ART DESCRIPTIONS

The Intelligence of Plants

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With Berlinde De Bruyckere, Thomas Feuerstein, Forschungszentrum Jülich, Marshmallow Laser Feast, Pflanzensoziologisches Institut, Abel Rodríguez, Diana Scherer and Nicola Toffolini

Forschungszentrum Jülich

The Frankfurter Kunstverein has invited natural scientists and artists to visually transfer their work and knowledge into the exhibition spaces. The collaboration resulted from the cooperation with Prof. Dr. Ulrich Schurr, Director of the Institute of Bio- and Geosciences: Plant Sciences and the scientists Dr. Robert Koller and Dr. Andreas Müller.

How do plants live (and survive) now and in the future? What do plants need for their existence? How is their survival influenced by their environment? What do plants provide to humans?

In order to answer such questions, biologists, biochemists, chemists, computer scientists, mathematicians, physicists and engineers are researching a wide variety of plant species at IBG-2 (Institute of Bio- and Geosciences, Plant Sciences) at Forschungszentrum Jülich. Forschungszentrum Jülich is part of the Helmholtz Association (HGF) and, with over 6,500 employees, is one of the largest research centres in Germany.

Forschungszentrum Jülich makes effective contributions to solving major societal challenges in the fields of information, energy and bioeconomy.

Especially bioeconomy is becoming increasingly relevant with the challenges of today's society. Oriented towards natural cycles, a sustainable and bio-based economy is to be created. The focus topics of IBG-2 are: Plants as the basis for food, renewable raw materials and energy, key technologies for the study of plants (=phenotyping) and concepts of the bioeconomy.

At IBG-2, the most innovative approaches to plant phenotyping and modelling are combined to better understand the interaction of the plant genome with its environment and the appearance of plants.

For example, the Plant Phenotyping Centre at IBG-2 used non-invasive sensors to quantify structural and functional traits of plants. Automated analysis procedures record the growth of sprouts and root characteristics, for example, via their root length, number of lateral roots and tending angle. Using model plants and also agricultural crops such as cereals, beans, peas and miscanthus.

Human survival depends on plants. Plants are used for nutrition, energy production, but also as basic materials for everyday objects or for construction and even for medical purposes. Globally, people are faced with the challenge of shaping agricultural production under the increasingly extreme conditions of climate change and resource scarcity with sustainability in mind.

This requires resistant crops that can be grown and used sustainably even under extreme environmental conditions, such as nutrient-poor soils or extreme dry periods. The mission of Forschungszentrum Jülich is to use state-of-the-art methods and technologies to research crops and the complex interactions between plants and the environment. To do this, the plant phenotype, the appearance of the plant, is analysed and determined. Phenotyping is the quantitative description of the appearance, i.e. the phenotype of whole plants or parts thereof, including the link to their function. This includes the above-ground part with leaves, stems, flowers and fruits, as well as the underground part of the plant, the roots, which in most cases are hidden in the soil.

Roots play a crucial role in anchoring plants in the soil, but also in supplying the plant with water and essential nutrients. Because roots are difficult to access and thus observe, they have long been neglected. However, a plant's yield, stability and resistance depend largely on the good growth of its roots. The work at IBG-2 focuses on the development of new methods and technologies to non-destructively observe and thus better research the invisible but so essential part of living plants, the roots.

Root phenotyping methods use optical and non-optical technologies such as nuclear magnetic resonance or light and moisture sensors, as well as cameras. Automated systems are also used, which can process large quantities of samples and thus make it possible to measure hundreds of different lines fully automatically. Some systems allow the simultaneous measurement of above and below ground plant parts under changing environmental conditions. One example is the measurement of plants in the so-called rhizotron - planters that have a transparent disc that allows non-destructive measurement of dynamic root growth over a longer period of time. At the same time, the shoot can grow out and also be measured. This allows unique conclusions to be drawn about the adaptability of plants to periods of drought, for example, and thus helps to speed up the selection of resistant varieties.

With imaging techniques such as magnetic resonance imaging (MRI) and positron emission tomography (PET), the root architecture of plants can also be analysed in 3D, additionally with the temporal factor, i.e. 4D. MRI is a procedure from medical diagnostics for visualising the structure and function of tissue. PET is also known from medicine and is a nuclear medicine procedure that allows us to visualise metabolic processes inside plants. With the help of radioactive markers, material flows within the plant are made comprehensible and recognisable.

The Frankfurter Kunstverein explicitly exhibits crops such as pea, bean, old winter wheat varieties and miscanthus, which will grow under artificial conditions for the duration of the exhibition.

With artificial light, controlled room temperature and water and nutrient supply, crops are increasingly being grown in large facilities, greenhouses and vertical farms, which are intended to achieve increased yields under optimised, regulated conditions in shortened periods of time. But also in the field, plant species are used whose characteristics and behavior are selected according to the properties of sites or desired results.

