TOBACCO: A MASS OF ATOMS, A BIOFACTORY, AND A GENEROUS FRIEND

by Karel Doing

I have been exploring new forms of meaning-making through a co-creational approach that involves plants as signifiers over the course of the past five years. I have dubbed my technique "phytography" (i.e., writing with plants) (Doing, 2020). Phytography is a form of photography that I developed by modifying and expanding established photochemical processes. My technique is deceptively simple, given that it is based on household chemicals and requires very few specialized tools and/or *a priori* knowledge. This technique has opened up many new avenues for me as an artist, educator, and researcher. In 2020, I successfully applied for an artist-in-residence program organized by Biofaction. What follows is a reflection on this residency at the Institute for Infection and Immunology at St. George's University, London. Plants are being studied in a surprising context in this research laboratory, hence the connection to my work.

The relationship between plants and photography is not at all obvious. Plants can certainly be objects when placed in front of a camera. These images are classified as 'still lifes' and are compositions of inanimate objects that can be read as metaphorical signs. Obvious examples include the sexualized fruits and flowers that appear in Robert Mapplethorpes' work. These photographs are grouped together with Mapplethorpes' openly homoerotic nudes, according to art historian Peter Schultz, and are consistently described as "symbolic representations of male genitals" (Schienbinger, 1996). In this scheme, a fruit or a flower transforms into a carrier of meaning, transcending beyond its usual inanimate being in the world. Signification is assigned to the plant by the photographer by means of precise lighting and composition.

Even plant taxonomy has not always steered clear of similar analogies and the resulting controversy. Linnaeus, who is widely seen as the founding father of modern taxonomy, based his classification system on plants'

reproductive organs. As Londa Schiebinger highlights in her article about the famous scientist, "bloody and protracted battles erupted almost immediately over the scientific and moral implications of Linnaeus' classification system" (Schiebinger, 1996:110). His ideas were seen as obscene by some of his contemporaries, but Linnaeus himself attempted to project an idealized view of gender and marriage onto the plant kingdom, contradicting his own methodology in the process.

Another possible appearance of plants in photography and film is not as clearly imbued with meaning; namely, their appearance in the background or as part of the background. However, plants might have more agency than expected in this case. The 'accidental' appearance of nature in photography and film is regularly discussed in cultural theory as one of the medium's unique properties. This is often exemplified in the literature by the movement of leaves in the film *Le Repas de Bébé* by the Lumières brothers (1895), something that was widely admired by the audience as a captivating element. Avant-garde film director Maya Deren comments on this often-overlooked aspect of photography in a pertinent way:

> "Only in photography – by the delicate manipulation which I call controlled accident – can natural phenomena be incorporated into our own creativity, to yield an image where the reality of a tree confers its truth upon the events we cause to transpire beneath it." (Deren, 1960.)

Entering a modern scientific research laboratory with this contextual background in mind complicates the delicate conversation between the arts and the sciences right from the outset. With or without realizing it, the modern scientist's thinking is irrevocably influenced by Richard Dawkins' *The Blind Watchmaker* (1996), which emphasizes the (presumably) purely objective point of view of scientific observation and the presumed absence of any form of determination in the natural world. Plants, as an object of study, are purely passive and can be freely manipulated for any human purpose. Therefore, a photographic image of a plant is either purely instructive or, alternatively, is no more than a decorative illustration.

However, common ground is much easier to find between the material and processual nature of both the arts and the sciences. Research scientists are interested in processes and visualization techniques that can be used to confirm the manifestation of certain bacteria, viruses, enzymes, or proteins. Common techniques include gel electrophoresis, dot blots, and Elisa plates.

These methods rely upon biochemical reactions that are similar to the reactions that occur in analog photography; there is even an unambiguous overlap in some cases. Visual information is routinely used in order to answer simple yes/no questions or to quantify the occurrence of a certain molecule that is of interest. This type of information is gathered continuously and is reworked in graphs and tables thereafter. Hence, the results of the research undertaken in a laboratory appears in a digital, highly organized format to the outside world. However, the day-to-day work relies on a practice that is not all that far removed from the work done by photographers in a darkroom or by painters who prepare their own pigments.

The residency at St. George's University was an excellent opportunity to compare and contrast the material and processual aspects of my own work in relation to the research done in the lab of Prof. Julian Ma and his group; it was particularly interesting given my background as both a photographer and filmmaker who is interested in alternative photographic processes. In addition to the overlap described previously, a second common interest appeared, namely the plants' proficiency to perform complex tasks. The group's research focuses on the plants' ability to produce enzymes that can be used in novel treatments to prevent and cure diseases, such as HIV and COVID-19. Both common tobacco plants and the closely related *Nicotiana Benthamiana* species are the 'primal helpers' in this astonishing process.

