HEAT REGULATION CABLES

ARTIST: MARÍA LUZ SÁNCHEZ SILVA
COLLABORATING ARTIST: Antonio Villafranca Alberca

In the image we can see the structure of a pair of tights seen through a scanning electron microscope. The purpose of the research was to develop heat regulation fabric, such as these tights. To achieve this, polymer microcapsules were added that contained phase-shifting materials such as paraffins. These microcapsules are so small that it is a great achievement to be able to incorporate them into the threads that make up the mesh of the tights. The human eye cannot appreciate the capacity of certain materials to form such interesting structures like the one shown in the image.

CAMERA EQUIPMENT: Scanning electron microscope.
YOU’LL LOVE ME EVEN IF YOU DON’T: I’M YOUR MICROBIOME

ARTIST: MANUEL AVELLA

We are multicellular organisms or superorganisms, a collection of different organisms that come together to form a different one. Bacteria, our microbiome, are part of us from the very beginning. We could say that they are our forbearers that still live with us and look after us. In general terms, we need them and we wouldn’t be what we are without them. But, it’s also true that other bacteria can be very harmful to our health. *Staphylococcus epidermidis* are found in the epidermis and they protect us from other harmful bacteria, such as *Staphylococcus aureus*. In the image we can see a colony of *Staphylococcus epidermidis* forming a biofilm. Bacteria have an approximate diameter of 1µm. We can also see the filaments that they generate and how they come together to form the film. This image has been taken using a clear field scanning electron microscope (FE-SEM, Quanta 200F from FEI) and a secondary electron detector. The field of vision in the image is 30µm.

CAMERA EQUIPMENT: Clear field scanning electron microscope (FE-SEM, Quanta 200F from FEI) and a secondary electron detector. The field of vision in the image is 30µm.
THERE WAS A HUGE MOON IN THE MIDDLE OF THE WORLD AND I LOST MY EYES LOOKING AT IT

ARTIST: JULIA CASTILLO GONZÁLEZ

Co-culture of brain endothelial cells in a murine cell line alongside mouse neonatal astrocytes. Both cells form part of the blood-brain barrier, a crucial structure that separates the nervous system and the circulatory system, maintaining homoeostasis between the two systems. When these two types of cells grow together in a culture, the endothelial cells form a network of trabeculae that look like the blood vessels of the brain. The image was taken using a clear field microscope in which the trabeculae viewed through the lens are reminiscent of the surface of the moon. The title of the photo is a line taken from the novel Pedro Páramo by Juan Rulfo and modified.

CAMERA EQUIPMENT: BQ Aquarius U Plus camera through a 4x lens on an OLYMPUS CKX41 clear field microscope.
THE NERVOUS WHEEL

ARTIST: ANA VILLALBA REQUENA

When studying the nervous system, we have used lots of different animal models, but we now have tools such as the creation of “organoids”, mini brains generated from human progenitors. These mini brains form cortices with the same lamination as developing brains and we can genetically manipulate them. Genetic modification is done through electroporation, passing a current through the tissue allowing the cells to incorporate DNA injected into the inside of the ventricle. In the image, we can see one of these ventricles with progenitor cells in red, neurones in white and cells expressing the gene being studied in green.

CAMERA EQUIPMENT: Confocal Olympus 40x zoom.
In this image we can see a portion of the internal filament of a used fuse in an ultrasound bath. To see it through the microscope, a part of this filament that hadn't melted was extracted and placed on a conductive carbon disc (background turquoise colour). The filament in the image is made up of a central nucleus of fibres made out of a ceramic material that act as an insulator and a rigid support for the tin thread that spirals around them. The function of fuses is based on the physical phenomenon known as the Joule effect. Since an electric current flows through the metal filament, it heats up due to the resistance, making it glow. If the electric current that goes through this filament is greater than the one allowed (short circuit), the filament will melt and the electric circuit will be broken, protecting the electronic equipment from any possible damage or faults.