Three factors are essential for photosynthesis in plants: water, carbon dioxide and light. Light is used by the plant as an energy source to produce oxygen and glucose from water and carbon dioxide. Since photosynthesis in plants takes place mainly in the wavelength ranges between 400 - 500 nm (blue), and 600 - 700 nm (bright red), LED luminaires are used to specifically illuminate the plants in these two spectra. The distance of the luminaires from the plants also plays an important role, as the leaves risk being burnt if they are too close or undersupplied if they are too far away.

In the Frankfurter Kunstverein, timers clock the lighting between 6 a.m. and 10 p.m. to allow the plants a recovery phase. It is important that artificial lighting pauses for several hours to simulate a night's rest. The length of exposure to light, i.e. between day and night, clocks plants, which derive their perception of seasons from it.

Plants also derive important information for their existence from temperatures. If the difference between the temperature during day and night is not too big, plants have ideal growth conditions, as in early summer phases. By regulating temperature differences, one can artificially mimic seasons. In addition, temperature has a direct and great influence on the photosynthesis of the plant. Plant roots react very sensitively to temperatures that are too low or too high, which can lead to stress and damage. If plants are permanently exposed to temperatures below 5 degrees, they switch their metabolism to winter and thus to a prolonged resting phase.

Rhizotrons Showbox
Plastic, aluminium
200 x 160 x 100 cm
On loan from: IBG-2, Forschungszentrum Jülich, own creation

Rhizotron
Plastic, aluminium
137 x 44 x 89 cm
On loan from: IBG-3, Forschungszentrum Jülich, own creation

Rhizotrons are special measuring boxes used for root research. The vessels, which are filled with soil and open at the top, allow the observation of plant roots through a transparent disc and thus enable the simultaneous and non-destructive measurement of root and shoot characteristics of various plant species.

A show rhizotron makes visible how different soils (substrates) affect the growth of roots in the soil. Here, the effects of soil strength, moisture, nutrients or toxins, up to the influence of other

living organisms as competitors or helpers on the plants are examined. This is illustrated by the different layers of substrates, e.g. peat soil, expanded clay, vermiculite, perlite, which show how differently the roots grow in them.

The special rhizotrons, which can be seen in the exhibition *The Intelligence of Plants*, were also equipped with a grid of several hundred holes in the transparent disc on the back. This perforated plate enables - in addition to the imaging representation of the root system - the removal of small amounts of soil both in the immediate vicinity of roots and in the root-free soil. Liquid can also be taken from the soil or substances can be introduced near roots via this hole system. All this makes it possible to study the nutrient and water uptake of roots at different soil depths as well as the effect of plant roots on the soil and its biological activity.

Gießbert
Plastic, electronics
40 x 30 cm^2
On loan from: IBG-2, Forschungszentrum Jülich, own creation

Besides light, plants also need water. The so-called *Gießbert* determines the measured value "moisture of the soil" and only adds water when the soil shows signs of drying out. This precise and local measurement of the soil provides insights into the water uptake of plant roots and how this changes and adapts under different environmental conditions. As the irrigation is fully automated and can be connected to a sensor network, the *Gießbert* not only helps to collect scientific data, but also enables autonomous and very precise plant supply.

Plant rack
Wood, metal
189 x 140 x 56 cm
On loan from: IBG-2, Forschungszentrum Jülich, own creation

Für die Vermessung der Pflanzen, die sogenannte Phänotypisierung, müssen die Pflanzen angezogen und unter individuellen Bedingungen kultiviert werden. Vielfach wird über die Lichtquelle auf das Wachstum Einfluss genommen – über die Lichtfarbe oder -Intensität (rotes Abendlicht oder grelles Mittagslicht) oder über die Nähe zur Lichtquelle. Dies beeinflusst das Wachstum und die Vitalität der Pflanzen, auch indirekt über ihre Temperatur. In der Ausstellung werden aktuell beforschte Nutzpflanzenarten präsentiert, bei denen untersucht wird, wie sie sich mit ihren spezifischen Eigenschaften noch besser für den Klimawandel oder das zunehmende Bevölkerungswachstum eignen könnten. Erbse, Bohne und Winterweizen werden vor allem als Nahrungsmittel genutzt. Miscanthus spielt bei der Entwicklung von innovativen Produkten für die Baustoffindustrie oder als Plastikersatz eine wichtige Rolle. Moderne Weizensorten haben teilweise einen Verlust an ursprünglichen Eigenschaften, die heute wieder wichtig wären. Alte Sorten wie Emmer könnten helfen, wieder mit weniger Nährstoffen wie Nitrat optimale Erträge zu liefern und widerstandsfähiger zu werden.

