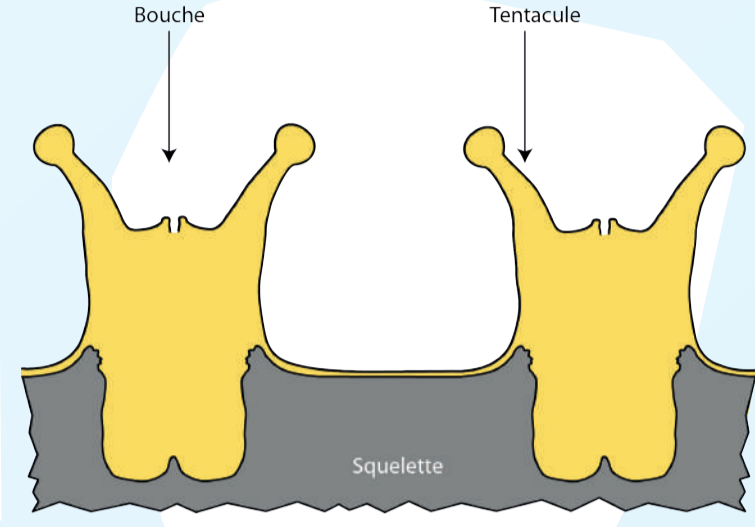
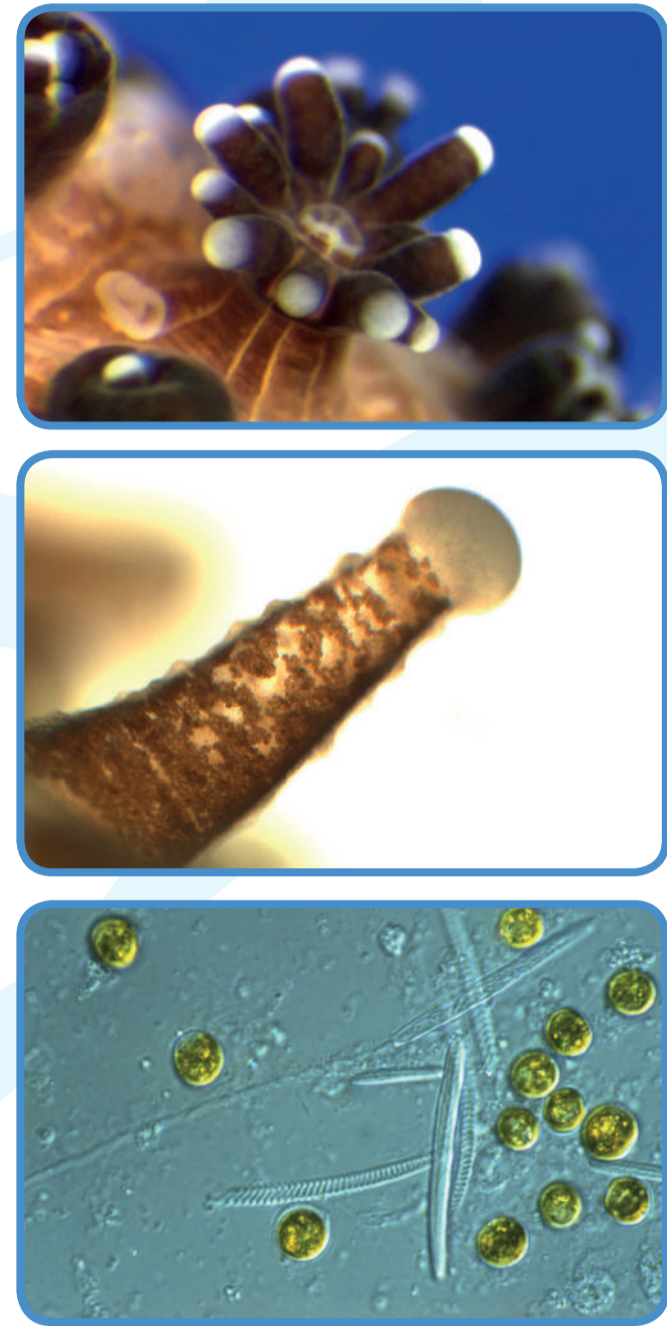


Teams utilize a wide range of techniques in ecology, physiology, cell biology and molecular biology disciplines. The impact of climate change on corals is a research priority.



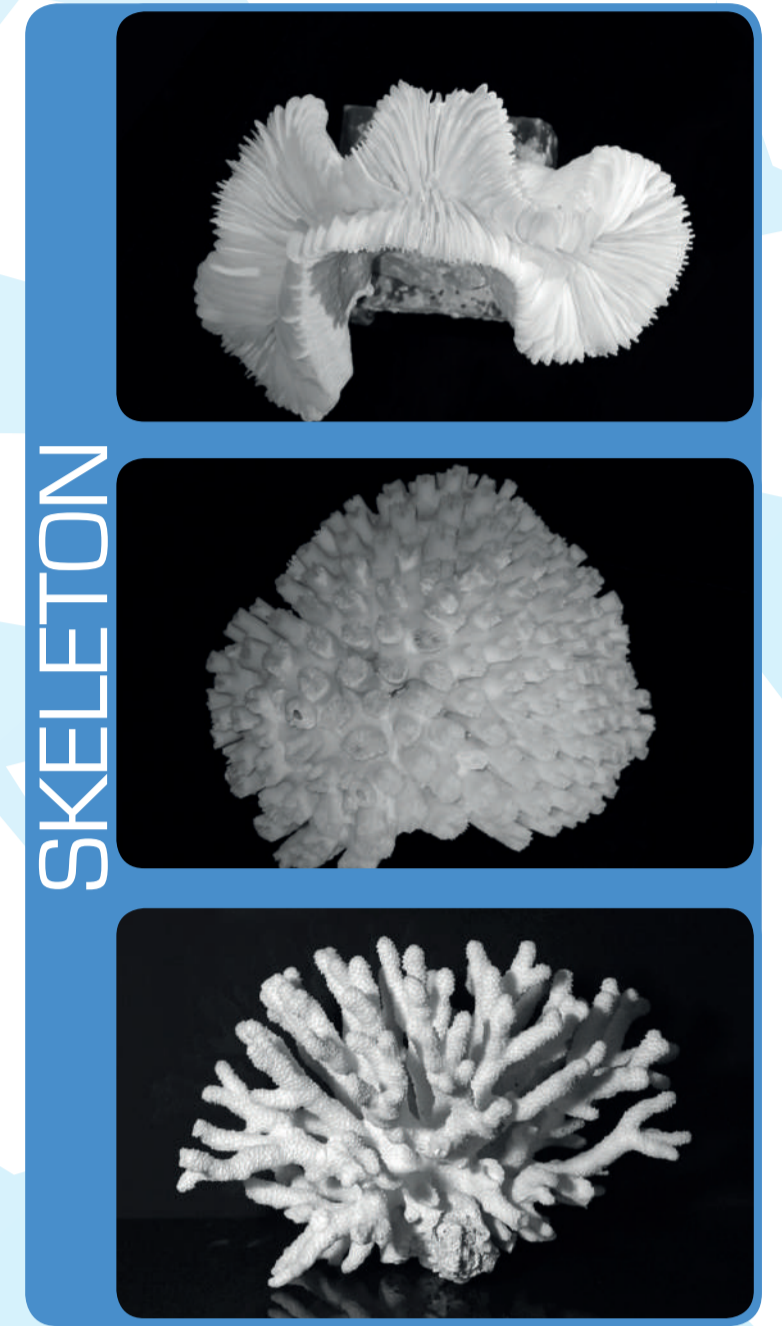
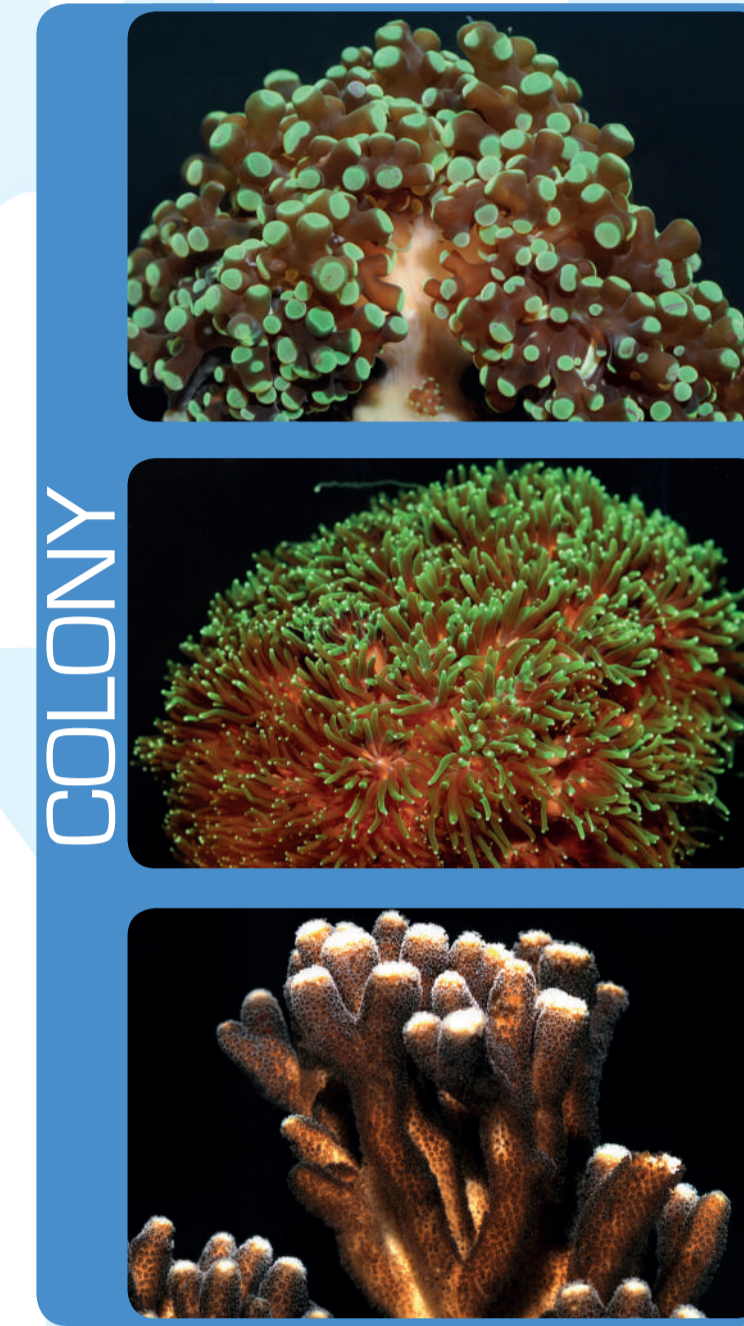
Department of Marine Biology: From Coral Reefs to Genes