CAMERA EQUIPMENT: Hitachi S-3000N Scanning Electron Microscope, 80x zoom, 17.4 mm working distance, 20kV accelerating voltage.
Cross section of an apple blossom pistil. Histology techniques were used to find out what flowers are like in detail and how pollen (the male part) interact with the pistil (the female part). The shiny yellow parts are the vascular bundles that hydrate the flowers. The compact parts are the cells in the transmitting tissue, through which the pollen tubes stretch out; there are five in total. Knowing how the male and female parts of fruit trees interact is essential for optimising more sustainable fruit production. This way for example, we know that the pollen tubes fertilise the ova quicker when temperatures rise.

CAMERA EQUIPMENT: Leica2500 microscope with DCM2500 camera.
A RED SUNSET OVER THE GIANT’S CAUSEWAY

ARTIST: MARÍA FERNANDA NAVARRO POUPARD

The image shows rocks falling from a giant’s bag, which he’s taking off to build a castle at the highest point of the mountain. This marvellous material is known as calcium carbonate and is mainly found in rocks from across the world. It has three different crystalline forms: calcite, aragonite and vaterite. The particles shown in the image measure around 3 micra and they contain calcite in its crystalline form. However, calcium carbonate in its vaterite form is used in the world of nanoscience since it is highly porous, more soluble in water and much easier to dissolve.

CAMERA EQUIPMENT: Scanning electron microscopy (SEM) by means of a Phillips CM-12 and a FESEM Ultra Plus electronic microscopes operating at 3.0 kV.
A NEW WORLD
ARTIST: EGOITZ IKAZA GONZÁLEZ

Water normally flows everywhere, starting high up in the mountains and it comes down through streams and cascades, even underground. When some drops of water end up in a pool which is blocked by various elements, the water becomes stagnant. It slowly evaporates and at the same time, the small amount of oxygen left is used up. In a few days, it starts to smell and where there appeared to be no life, there now is. A small film starts to form which, at first, is fairly transparent, but it slowly starts to grow, which is actually the multiplication of bacteria that are taking over the small pool (*Leptothrix discophora*).

CAMERA EQUIPMENT: Olympus Omd Em1 Mark2 + 60mm macro F2.8.
SANTIAGO CROSSES

ARTIST: RAMÓN FERNÁNDEZ-RUIZ

A tapestry of swords or daggers, that copy the form of Santiago Crosses, are the result of a deposition on a quartz reflector in a buffer solution tris(hydroxymethyl)aminomethane (Tris) used in research on the metal content of a metalloprotein through the microscopy of the total reflection X-ray fluorescence (TXRF). TXRF has great potential in the field of metallomics due to the capacity to analyse micro-quantities in a sample. This fact allows us to determine picograms of a metallic element included in the structure of just a few micrograms of protein.

CAMERA EQUIPMENT: Nikon SMZ800 stereo zoom microscope.
This image displays a new material developed using the sol-gel process and freeze-drying. These kinds of materials are known as aerogels. Their main feature is how light they are, which means they can be used in the aeronautical sector and in architecture. What’s more, they’re known for being superinsulators. The image, taken using an electron microscope, arouses a lot of interest since its multi-layered structure looks like the shape of a dragon with its mouth open. The shapes of these materials are eye-catching due to the effect caused by removing the water or solvent used in its synthesis.

CAMERA EQUIPMENT: Scanning electron microscope (SEM).
PETIT BOUQUET

ARTIST: DAVID TALENS PERALES

Enzymes are protein macromolecules that are essential for life and have also become crucial tools in the food, chemical and pharmaceutical industries. Biotechnology research seeks to improve the properties of enzymes and to obtain new material with enzymatic properties by bringing enzymes together on organic or inorganic mounts. In this scanning electron microscope image we can see three different enzymes forming crystalline complexes with copper phosphate. The protein and salt complexes grow by forming structures that look like flowers.