Development from wild emmer to modern wheat varieties

Wheat domestication took place about 12,000 years ago in the Fertile Crescent in the north of the Arabian Peninsula. The wild emmer was the original form from which the first domesticated

(=transformed into a cultivated variety) wheat emerged. Around 2000 years after this event, the migrations of peoples and the spread of agriculture caused emmer cultivation to spread to Europe. In the course of time, modern wheat varieties developed from emmer, such as durum wheat (used for pasta, noodles) and soft wheat (used e.g. for bread). Modern wheat differs from wild emmer, for example, in larger seeds or more upright growth and shorter seed dormancy. However, the process of domestication has led to a loss of genetic diversity. Modern varieties produce high yields if sufficient fertiliser (especially nitrate) is available. Problem: Nitrate is soluble in soil water and the nitrate that is not immediately taken up by the plants is washed into the groundwater with the rain. To reduce groundwater contamination, fertiliser levels must be reduced. This is where old varieties like emmer come into play, which cope well with less fertiliser. By crossing emmer into modern varieties, new varieties can be bred that deliver optimal yields with less nitrate and are also more resistant. Properties of the roots that are responsible for fertiliser uptake can also be incorporated. This is made possible by modern methods (such as rhizotrons), with which root growth can be observed and measured non-destructively

Pflanzensoziologisches Institut

Prepared ash tree, 1999
100 x 640 cm
Courtesy Dr. Edith Zewell

Prepared winter dandelion, 1997
400 x 40 cm
Courtesy Dr. Roland Eberwein

Drawings by Dipl.-Ing. Dr. Erwin Lichtenegger

(left wall)

Tanne (*Abies alba*), 1998, 72 x 56 cm
Zuckerrübe (*Beta vulgaris*), 2003, 62 x 27 cm
Wiesen-Schwingel (*Festuca pratensis*), 1969, 62 x 39 cm
Kraus-Ampfer (*Rumex crispus*), 1958, 53 x 30 cm
Acker-Winde (*Convolvulus arvensis*), 1957, 58 x 12 cm

(right wall)
Fichte (*Picea alba*), 1998, 83 x 50 cm
Stiel-Eiche (*Quercus robus*), 1998, 49 x 60 cm
Berberitze (*Berberis vulgaris*), 1998, 48 x 49 cm
Kopfsalat (Lactuca sativa), Jahr unbekannt, 39 x 54 cm

Courtesy Dr. Hilde Lichtenegger

Drawings and plant specimens in the exhibition come from the extensive collection of the Pflanzensoziologisches Institut (Klagenfurt, AT), which is headed by botanist Dr. Monika Sobotik. The Austrian Pflanzensoziologische Institut (Institute for the Sociology of Plants) deals with plant-sociological and root-ecological issues.

The name of the institute refers to the discipline of plant sociology. This is a systematic research method of geobotany and the study of the socialisation of plant species. One focus of plant sociology is the study of site conditions and the interaction between species. The term plant sociology was also used by sociologist and philosopher Bruno Latour as a model of thought, as it aims to describe and understand societies made up of heterogeneous components, which this natural science, according to Latour, can serve as a metaphor for the social sciences.

Since the 1960s, the researchers of the Pflanzensoziologisches Institut, Dipl.-Ing. Dr. Lore Kutschera, Dipl.-Ing. Dr. Erwin Lichtenegger and Dr. Monika Sobotik, have systematically and with extreme care excavated, photographed, documented, drawn and in some cases made preparations of the root systems of plants in their natural habitats. For these scientists, root research means uncovering roots as they grow in their natural environment and to which conditions they react individually. Lichtenegger drew the exposed roots as true-to-scale mapping, because this manual method allows a documentation that photographic documentation does not make possible. The drawings are unique instruments for making visible something that is otherwise not visible in its complexity. Down to the finest details, the drawings show the growth of the roots, so that a different perspective and an awareness of the dimensions of that part of the plants becomes comprehensible, which cannot be derived from the view of plants above the surface of the soil.

Today, researchers across disciplines recognise the central role and essential performance of plants for life on the planet and that a complex interplay of different species and geographical conditions is what makes biodiversity possible in the first place. One of the services plants provide is to transport elements from the air to the depths of the soil via their metabolism. Conversely, they release water and oxygen into the air, as well as numerous messenger substances that have only been rudimentarily researched today, which become part of the atmosphere and have an impact on the physiology of animals and humans. The fertile, uppermost humus layer is only created by the coexistence and metabolism of countless microorganisms, which create a living substrate in association with plants and their roots.