The coral, a symbiotic animal



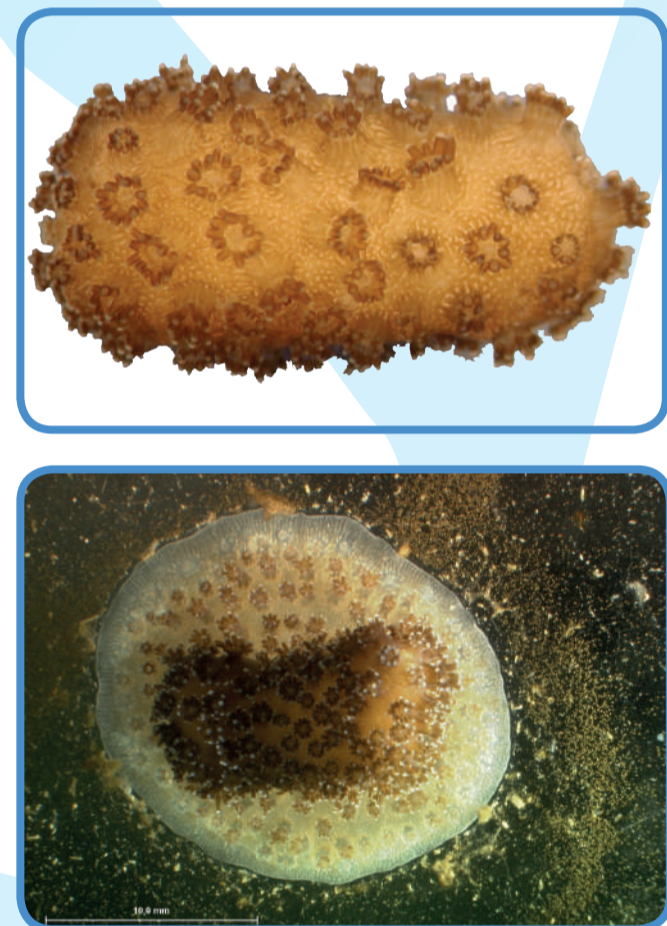
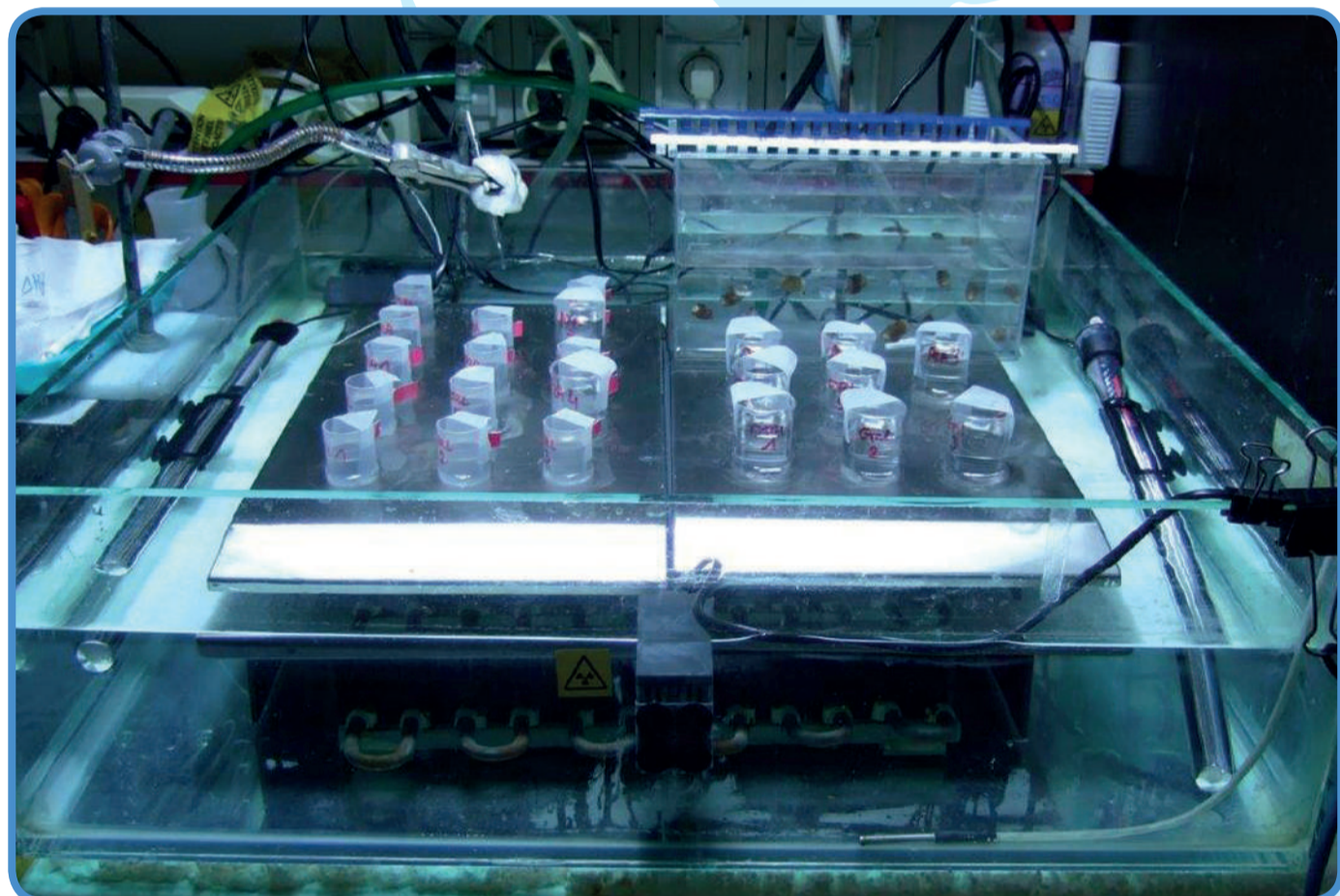
The coral is a colonial animal, that is to say that thousands individuals (polyps) connected to each other to form a colony. Corals live in symbiosis with photosynthetic microalgae which it houses within its cells.