CAMERA EQUIPMENT: SEM Hitachi S-4800.
A network of fungus hypha and spores forming arbuscular mycorrhizas. 90% of land plants establish a symbiotic relationship with helpful fungi in the soil through their roots. These associations between plants and fungi are called mycorrhizas. Plants provide fixed carbon to the fungi through photosynthesis while the fungi provide water and minerals for the plants. Furthermore, through the network of hyphae hidden in the soil, which go far beyond their roots, plants can communicate with each other and exchange signals and nutrients to act as a group, helping sick individuals, alerting other plants to near-by dangers and, this way, overcoming threats collaboratively. For that reason, we could say that plants are connected to their own social networks.

SHARING THE BOUNTY

ARTIST: EBERHARDT JOSUÉ FRIEDRICH KERNAHAN
COLLABORATING ARTISTS: Ramón Fernández Ruiz and Mª Jesús Redrejo Rodríguez

Nature has many ways of hiding away its treasure and this image is a clear example of that. An preliminary analytical study on a sample of natural halite through total reflection X-ray fluorescence (TXRF) uncovered the presence of strangely high levels of Si and Al. Inspection with a scanning electron microscope on an inner section of the sample uncovered the microscopic presence of crystalline growths with bipyramidal structures of aluminium silicates piled up in bunches like a stash of jewels that an intrepid pirate captain is getting ready to share out.

CAMERA EQUIPMENT: Hitachi S-3000N Scanning Electron Microscope, 550x zoom, 11.4mm working distance, 20kV accelerating voltage.
CRYSTALLISATION

ARTIST: JORGE SERRA LÓPEZ

Has nature chosen to copy abstract artists, or have they copied from nature? When looking for crystallisations, I came across methylene blue. After heating the sample and leaving it to slowly cool, it developed these rectangular crystals that overlap at a central point and form these gorgeous crosses. These crystals seen under polarised light give off this fascinating range of colours under an optical microscope. In this case, looking beyond its physical and chemical implications, I’ll stick with the aesthetics.

CAMERA EQUIPMENT: Olympus CX31 microscope + Canon 600D camera.
A retina being formed in the imaginal disc of the eye during larval development. In Drosophila (fruit flies), the precursory organs to the adult’s compound eye grow and differentiate during the larval stages as epithelial sacks known as imaginal discs. During metamorphosis, the different imaginal discs evert and differentiate the epidermal structures and the peripheral nervous system of the adult’s visual organs. The image displays the body of photoreceptive neurones marked by the fluorescence protein GFP in the cells that express the fasciculin 2 adhesion protein. In turn, fasciculin 2 is marked in fluorescent red with a specific antibody against its transmembrane isoform. We can see the greater intensity of fasciculin 2 in the axons of the photoreceptors as they project to optical lobe of the brain.

CAMERA EQUIPMENT: Nikon Eclipse Optigrid microscope. Plan Apo 20x.
The regeneration of cartilage defects in the joints, especially in the knees, is still an important challenge for medicine. Current treatments do not manage to reconstruct the tissues' inherent microstructure. This image shows a section of osteochondral tissue. The sample was dyed with haematoxylin and eosin and the image was taken with a polarised light microscope. The structure of the cartilage and the bone tissue is clearly visible. The upper layer, the joint cartilage, is characterised by the presence of a dense matrix encrusted into the vertical violet-blue fibres fit with the aggrecan, a cartilage-specific proteoglycan core protein. What’s more, the subchondral bone displays a trabecular structure with the bone marrow, which shows through in black, surrounded by collagen fibres shown in orange. The dye allows us to study the composition of the different tissues while the polarised light microscope allows us to study the direction of the fibres within the tissues. The characterisation of the original microstructure could define new strategies for cartilage tissue engineering.

Camera equipment: Traditional clear field and polarised light microscope.

The Universe “On Its Knees”

Artist: Pedro Díaz Payno