The mineral soil is kept stable by a branched network of roots, so that soil erosion caused by water, wind and earth movements is counteracted. At the same time, roots loosen soils and contribute significantly to the formation of humus. In symbiosis with fungi and bacteria, a complex interplay between organic and inorganic materials and living beings is thus created, the functions of which are currently being researched more and more and are recognised as existential for the continued existence of all species on earth.

With its work, the Austrian Pflanzensoziologisches Institut has created the basis for root-ecological questions. The visualisation of the space below the soil surface has structurally ordered ancient knowledge about plant communities. The research is based on the aim that by observing the root systems and the associated soils, it is necessary to understand not only the individual plant, but also its interaction in the network of entire plant societies. The research evolved with the understanding of the importance of plant diversity for fertile soils and a high occurrence of microorganisms with which the plants live in association.

At the Frankfurter Kunstverein, a prepared ash tree with its extensive root system (excavated by Dieter Haas and Dipl.-Ing. Dr. Erwin Lichtenegger), a prepared winter dandelion with its more than four-meter-long root and original drawings with illustrations of mapped roots of Central European wild and agricultural plants are on display.

Diana Scherer (*1972, Lauingen, DE)

Interwoven, 2021
Plantroots oats
150 x 120 cm

Hyper Rhizome #4, 2021
Plantroots oats, framed
42 x 58 cm

Hyper Rhizome #6, #7, #3, #8, 2021
Plantroots oats, framed
36 x 27 cm

Interwoven #8, #9, 2021
Plantroots oats, framed
33 x 58 cm

Interwoven #10, #11, 2021
Plantroots oats, framed
45 x 42 cm

Interwoven, 2021
Plantroots oats
300 x 300 cm

Courtesy the artist

Since the beginning of time, the relationship between man and nature has been a field of tension between contemplative admiration and the will to control. The concept of nature, however, remains fluid over the ages and changes, just as the self-image of man changes.

Diana Scherer is an artist who has been working with the root systems of living plants since 2012. Her works emerge from structures that take place through the natural growth of seeds in an artificial manipulation of root propagation. Through years of observation, Scherer developed techniques to work with the plant to create new forms and new weaves. The artist makes use of the intelligence of plants and makes their hidden world visible.

Scherer uses templates, shapes that she places under the soil. She has developed different techniques: as an artist she shows the root structures with soil and stones, as a designer she

shows only their bare structure. The templates are made of the bioplastic PLA and can be reused. Scherer derives the patterns from traditional forms based on the geometry of nature, such as the hexagonal honeycomb structures or the leaf pattern. On the templates, the artist sows seeds and waits for the plants to complete their growth.

Scherer has experimented with many types of seeds. Grasses and cereals, especially oats, wheat and maize are her favourite varieties because they grow quickly and their roots are strong. The artist speaks of her artistic practice as a manipulation of nature. She perceives in her human work with living beings, with plants, an inner conflict, which takes place between a sense of reverence for the nature and cruelty in the exercise of coercion and destruction. It reflects the dependence of human beings, who have always secured their existence through the cultural use of their natural environment.

Scherer thematises the coercion with which she herself manipulates living plants. According to the artist, her works leave no room at all for the roots to do what they want. The work is essential: only the naked plant and manipulation.

Her artistic practice is similar to the work of scientists who observe and classify natural phenomena in order to transform and use them culturally. Roots react situationally to their environment and adapt to it individually. How these processes function and whether this characteristic can be regarded as the intelligence of the plant has been part of a discursive polarisation within the botanical scientific community in recent years. Scherer collaborates with scientists, plant biologists from Delft University of Technology and Radboud University in Nijmegen, to deepen her understanding of root systems. In addition to her studio in Amsterdam, she has a workspace in the greenhouse of Radboud University Nijmegen, where she can work during the winter.

For the Frankfurter Kunstverein, Diana Scherer has created one of her large, living floor works *Interwoven*, for which she allows oat seeds to grow into a fabric. Only a few hours before the exhibition opens, the artist turns the plant fabric so that the bare roots are revealed to the visitors. Fragile and beautiful, they lie exposed to the light and air without protection. It is kept alive by watering it for a few days longer. The price of visibility lies in the ephemerality to which the living roots are exposed.

Thomas Feuerstein (*1968, Innsbruck, AT)

Hydra, 2021
Green algae (Chlorella vulgaris), plastic, steel, glass, pumping system, bioreactor made of glass, steel, pumping technology, PVC tubes, light element
110 x 110 x 495 cm; 315 x 100 x 100 cm (Bioreactor)
With the kind support of Muffathalle München

Green Hydra, 2021
Hydra (many-headed Hydra viritissima), glass, plastic, pump technology, refrigerator
170 x 72 x 57 cm

Harvest, 2007
Carbonized algae and synthetic resin on wood
200 x 270 cm

Green Blood, 2021
Wall graphic
325 x 250 cm; 325 x 1137 cm

Courtesy of the artist and Galerie Elisabeth & Klaus Thoman

Thomas Feuerstein is a universal artist who pursues philosophy, writes literary and science fiction texts, conceives scientific experimental set-ups and uses laboratory methods to extract raw materials which he uses to create painterly and sculptural works. For almost thirty years, he has worked at the intersection of all these disciplines, exploring the interaction of science, art, and being interested in the overarching questions of human existence.