The coral, a calcifying animal



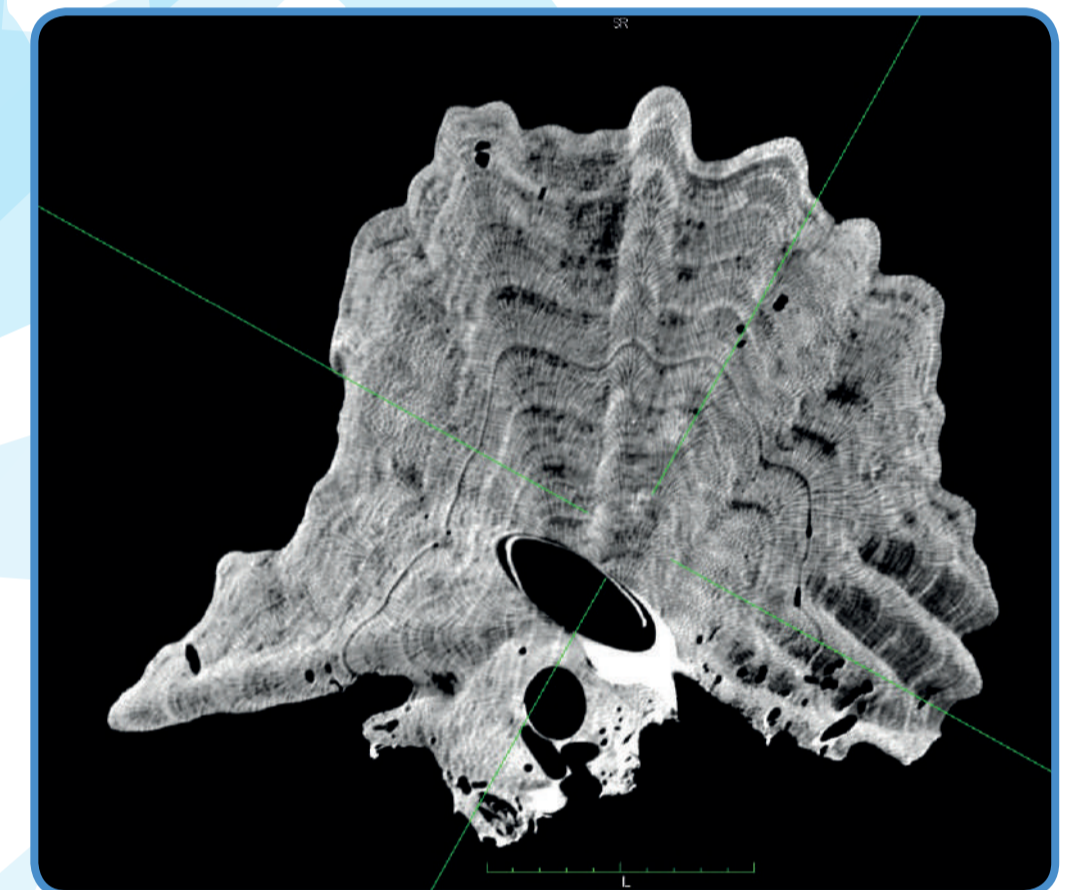
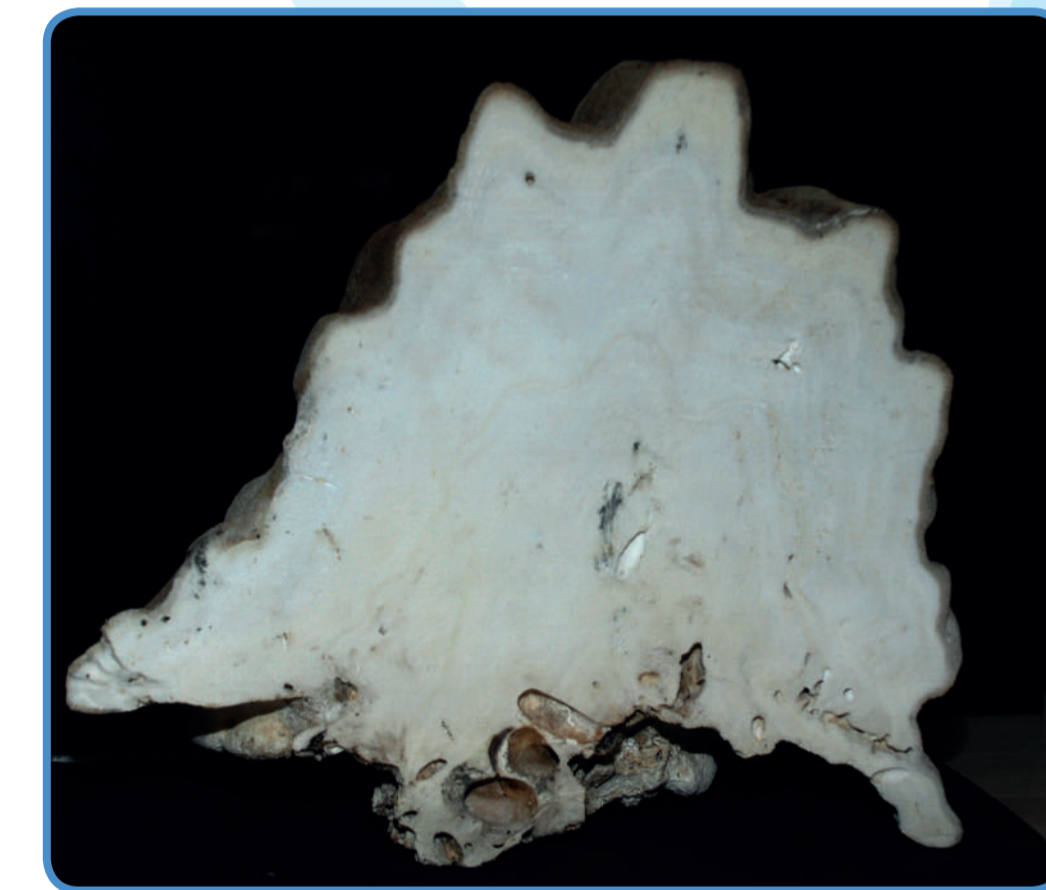
Corals have a dual mode of nutrition: autotrophic by the nutrients it receives from symbiotic microalgae and heterotrophic by predation (plankton). Coral produces an external limestone skeleton, which over time forms the reef.

Coral nubbins for physiological investigations



Coral "cuttings" or "nubbins" are prepared for experiments. X-rays of coral skeletons can reveal environmental events that have affected growth during the life of the coral.

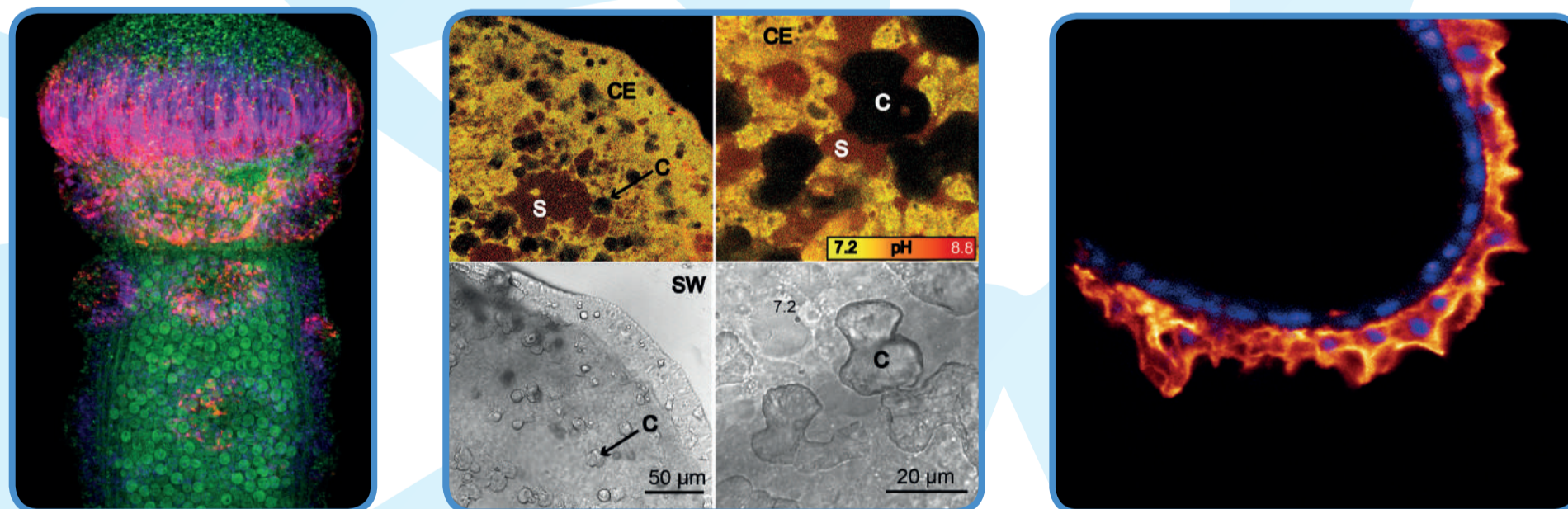
Life histories reveal by x-ray



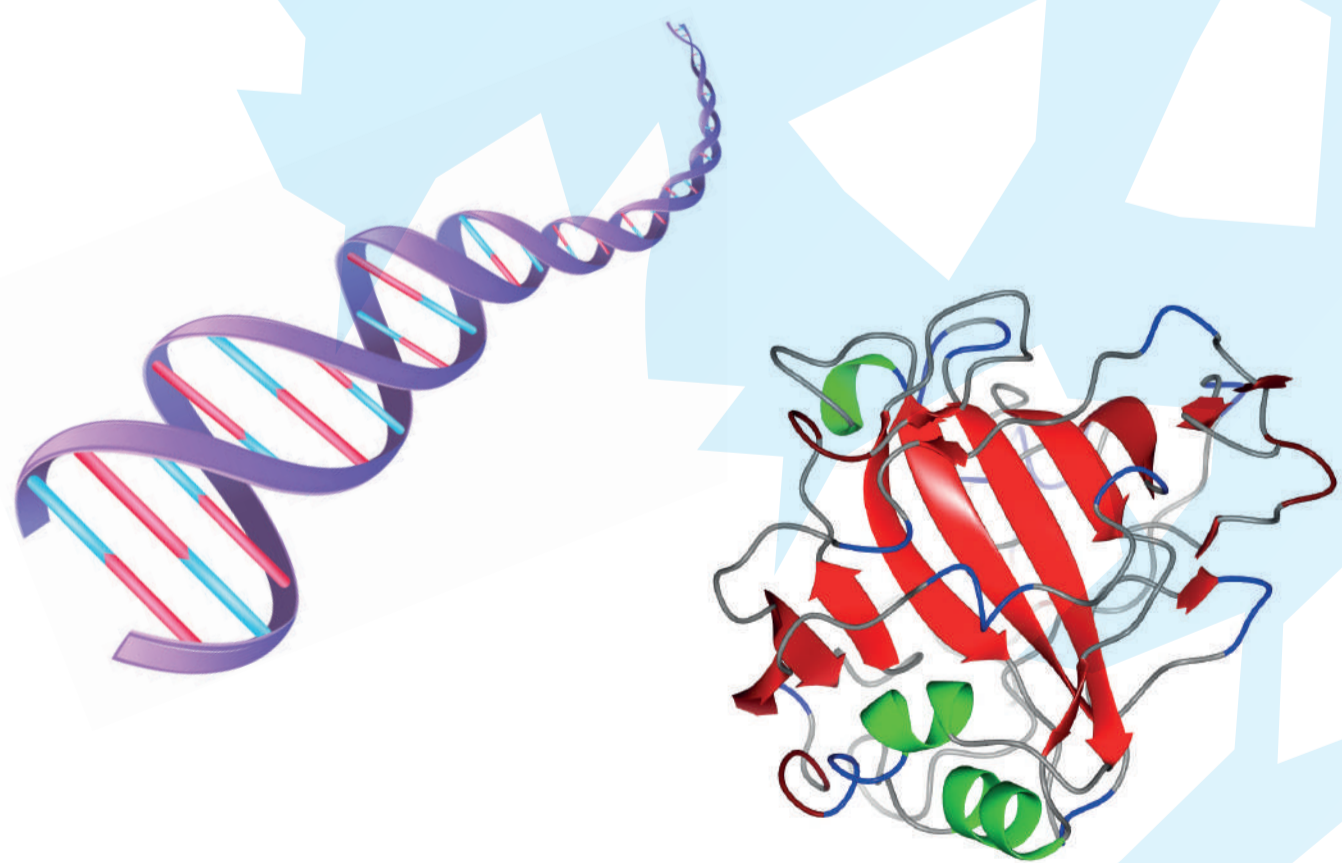
Skeleton and his X-rays

Cellular details revealed by confocal microscope

This approach provides insight into the health of a coral at a cellular level.