One of my project's most important aims was to gain a further understanding of the lab's workflow. It is significant to mention a fact that might seem very obvious here: the scientists' aim was to develop new treatments and new ways of producing medicines. Tobacco plants are presented and described as biofactories throughout their publications. Research starts from the patient's perspective, by looking at the pathogen that causes disease first. Certain patients develop antibodies that can be isolated in the lab. The biochemical composition of the enzymes in question are then studied and the resulting sequence is amplified and introduced to a bacterial colony. Some bacteria will start to produce the desired enzyme and, after selecting these, the bacterial strain will be introduced to a tobacco plant. This is done through agro-infiltration in which a buffer solution, containing the bacterial strain, is injected into the leaves. The plants that survive this process will start replicating the desired enzymes. Clippings of the plant can also be grown and the product can then be harvested and purified.

Each step of this complex procedure is repeated many times in order to refine and to optimize the process and, subsequently, to breed tobacco plants that perform the task that is assigned to them in the most optimal way.

Researchers carry out a mixture of experiments relating to different stages of the whole process on a typical workday in the lab, thereby resulting in a seemingly chaotic flurry of activities. Tools vary from improvised DIY setups to high-tech equipment. The materials also vary greatly; in addition to the highly specialized products that are produced industrially by specialist companies, researchers also use household products such as milk, salt, and ice. In this process numerous blot plots, gels, and colorimetrics are produced while bottles, plates, vials, plant pots, and even individual leaves need to be labelled in order to keep track of each iteration. The information obtained through these methods is, finally, condensed in graphs and tables in order to be presented at conferences and in journals.

Scientists use frequently used words in addition to the technical terminology that is used in their articles. Genes are 'expressed' in leaf tissue, proteins are 'humanized', and plant lines have 'characteristics'. However, the typical point of view is viewed as both deterministic and the researcher's relationship with the tobacco plants is viewed as utilitarian. This does not mean that the people in question have no feeling toward the objects, processes, and creatures that reside in the lab. In practice, it is common to talk about several aspects of their work in more relational terms. My project's focus has been to look closely at these quotidian areas of scientific practice: everyday visualizations, DIY solutions, ordinary gestures, notations, and evocative vocabulary.

I have explored a number of visualizations using both my own methods and the visualization tools and techniques available in the lab, in close collaboration with the scientists. My own method, phytography, is based on early photographic chemistry and the subsequent renaissance of recipes for plant-based developers that have recently gained widespread attention. By looking closely at such formulae, I hypothesized that it might be possible to use elements of plants in their entirety, instead of extracting their juices. The plant starts releasing polyphenols or terpenoids, molecules that can function as active ingredients in photochemical processes, after soaking leaves, petals, or stems in a deconstructed version of the original formula. Plants make their own image on photographic emulsion by means of this concept.

Firstly, I used mature *Nicotiana tabacum* leaves, preparing these in a Vitamin C and soda solution. The primed leaves were then pressed onto photographic emulsion for several hours. The resulting image shows the structure and chemical make-up of the leaf, but simultaneously has a painterly quality, resembling abstract expressionist paintings. Secondly, I used a similar leaf as an overlay for a photograph of the purifying machine that

can be found in the lab. I first exposed a roll of black and white film, taking shots of this intriguing machine. I then developed these images by following the reversal process. Reversal processing is used for slides and certain types of cine-film. I used a primed tobacco leaf instead of using the required second developer. The result is a superimposition, a combination of a camera image and a phytogram, a dreamy, almost surreal image of a sleekly designed technical tool. Next, I used the (much smaller) leaves of 'wild type' *Nicotiana benthamiana* in order to make a phytogram on a laboratory high speed film. Both the film and the leaves are much more delicate, resulting in an image resembling a Chinese Ink drawing. Finally, I photographed a flowering tobacco plant and developed the roll in the juices of this very same plant. After taking the photographs, the flowers were used to make a strong 'tea'. By adding Vitamin C and soda to this liquid, I created a workable photographic developer. The resulting 'self-portrait' has an ominous quality, imbuing the plant with a hitherto undisclosed form of power.