Hydra is his new spatial installation. It is a closed system powered by a photobioreactor, reminiscent of a submarine or whale, that dominates the space. Connected to the metal form are numerous tubes from which a green liquid is pumped, a preparation of water and living green algae (*Chlorella vulgaris*). The polyurethane tubes, which are over 1000 meters long, are transparent so that the living organisms receive light to carry out the photosynthesis that is vital for them.

Chlorella vulgaris is used again and again in Feuerstein's works. This microalgae is a model organism in botany that is cultivated in large numbers in the laboratory to be used as a test object for biological, medical and biotechnological research. From the very beginning of its research, concepts were developed for its use as food, and later as an energy source and biomass in bioeconomic production.

Feuerstein's *Hydra* photoreactor is part of a cycle to filter, dry and then carbonise the living material algae. This process takes place over millions of years in the natural formation of coal, but is extremely concentrated in time and space by human technology and its quest for use. From the black pigment obtained, the artist presses pencils with which he produces drawings and paintings. In the exhibition, the painting *Ernte* (Harvest) is presented. As is often the case with Feuerstein, terms are borrowed from productive and economic contexts. For economy, according to the artist, is a fundamental principle of living together and community building. Both on a microbiological level and in human communities. The process of metabolism repeatedly serves Feuerstein as a model of a principle of life. Just as the end product of the chemical transformation of one cell serves as building material for another, Feuerstein elevates this real process to a metaphorical model of thought. His works are not passive objects but autonomous agents. Real transformations take place in them, metabolic processes that must be kept alive for the duration of the exhibition.

The *Green Hydra* is a handmade glass sculpture that contains the creatures whose outer form it magnifies. Microscopic jellyfish live in a liquid and enter into a symbiotic relationship with chlorella algae. Inside their transparent bodies, you can see the green pigment of the microalgae. Both organisms enable each other to live through their different metabolic processes. In recent

years, symbiotic partnerships have taken on a metaphorical significance in the debate about new models of society. Lynn Margulis, in her book *Symbiotic Planet* (1998), applied biochemical observations to human life forms and championed these intellectual abstractions across disciplines. She emphasised the ability of plant life to connect with its environment through cooperation with other species, so that the life of different species remains in a permanent balance.

Feuerstein has also been working interdisciplinarily for years with a team of biochemists, physicists and microbiologists from various universities. Feuerstein uses biochemical processes in his living installations with a high level of scientific and engineering competence. He enhances these experimental arrangements with his knowledge of the humanities. The titles of the works refer to ancient narratives. The Hydra, the many-headed monster of Greek mythology, which grows two heads when one is cut off, stands today as a parable for constellations in which every attempt at containment or suppression only leads to an escalation.

Natural science and art combine the potential to develop new ideas about reality. Where the sciences formulate a thesis that has to be objectively proven by developing experiments, art asserts the hypothesis and builds a model of thought on it that is carried into the public discourse with an open mind. The fiction emerges as a publicly negotiable image that can initiate a social debate.

Marshmallow Laser Feast (London, UK)

Trehugger: Wawona, 2017
VR experience and installation
Concept by Marshmallow Laser Feast
Team: Barney Steel ,Ersin Han Ersin, Robin McNicholas (direction), Mileece Ianson, Natan Sinigaglia (collaborating artists)
Scientific advice by Natural History Museum, London, University of Salford, PNY, 3Dception, Macaulay Library, Cornell Lab of Ornithology, Ithaca
Treehugger: Wawona is commissioned by Cinekid Foundation, STRP, Southbank Centre and Migrations.

Courtesy Marshmallow Laser Feast

Marshmallow Laser Feast (MLF) is a London-based collective of artists working at the intersection of science, art and technology, using a range of creative disciplines from installation to kinetic sculpture, film and live performance.

Much of their work explores human perception through the use of innovative technologies. With *Treehugger: Wawona*, the collective produced a multimedia virtual reality installation that focuses on a giant sequoia (*Sequoiadendron giganteum*), one of the oldest trees on the planet. Visitors put on the data glasses and change the human perspective to follow the metabolic cycle of a drop of water on its way into the ground and from there into the roots to the tree crown.