Gene expression and molecular biology



In collaboration with the European Molecular Biology Laboratory and the King Abdullah University of Science and Technology, the CSM is sequencing the genome of a number of corals.



Identification of genes and analysis of their expression allows us to determine their function.

Environmental Economics

Environmental Economics examines the socio-economic implications of global changes and evaluates recommendations for policy makers for the aim of sustainable development.



Department of Biomedicine

Combating Cancer in Monaco

SAS Prince Albert II of Monaco,
Honorary President of EORTC



The Sovereign replaced the Royal Princess Astrid of Belgium in February 2014 in the role of Honorary President of the European Organization for Research and Treatment of Cancer.

Cancer research at CHPG



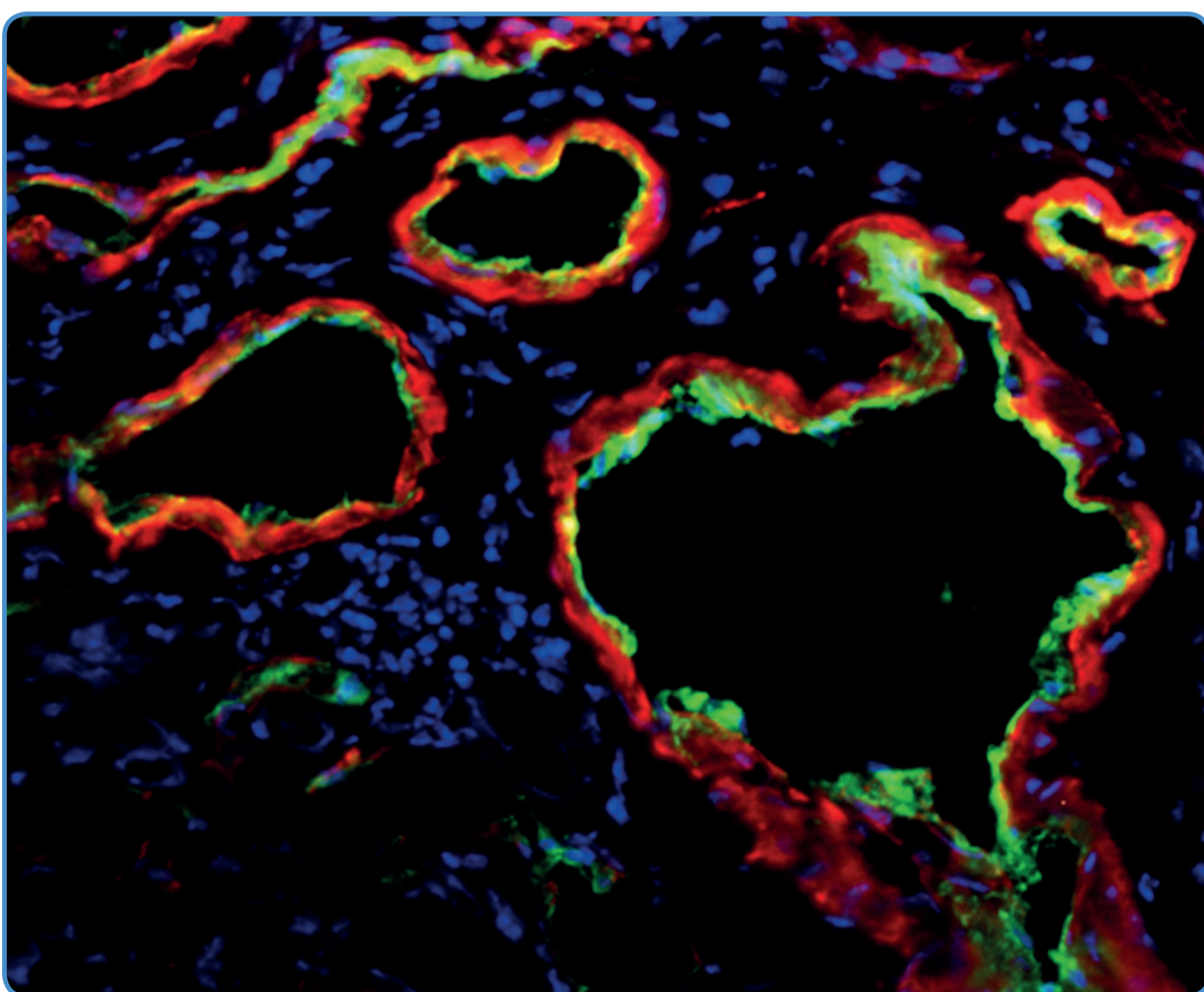
CENTRE HOSPITALIER
Princesse Grace

The CHPG has specialized in cancer for many years. The range of disciplines available on site, collaboration with societies and links with various companies and industries allows the patient to have access to the most innovative strategies in oncology.

Cancer Research at CSM

Tumors and blood vessels

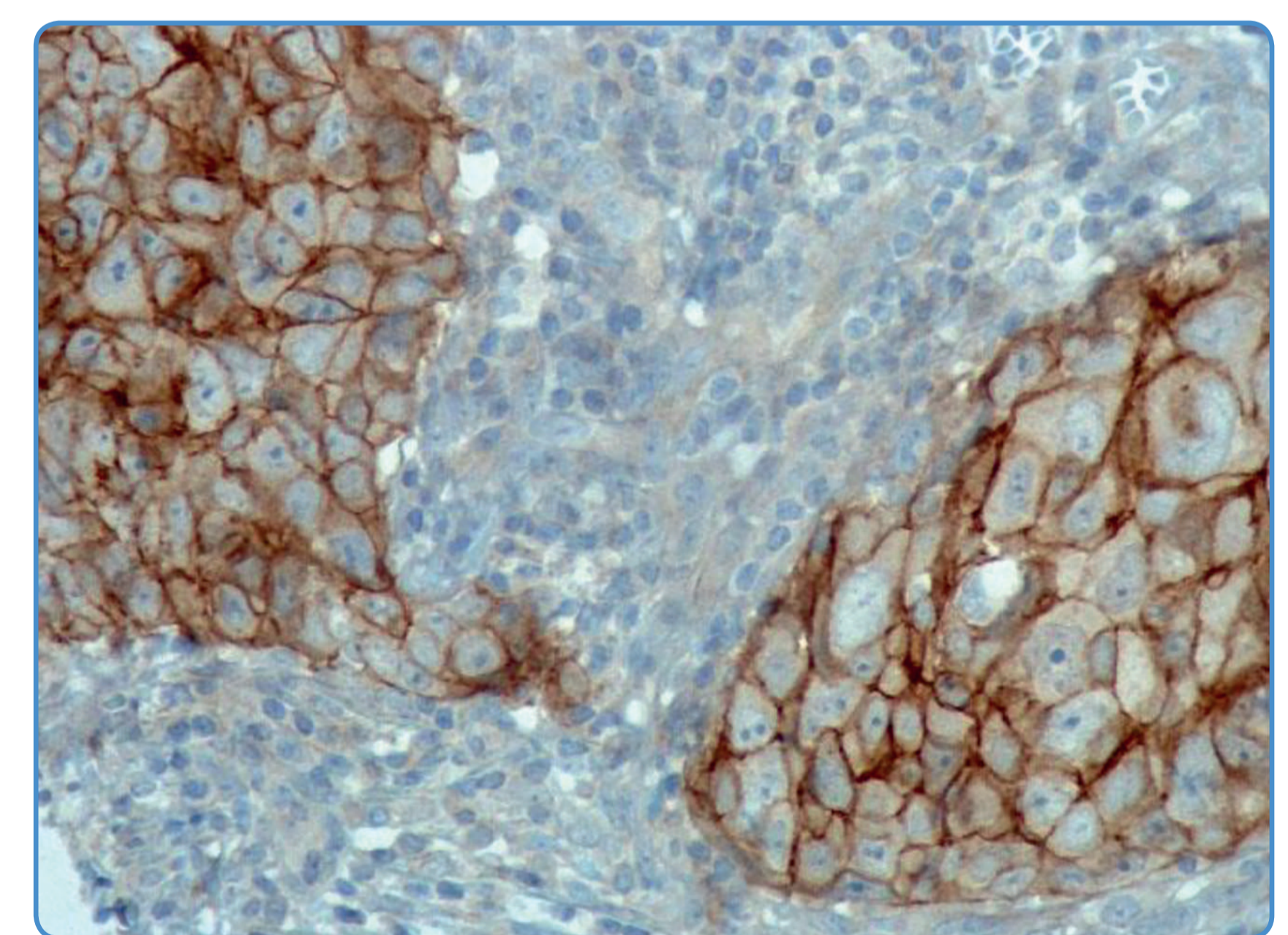
An avascular network develops in tumors to supply oxygen and nutrients. Therapies targeting this vasculature may contain the progression of certain tumors.