The giant sequoias in Northern California reach a size and age where human imagination reaches its limit. They are the largest single organisms on earth. They can grow taller than a ten-storey

building and live for more than three thousand years. The more we know about them, the more questions arise. The fascination of these special creatures has inspired numerous authors. Richard Powers' novel *The Overstory* (2018), in which trees become the protagonists of a cross-species plot, is particularly groundbreaking.

The giant sequoia from *Treehugger: Wawona* is a real tree in Sequoia National Park in California, USA. Wawona is the native American word of the local Miwok for "hoot of an owl" and onomatopoeically imitates the sound of the spotted owl, which is considered the spiritual guardian of the tree.

In collaboration with leading researchers from the London Natural History Museum and the University of Salford, *Treehugger: Wawona* used a combination of the three-dimensional laser scanning system LIDAR, white light and CT scanning to create high-resolution textures. The digital representation creates a distortion of the usual human perception of space and time and makes the invisible visible. For *Treehugger: Wawona*, scientific data was used to create a graphic simulation of how water and carbon dioxide flow through the tree. In the VR experience, users experience the metabolic processes taking place in the tree in a temporally accelerated way. Through the power of immersive technology, an experience can take place in which the user overcomes the limitations of their own human body to empathise with that of the tree. A transfer of experience can take place, an empathic transference of the self to another being.

The soundscape extends the scientific data by acoustically reproducing the vascular system of the tree. The capture of biosignals was generated via the representation of data into sounds via hardware and software co-developed by sound artist and environmental designer Mileece I'Anson. The bioacoustics of the Sequoia National Park are audibly represented via a binaural soundscape of the tree - this is created when a separate sound with a slightly different frequency hits each ear. For this, the soundtrack of birds, insects, amphibians, rain and wind was mixed in a sound weave to create an immersive sound field in which visitors can move around.

One of the concerns of Marshmallow Laser Feast, in the face of an increasingly urgent ecological situation, is to help people leave their anthropocentric view and, thanks to their artistic work, put themselves in the place of another, non-human being.

Nicola Toffolini (*1975 Udine, IT)

Sezione B#01, 2013
Drawings with Copic Multiliner SP 0.03, 0.05, 0.1, 0.2, 0.25, 0.3, 0.35, 0.5, 0.7 black pens, Copic Marker, Copic Wide, Copic Sketch colors 100 Black and 110 Special Black on Fabriano Accademia Drawing Paper 200gsm
250 x 150 cm

Sezione A#01, 2013
Drawing with Copic Multiliner SP 0.03, 0.05, 0.1, 0.2, 0.25, 0.3, 0.35, 0.5, 0.7 black pens on Fabriano Accademia Drawing Paper 200gsm
250 x 150 cm

Sezione Doppia B#01, 2020
Drawing with Copic Multiliner SP 0.03, 0.05, 0.1, 0.2, 0.25, 0.3, 0.35, 0.5, 0.7 black pens, Copic Marker, Copic Wide, Copic Sketch colors 100 Black and 110 Spezial Black on Fabriano Accademia Drawing Paper 200gsm
300 x 260 cm (2 pieces)

Sezione B#03, 2020
Sezione B#04, 2020
Sezione B#02, 2020
Drawings with Copic Multiliner SP 0.03, 0.05, 0.1, 0.2, 0.25, 0.3, 0.35, 0.5, 0.7 black pens, Copic Marker, Copic Wide, Copic Sketch colors 100 Black and 110 Special Black on Fabriano Accademia Drawing Paper 200gsm
250 x 150 cm

Pòst #01, 2020
Drawing with Molotow Blackliner 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 0.9 and 1.0 mm black pens, Liquitex Acrylic Gouache on Fabriano Artistico Drawing Paper 640 gsm
140 x 140 cm

(on the wall)
Studi erosioni (gessi), 1999 – 2000
Parassiti, 2011 – 2012
CX, 2013 – 2016
(in the showcases)
Ciambelle, 2013 – 2015
Architetture utopiche, 2019 – fortlaufend
Drawings with Sakura Pigma Micron 005, 01, 02, 03, 05, 08 and brush black pens on Moleskine Japanese Pocket Album
9 x 279 x 1 cm; closed 9 x 14 x 1 cm

Courtesy the artist

Nicola Toffolini has been studying texts on botany, philosophy of science, science fiction and Renaissance prints for two decades. Toffolini transforms his research and knowledge into the medium of drawing and multimedia objects.

At the Frankfurter Kunstverein, the selection of works focuses on his graphic oeuvre in the form of the overall installation, which consists of eight drawing panels. At the very edge of the picture, the grass sward with the first layers of soil can still be seen, drawn in a reduced naturalistic style. But his central pictorial motif is the space that eludes the human eye, below the surface of the earth. With the finest ink pens and black copymarkers,

Toffolini draws plants and soil cross-sections with the precision of a botanist or technician. The stylised mappings not only depict a controlled nature, but they also have inscribed in them the temporal dimension of the manual drawing process.