◀ *Tumor blood vessel cells stained in red and green in a section of a renal tumor.*

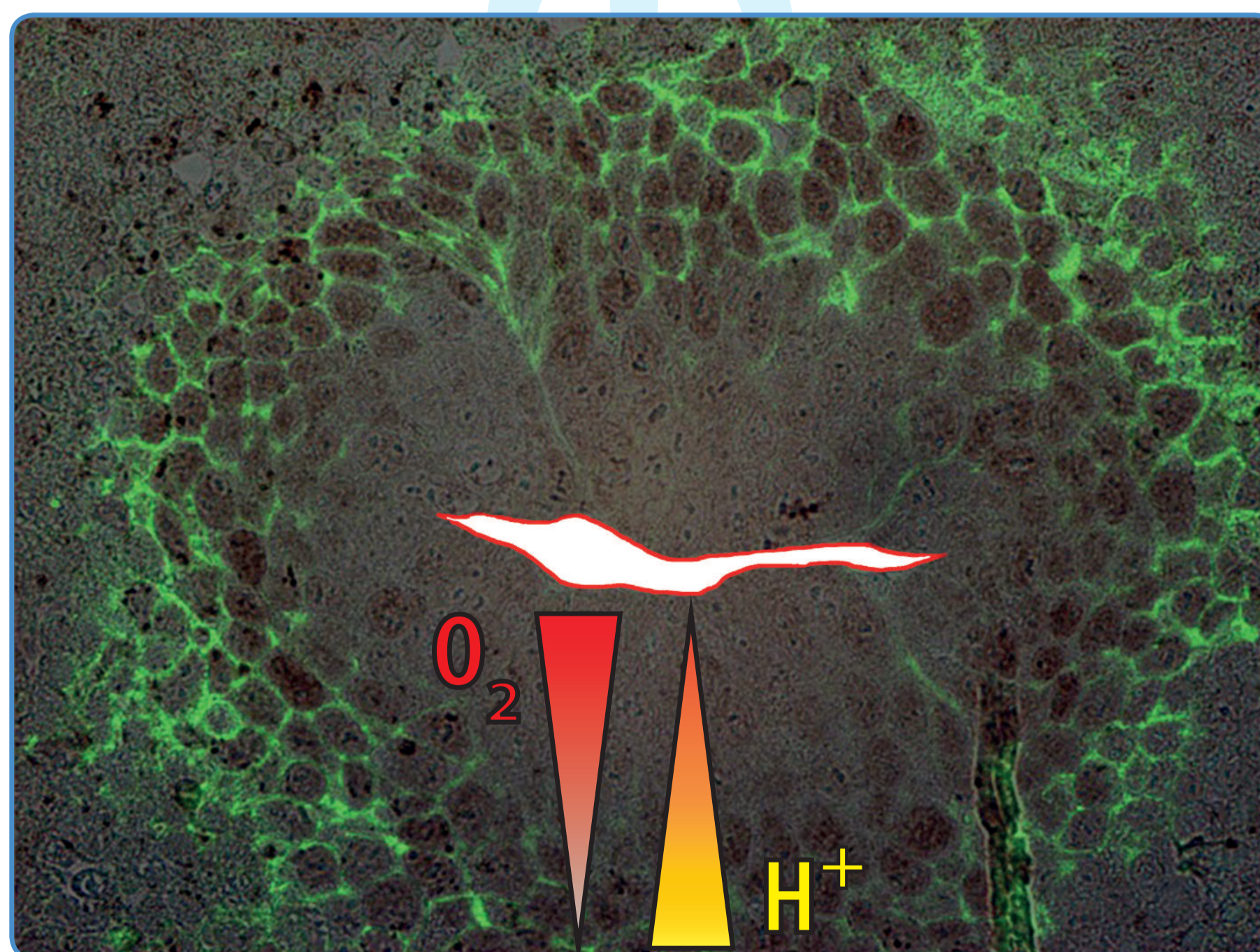
Tumor metabolism

The highly active metabolism of cancer cells consumes oxygen and acidifies their environment. Mechanisms that allow cancer cells to adapt to this hostile environment are therefore promising therapeutic targets.



▶ *Expression of the marker of tumor aggressiveness MCT1 (brown) in section of a breast tumor.*

▶ *Blood vessel supplying a tumor. Oxygen and pH gradients revealed by the green stain occur from the vessel lumen (white, center) to the periphery.*



Department of Biomedicine

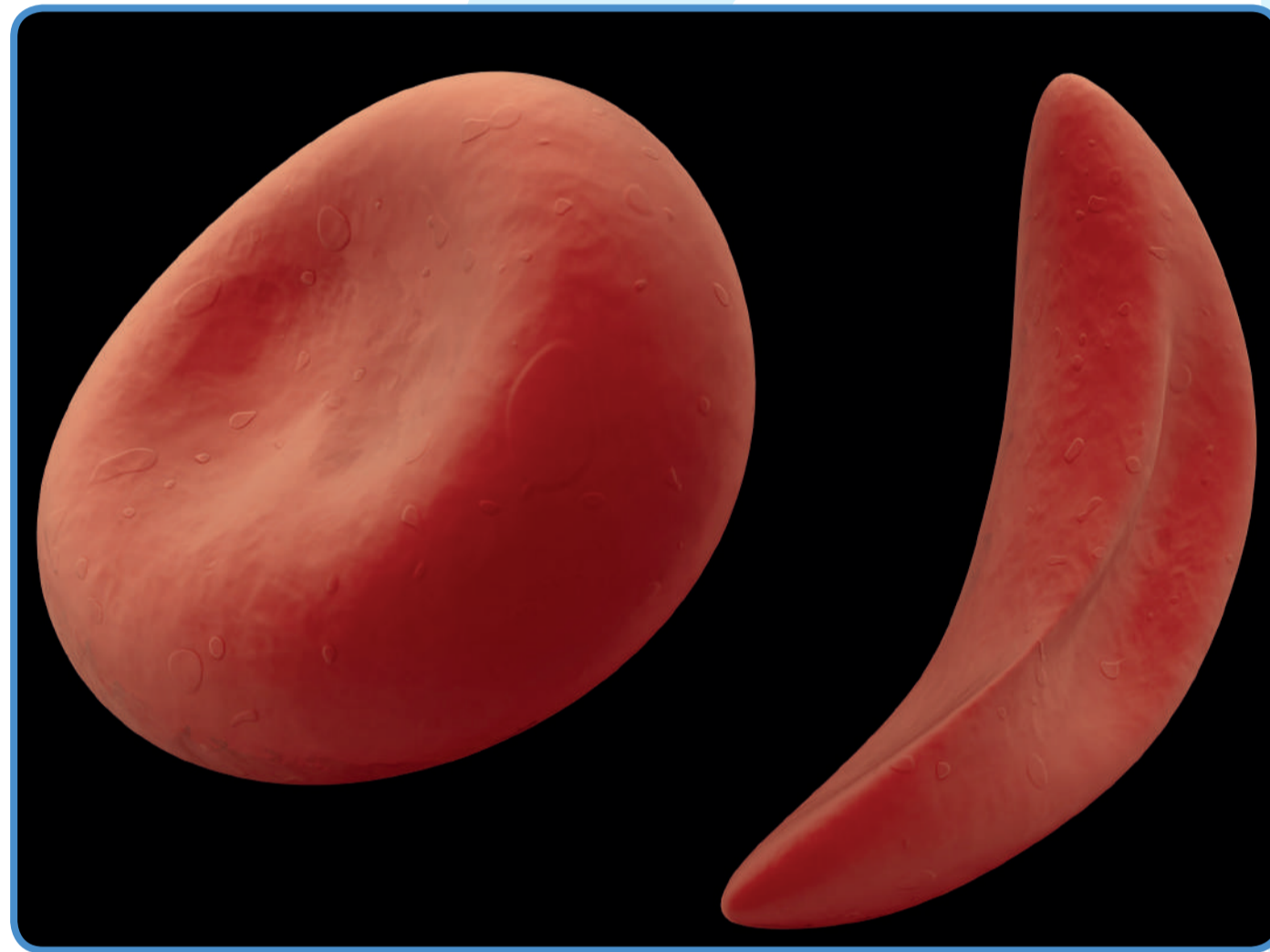
The partners of CSM

Monacord



In partnership with the Centre Scientifique de Monaco, Eurocord developed the project Monacord. It aims to establish an "International Sickle Cell Observatory" whose main objective is to coordinate research on the diagnosis and treatment of this disease.

Sickle cell disease (SCD) is a hereditary disease affecting hemoglobin, which transports oxygen in the blood. The most severe forms of SCD can be treated by transplants of marrow or umbilical cord blood.



This is a disease that mainly affects people from sub-Saharan Africa. Monacord implements cooperation between developed and developing countries in order to facilitate access to treatment for the sick.



Environmental Health



The Institute Pasteur, the Prince Albert II of Monaco Foundation and the Monaco Scientific Centre have teamed up to bring together the world's leading experts every two years in order to discuss **the consequences of changes in environmental factors on human health.**



The first edition of this symposium was held on 23 March 2012 and was devoted to the consequences of environmental change on disease vectors (spread by animals and insects).

The next edition of this conference will be held on 8 and 9 October 2015.



Presented for the first time on March 23 2012, the "Prince Albert II of Monaco and Institut Pasteur Prize" is given every two years to a renowned researcher who has made a significant contribution to the field of environmental and human health (Professor Michelle Bell was the first recipient of this award).

Institutional Partners



Support for Biotechnology Companies

Several programs are being evaluated:

- Predictive medicine
- Regenerative medicine
- New therapies



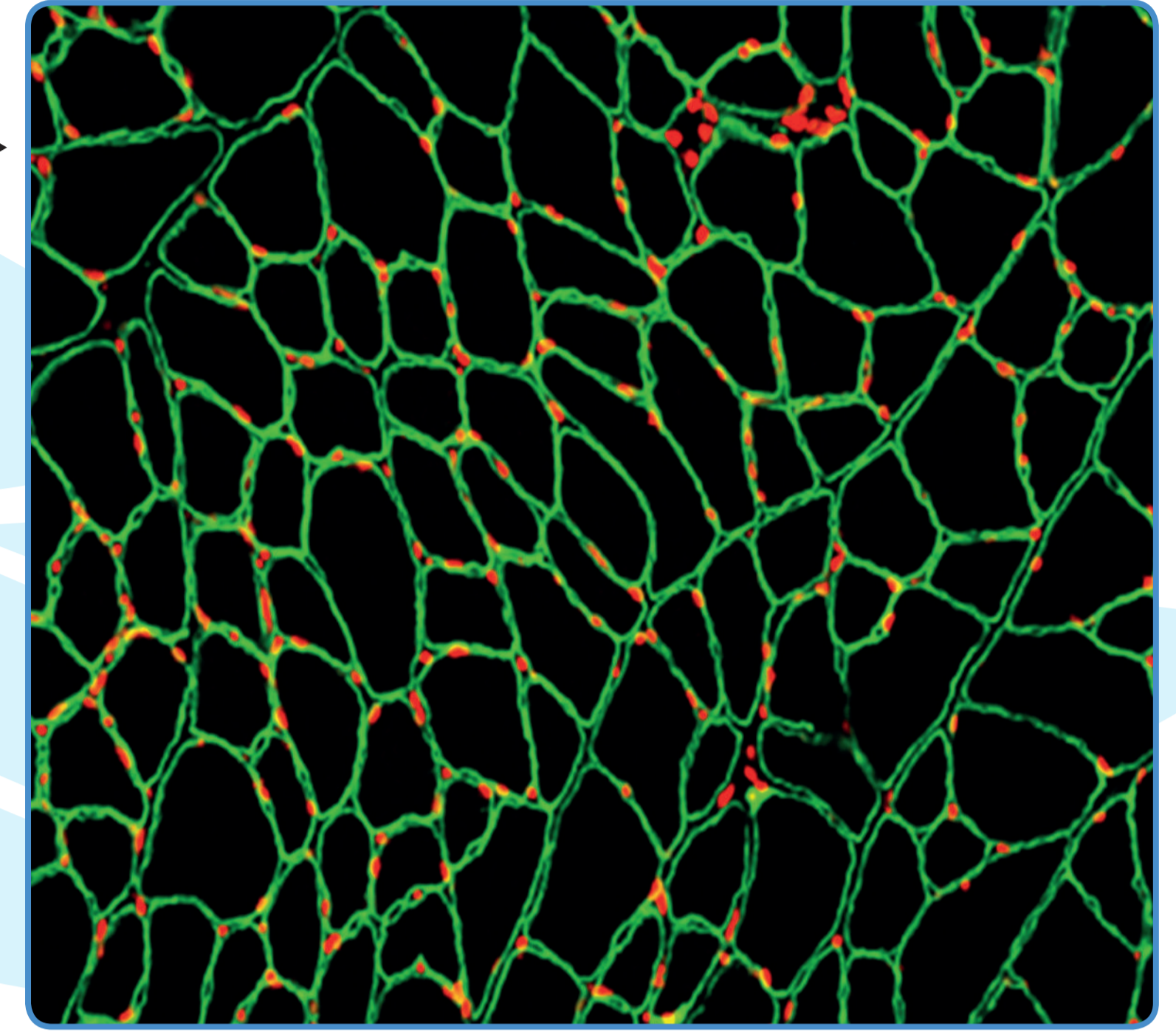
Department of Biomedicine

Neuromuscular handicaps

An emblematic research theme for the Principality

An International Associated Laboratory between the CSM and the University of Versailles dedicated to innovation in biotechnology and medical care for neuromuscular disabilities was created in 2013.

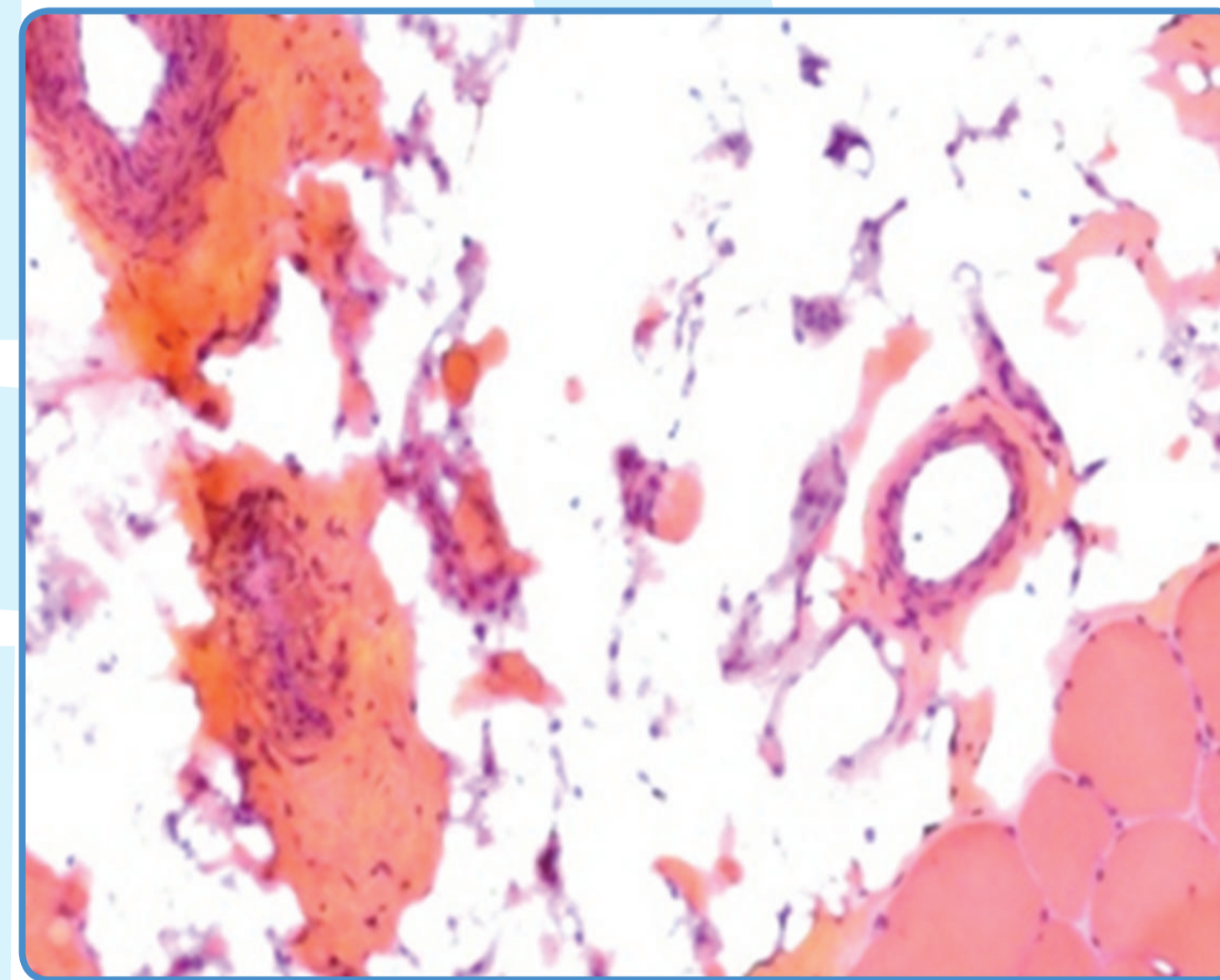
Cross section of healthy skeletal muscle showing the location dystrophin around muscle fibers (green). Cell nuclei containing inherited gene are marked red.



Association Monegasque against Myopathies



Through its actions (Round tables, ICE and Synthema) AMM has become one of major players in the research for therapies for Duchenne muscular dystrophy, an incurable rare genetic disease, affecting one boy in 3500 and due to mutations in the dystrophin gene.



In the absence of dystrophin, muscle fibers don't resist effort and the muscle tissue degenerates: it becomes fibrous and replaced by tissue fat (white).

Clinical research in the Principality

Innovative and modern treatments rely on active participation of physicians in biomedical research. Management of serious diseases is optimal where clinical research is closely associated with care. To fulfill the mission entrusted to it by the SAS Prince Albert II, the CSM has initiated **annual calls** since 2008 for research projects in order to fund clinical research taking place in health facilities in the Principality.

Since its inception, the program has provided more than one million Euros in funding for 20 projects Clinical Research at the Centre Hospitalier Princesse Grace de Monaco as well as the Institut Monégasque de Médecine et Chirurgie du Sport and the Centre Cardio Thoracique.

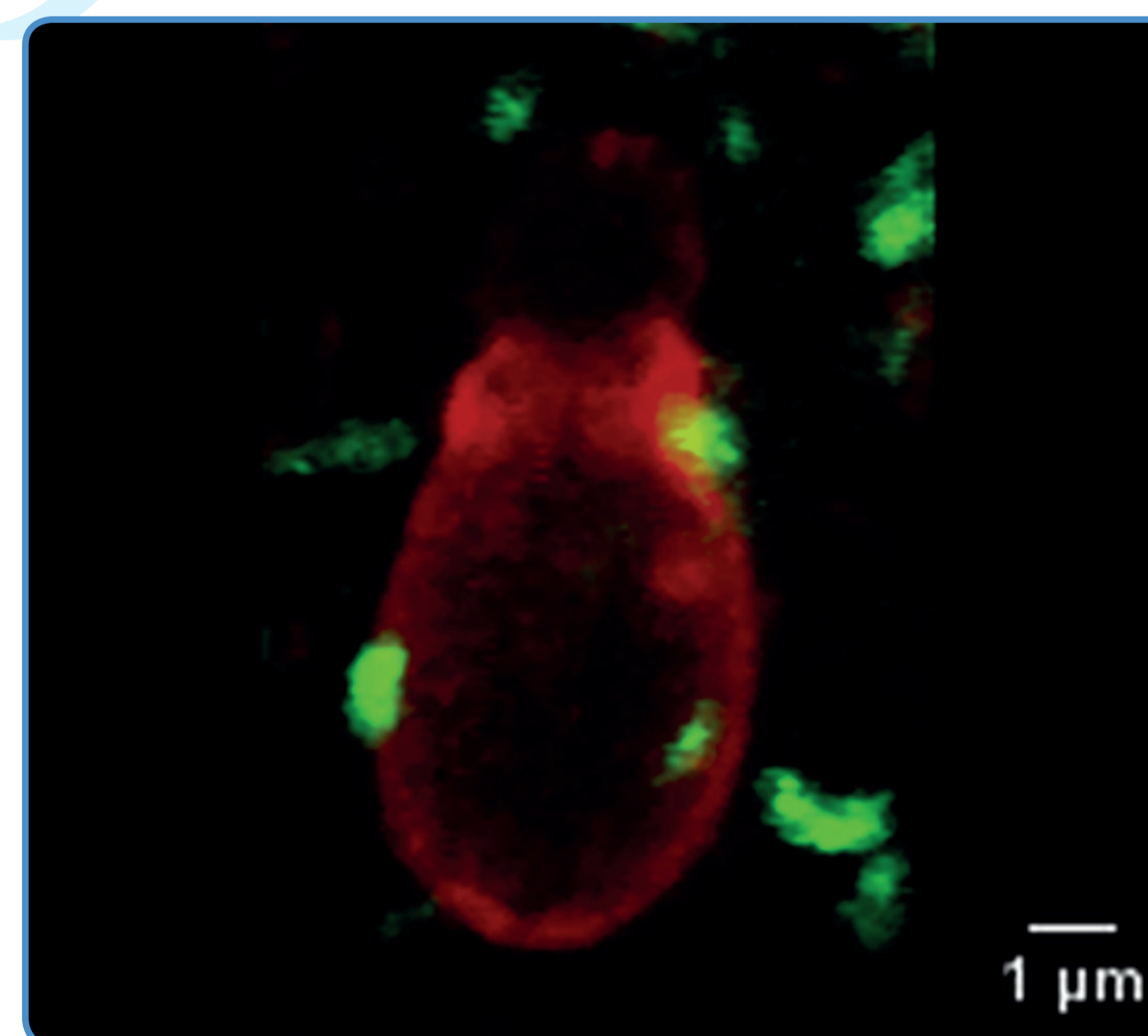


Research Group on digestive ecosystems

[partnership laboratory Biocodex]

The digestive tract is home to many bacteria and yeast in a complex ecosystem that profoundly influences our health. The digestive ecosystems team studies the effects of agents conducive to health (probiotics) on the intestinal mucosa and pathogenic bacteria.