The panels correspond to the size of a human body. The initially blank paper surface is altered by the artist with utensils used by technical draughtsmen for few and precise lines. Toffolini, on the other hand, covers square meters of surface with an almost obsessive execution of thin strokes until the space is completely filled or blackened.

This practice reminds of the art form of calligraphy, which sharpens one's own perception and method of movement in meticulous preparation, as a physical acting out of controlled placed gestures in search of inner peace.

Drawing thus becomes a physical act of thought and introspection, a bodily translation of thought, a physical act that focuses the mind in a concentrated direction.

On the one hand formally structured and consistent beyond measure, and on the other free in his association, Toffolini no longer adheres to the rules of real conditions, but deconstructs and recombines until imagined systems emerge. The pictorial worlds are composed of natural elements and technical structures. The control Toffolini exercises over his motifs reflects human intervention in the landscape. He constructs artificial worlds that seem uncanny in their manipulation.

Toffolini has always carried out his thinking processes in the intimate format of the foldable notebook. Five of them are on display in the exhibition. His drawing books are studies of individual botanical, geological or physical phenomena, which he transforms from a scientific knowledge into a pictorial abstraction. The result is a collection of thoughts, fragments of knowledge and pictorial thinking on topics such as ecological systems, climatic changes and human-induced natural disasters, which revolve around the tense relationship between human culture and nature.

As a contemporary artist, he is a witness to the flood of images in the media reporting on climatic phenomena, ecological catastrophes and the ever-increasing destruction of nature, and he processes them by trying to organise the images as material. In a private archive, Toffolini collects large quantities of image references, newspaper articles, literature, scientific texts and historical engravings by Italian scholars, which he has collected in a personal atlas. From these, his motifs emerge as the essence of a long process of image-finding, which he then merges into surreal pictorial constellations. This research and process serves him as a study for his works, in which he allows individual elements, connected with knowledge of ecological principles, to become independent visual worlds. Nicola Toffolini creates oversized drawings reminiscent of historical copperplate engravings, but instead of miniaturising the image, he does not seek to compress a whole world into a tiny space; on the contrary, he directs the viewer's attention to the details and amplifies them through size.

At first glance, Toffolini's works seem as precise and objective as today's high-resolution image-generating processes digitally scan every natural soil stratification and every living thing in search of patterns and facts. But in his relentlessly perfect drawings, we see a world that is no longer animated at its core, but disintegrates into fragments.

Abel Rodríguez (Mogaje Guihu, *ca. 1941, Cahuinarí, CO)

El árbol de la vida y la abundancia (The Tree of Life and Abundance), 2019
Ink on paper
150 x 150 cm

Bosque Vega (The Vega Forest), 2019
Ink on paper
50 x 70 cm

Courtesy Spore Foundation Collection

Abel Rodríguez (Nonuya name: Mogaje Guihu) is an elder of the Nonuya, an indigenous community from the middle of the Cahuinarí River in Colombia. Through drawings and storytelling, he passes on his ancestors' knowledge about plants in the Amazon basin, their coexistence with animals, and their mythological meanings to succeeding generations. Traditionally, in his community, the transmission of knowledge was entrusted to only a few members from generation to generation through a strict lineage. His community has been displaced by environmental exploitation and guerrilla operations by the Revolutionary Armed Forces of Colombia (FARC). To preserve his cultural heritage, Don Abel began to paint his knowledge.

In the 1980s, the Dutch Tropenbos Society, which works to preserve the Amazon and the lives of local communities, began methodically collecting Don Abel's knowledge of local plants with the assistance of a biologist. He translated his knowledge into botanical drawings so that researchers could understand and document it. Relocated to the million-strong city of Bogotá, he had to draw a lot from his memory. In his drawings, he noted color, flavor, flowering time, use, and the landscape in which specific plants grew. His mapping and oral descriptions became illustrated books, both in Muinane and in Spanish, that make traditional knowledge accessible to all.

Don Abel's collaboration with the Tropenbos Society united two different forms of knowledge. On the one hand, the traditional indigenous one, in which knowledge about the natural world also includes its spiritual meaning, which is based on an understanding of the whole universe as an inseparable unity. On the other hand, the Western scientific method, which works with classifications and taxonomies, and then from individual disciplines generates results via objective procedures.