The adhesion between *Saccharomyces boulardii* (red) and *Salmonella* (green), visualized by in vivo confocal microscopy eliminates pathogenic bacteria of the gastrointestinal tract.



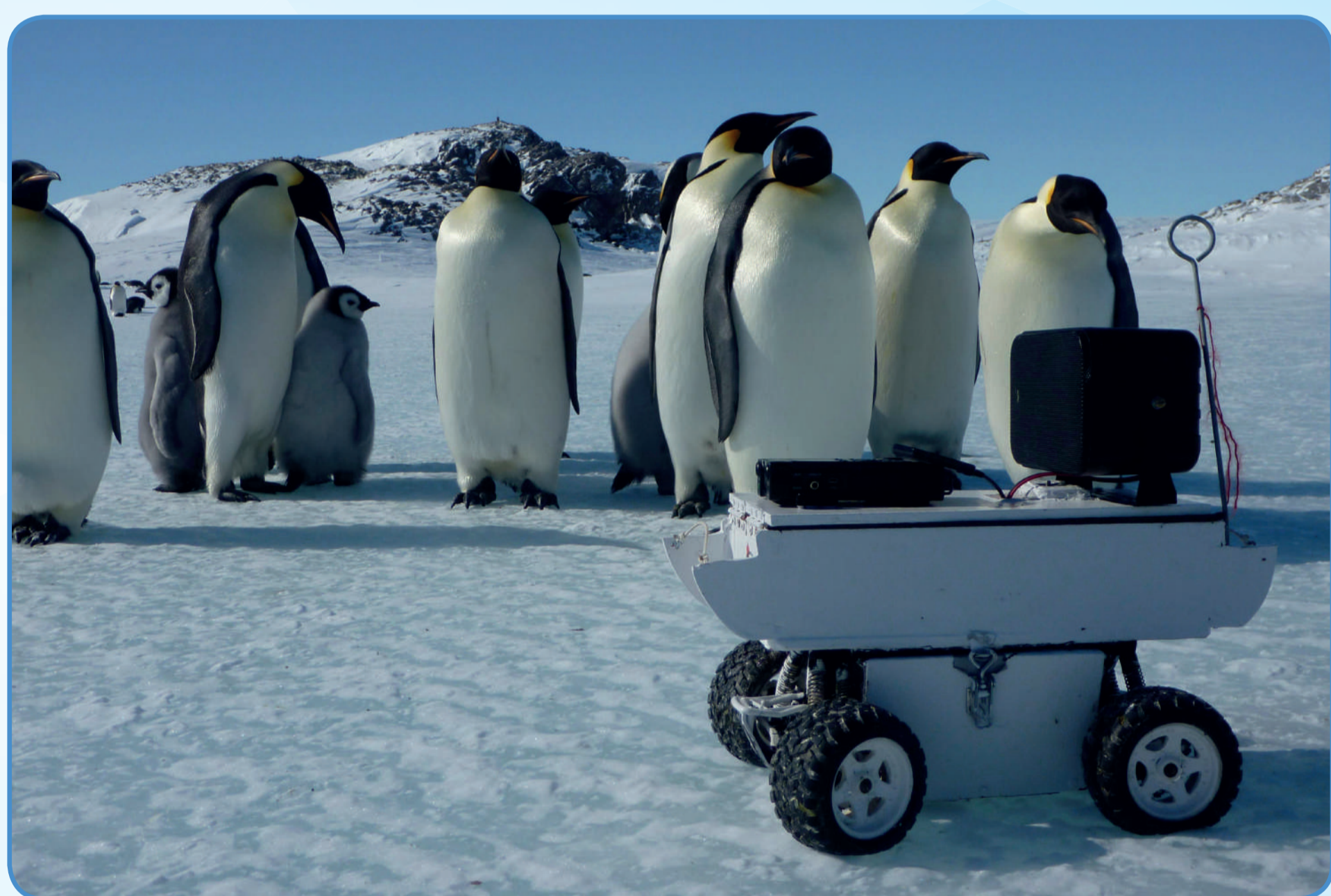
Department of Polar Biology

Long-term monitoring of populations

CSM is working on three species of penguins (King Penguins, Adélie and Emperors) at three sites (the sub-antarctic islands of Crozet and Kerguelen and Terre Adélie on Antarctica) with the support of the French Polar Institute Paul-Emile Victor (IPEV).



Emperor penguins on the sea ice



Technological Innovations

CSM develops mobile automatic identification systems. For example, rovers with antennas, GPS systems and acoustic equipment, capable of tracking penguins tagged with an electronic chip within colonies, while avoiding disruption and stress to the animals.



An Adélie penguin couple feeding their chicks



Close up of a King penguin

Activities of the Department of Polar Biology fall within the scope of an International Associated Laboratory "BioSensib" (in partnership with CNRS and University of Strasbourg). At the interface between evolutionary ecology, genetics and population dynamics, this Department aims to assess the adaptive potential of organisms and the evolving capacities of their populations to rapid changes in their environment, to understand how global changes affect polar ecosystems.



Observation in the field

Behavioural Ecology

In addition to the demographic population monitoring, the Polar Biology team is also interested in the behavior of these seabirds. Study of complex acoustic signals, personality traits, strategies for foraging or choice of partner and reproduction site, are all topics studied by CSM.



Recording acoustic signals



from the 7th of April to the 3rd of June

An exhibition of images At the heart of living crystals

Between Science and Art: the coral in images, from animal to crystal

Corals and crystals

When we talk of crystals, it brings to mind something mineral... but when we consider that crystals can also be produced by living organisms, it then becomes a biocrystal or biomineral.

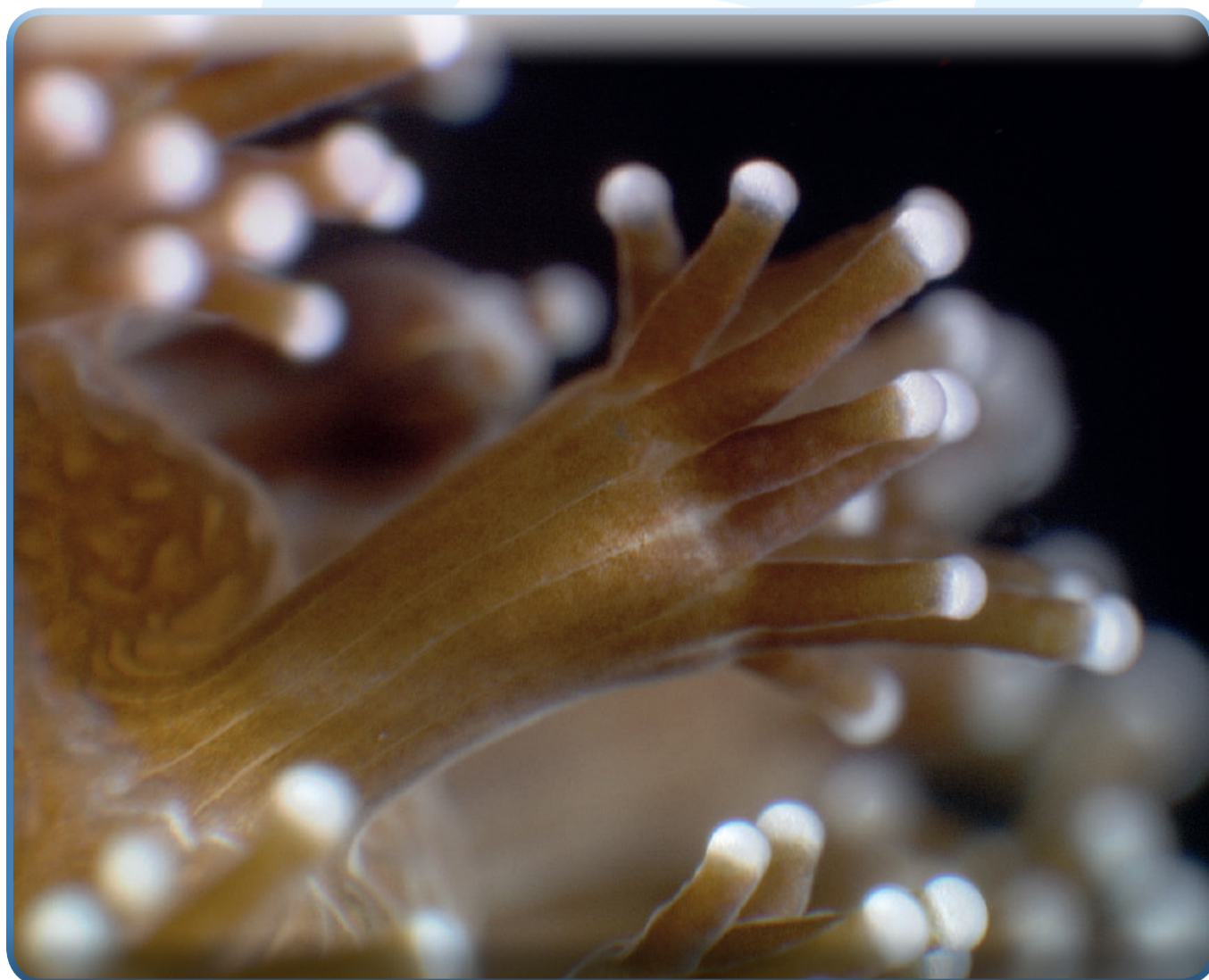
All living organisms produce biominerals, from bacteria to man: the mollusc shell, sea urchin test, our teeth and bones are examples.