In the exhibition *The Intelligence of Plants* are shown two drawings by Don Abel: *Bosque Vega* (The Vega Forest) and *El árbol de la vida y la abundancia* (The Tree of Life and Abundance). The first drawing is part of a series that describes the change of seasons in a fo,

rest area. The second work narrates the origin myth of the Nonuya community. The myth is not just a story. It becomes the overarching explanation of how people settled in the Amazon, how they fit into the natural system, and how communities organise themselves, including how plants are grown and how diseases are cured. Roots, branches, flowers, fruits and seeds all hold spiritual significance. The myth of the tree of life transmits the interconnections of the tree community within the forest's compound, as well as the properties of the tree. Each indigenous community in the Amazon passes on its own interpretation of the myth of creation, in which the

order of all living communities, and thus of the entire ecological system, is seen as a coherent creation derived from the idea of the primordial tree.

Don Abel tells the story of the Nonuya community about the origin of their food, about their traditional understanding of sustainable forest management and thus food security for all. The testimony of his cultural heritage becomes an appeal of respect for the laws of nature and the coexistence of species. Rituals serve as a connecting link between man and nature in a spiritual vision of the world. To the Nonuya community, every plant is sacred, especially yucca, coca and tobacco, which connect body and soul, evoking the unity of the all-encompassing tree of life. Don Abel's memory is not only an archive of botanical knowledge, but also of spiritual belief systems that are in danger of disappearing.

The Frankfurter Kunstverein has commissioned Colombian filmmaker Simon Hernandez to document the creation of the drawing *El árbol de la vida y la abundancia* in a video portrait. The short film aims to give Don Abel a voice that becomes that of his entire cultural community. Through the film documentary, we can participate in the cultural transmission of Nonuya history and worldview, which Don Abel thus brings to the world.

In addition, the exhibition shows the cinematic work of the colombian artist Fernando Arias. The film, titled *ABEL*, was made in Colombia in 2014 and captures the Amazon for posterity through poetic images and narratives.

Through the testimony that Don Abel passes on, he keeps alive the worldview that contradicts our industrialised society, and for which we may be longing; a wisdom that explains differently our relationship with the earth and the cosmos, and in which balance is the foundation for the life of all, human, animal and plant.

Berlinde De Bruyckere (*1964, Gent, BE)

Embalmed – Twins I, 2017
Embalmed – Twins II, 2017
Wax, fabric, leather, rope, wood, iron, epoxy
197 x 158 x 615 cm; 190 x 145 x 570 cm; iron structure: 80 x 107 x 178 cm

Courtesy the artist and Hauser & Wirth

Berlinde De Bruyckere's work emerges from a desire to find images to confront the great existential questions. Ephemerality and corporeality, defenselessness and connectedness to other beings are the themes that make her works unique experiences in contemporary art. The exhibition *The Intelligence of Plants* features the monumental double sculpture *Embalmed Twins I and II*. The sculptures were born out of a discovery in France. Two centuries-old oaks, which repeatedly impressed the artist in their majesty during her walks, fell victim to hurricane Cyrill in 2016. They had grown together and fell with their crowns intertwined, as if this were part of their destiny. Berlinde De Bruyckere wanted to translate the emotion of seeing the power of natural forces into a sculptural work.

With these found logs she began her work of transformation. Using wax, metal, epoxy and textiles, she transformed the found oak trees into bodies that no longer resemble a tree, but

were transformed by the materiality into a universal corporeality. Wounds, scars and veins showing through under the bark turn the tree into a being between human, animal and plant. Life has departed from the material, leaving behind pure physicality. The title refers to the ancient technique of embalming, a practice of preserving bodies that shapes Berlinde De Bruyckere's artistic activity.

The artist models new parts of the body in wax, assembles different materials to form new bodies that blur the attribution of whether plant, animal or human. The created beings are united by a wounded carnality that helplessly reveals itself.

The pictorial language echoes the traditions of Dutch and Flemish Renaissance painting from the 16th century. De Bruyckere draws on the heritage of the European Old Masters and Christian iconography, but creates new forms that translate these strong references into a contemporary language.

The *Embalmed Twins* lie alone, laid out, in a space illuminated by light that mimics that of the moon. Our bodies meet theirs without distance. The bodies of the two trees were the inspiration for De Bruyckere's reflections on the fragility of life and corporeality. It was the moment of encounter in the sight of the fallen trees, her profound perception of the loneliness that every being experiences in the abandonment of its aliveness, that the artist transferred into her work. It is the artist's empathetic gaze, which also touches the creaturely in the fallen tree. Neither fear nor disgust guide her, but an impulse to give protection, to care for the vulnerability of the being. She bandages parts of the tree, places blankets on it and protects the parts that reveal the transparency of ephemeral flesh. As an artist, she seeks the interstices of human experience, connecting with the deep-seated anxieties for which we can hardly find rituals or words today. With her art, De Bruyckere creates a space without words, offering us an encounter with the essence of the other. It is not a human being, an animal or a tree, it is the expression of vulnerable life per se, an *ecce homo* of organic mortality and inter-being corporeality.