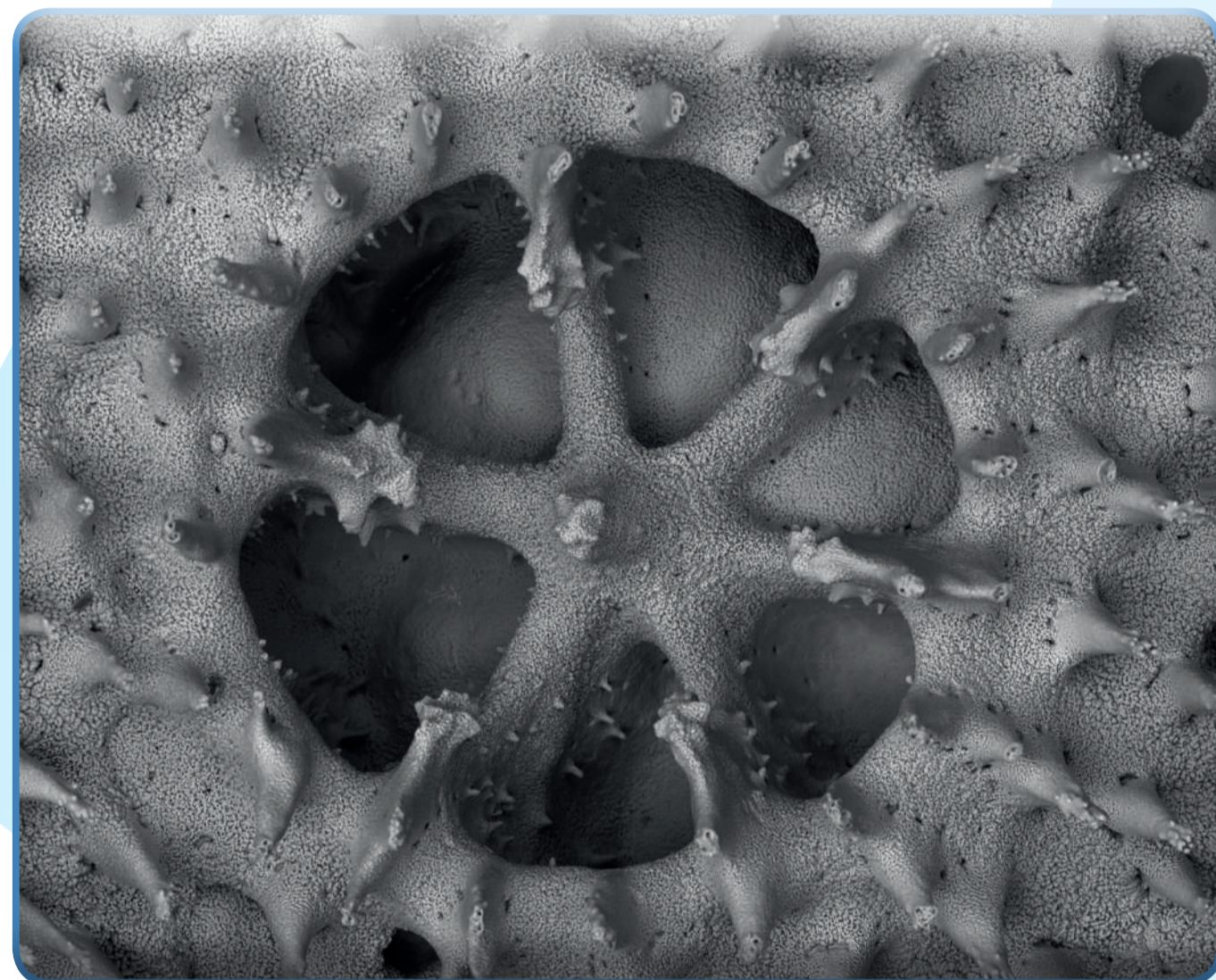
The coral colony



The coral skeleton



The animal



The impression on the skeleton

How does life make these delicate composite structures, resulting from an organo-mineral assemblage controlled by our genes?

Nobody knows yet, but researchers at the Centre Scientifique de Monaco try to solve this question by studying biomineralization in corals.

Research excellence is achieved by combining fundamental research, medical applications (the coral skeleton is used in orthopedic surgery and dentistry) and environmental investigations (the biomineralization process is sensitive to acidification oceans).

Tools used to observe life

All corals photographed in this exhibition are grown in the laboratories of CSM.

Two techniques of shooting are used:

A fluorescence microscope	A scanning electron microscope
magnification between x5 and x50	with magnification from x5 to x300 000

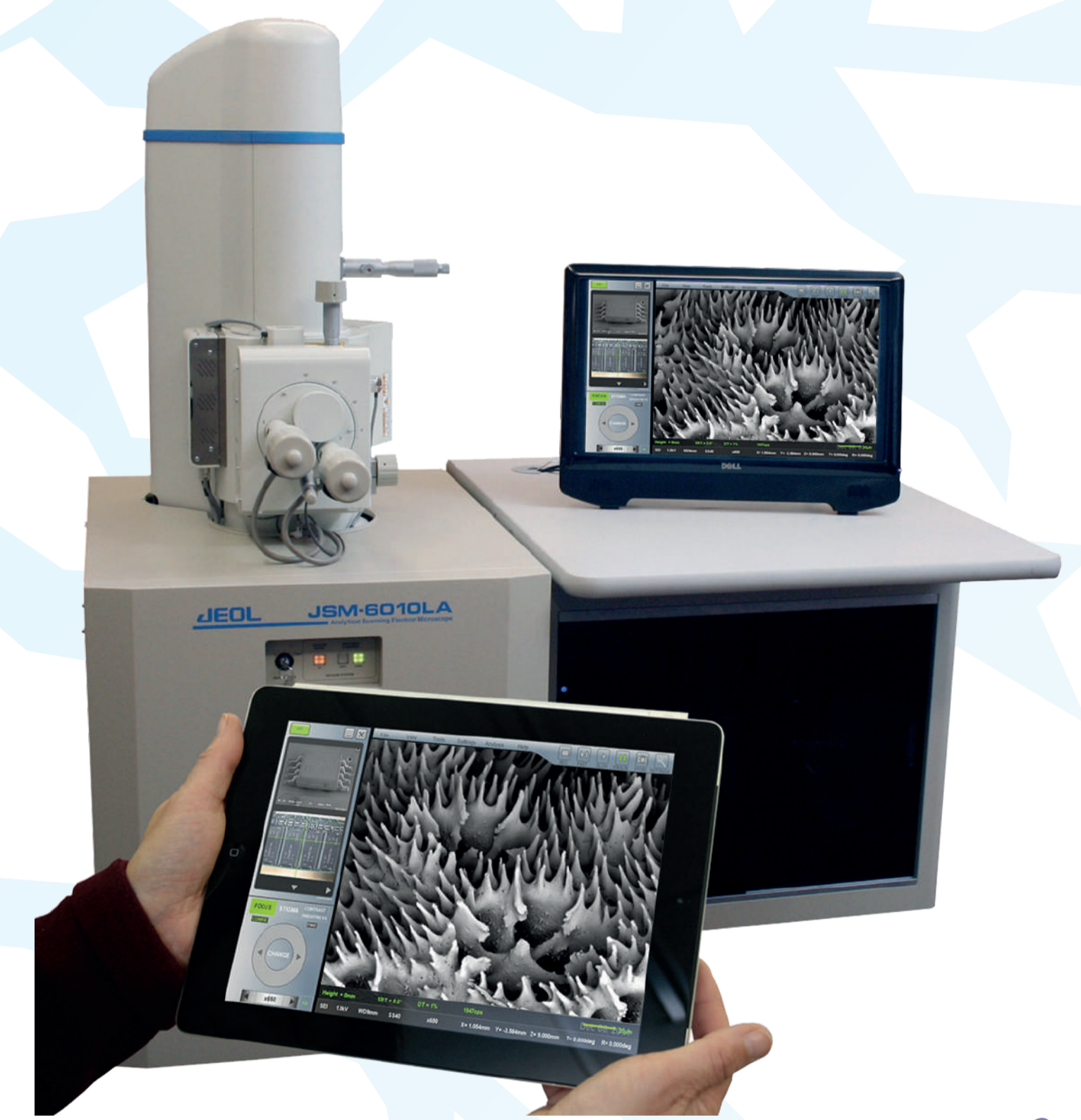
Nature seen through the microscope reveals a hidden beauty that we don't often see. The striking colours of corals, architects of coral reefs, are already impressive to the naked eye, but when the lens of a microscope interposes, it magnifies the natural object, revealing its hidden forms, spotlighting the microscopic details of its structure.

While this scientific process is essential to determine the intimate mechanisms of a coral skeleton's formation, the scientific images produced also become objects of art themselves.

It is in the spirit of this "symbiosis" at the heart of "living crystals" that we invite you to this presentation.



The fluorescence microscope



The scanning electron microscope

This exhibition benefits from financial support of the Foundation Paul Hamel and Prince's Government of Monaco

In support of



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International
Union of
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