In parallel to this, another set of images was assembled in close collaboration with the scientists working at the lab. These images have been uncoupled from a purely scientific context, allowing for a simultaneously scientific, aesthetic, and symbolic reading. Firstly, I explored dot blot and gel electrophoresis by isolating and enlarging the basic symbols used in these processes. An evocative image emerges by combining both tokens. Secondly, I photographed a stack of Elisa plates in extreme close-up, thereby accentuating the subtle color spectrum and the lens-like quality of the wells. Finally, I looked closely at a number of cryo-electron microscopy images, identifying a pattern in a seemingly random distributed protein swarm. I also took a number of 'traditional' photographs focusing on remarkable objects, tools, and gestures, aiming to hint at the devotion and intensity that is required in this line of work. In this way, the lab suddenly turned into a space filled with sculptures, installations, and performances, simply by allowing for an artistic point of view to be included.

The important point for me is to seek for a shift in possible readings of signs and symbols in both the arts and the sciences. I am interested in advancing a much more relational framework, instead of a utilitarian point of view or the typical dichotomy between the different fields. Visualizations, such as dot blots, gels, and Elisa plates, are not just carriers of scientific data; instead, these techniques are deeply embedded in a cultural framework and can function in various ways beyond a scientific context. Simple gestures, such as watering a plant or injecting that same plant with a fluid containing bacteria, define our ambiguous relationship with these living beings. I

propose that tobacco plants are clearly both ingenious and generous. These plants are able to produce complex enzymes almost effortlessly. While the production of a certain molecule would require a very expensive and complex factory in the human world, the plant is able to pull off the same feat with only minimal means. Plants donate their enzymes without protest and can potentially regrow and continue giving. Following this line of thought, the potentiality of tobacco plants is something to consider with awe.

I favor a layered and, therefore, insecure interpretation of the images that I produced. These photographs can be read in multiple ways, including scientific, material, symbolic, metaphorical, and posthuman interpretations. As concisely articulated by the philosopher Rosi Braidotti, our time calls for a point of view that is based on and/and, not either/or (Braidotti, 2019). A simple white dot on a black background can stand for a biochemical signal, a gesture made by the researcher, an expression of quantum mechanical relations, the moon, or even a full stop. The important point is that we recognize that information flows not only between humans, but that our entire environment brims with informational streams, connecting us not only to each other but also to such a complex and lavish creature commonly known as tobacco.

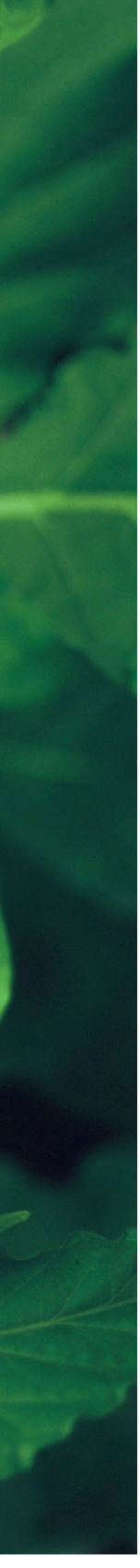
This relatively short exploration is part of an ongoing artistic investigation revolving around biosemiotics (the study of sign aspects in processes of life). The Newcotiana residency has provided me with new insights and has also sparked many new questions. Much remains unanswered and unexplored, bolstering my resolve to explore this line of inquiry further.

BIBLIOGRAPHY

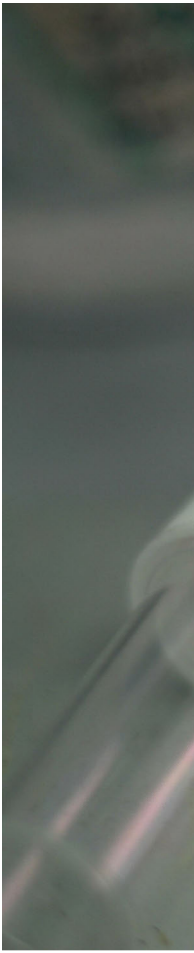
01. Braidotti, R. (2019). A Theoretical Framework for the Critical Posthumanities. *Theory, Culture & Society 36*, 31-61.
02. Dawkins, R. (1986). *The Blind Watchmaker*. Harlow, Longman.
03. Deren, M. (1960). Cinematography: the Creative Use of Reality. *Visual Arts Today*, Pp. 154-171.
04. Doing, K. (2020). Phytograms: Rebuilding Human–Plant Affiliations. *Animation 15,* 22-36.
05. Schiebinger, L. L. (1996). The Loves of the Plants. *Scientific American 274*(2) 110.
06. Schultz, P. (1998). Robert Mapplethorpe's Flowers. *History of Photography 22*, 84.

VISUAL ESSAY

by Karel Doing



falling in love with your tools

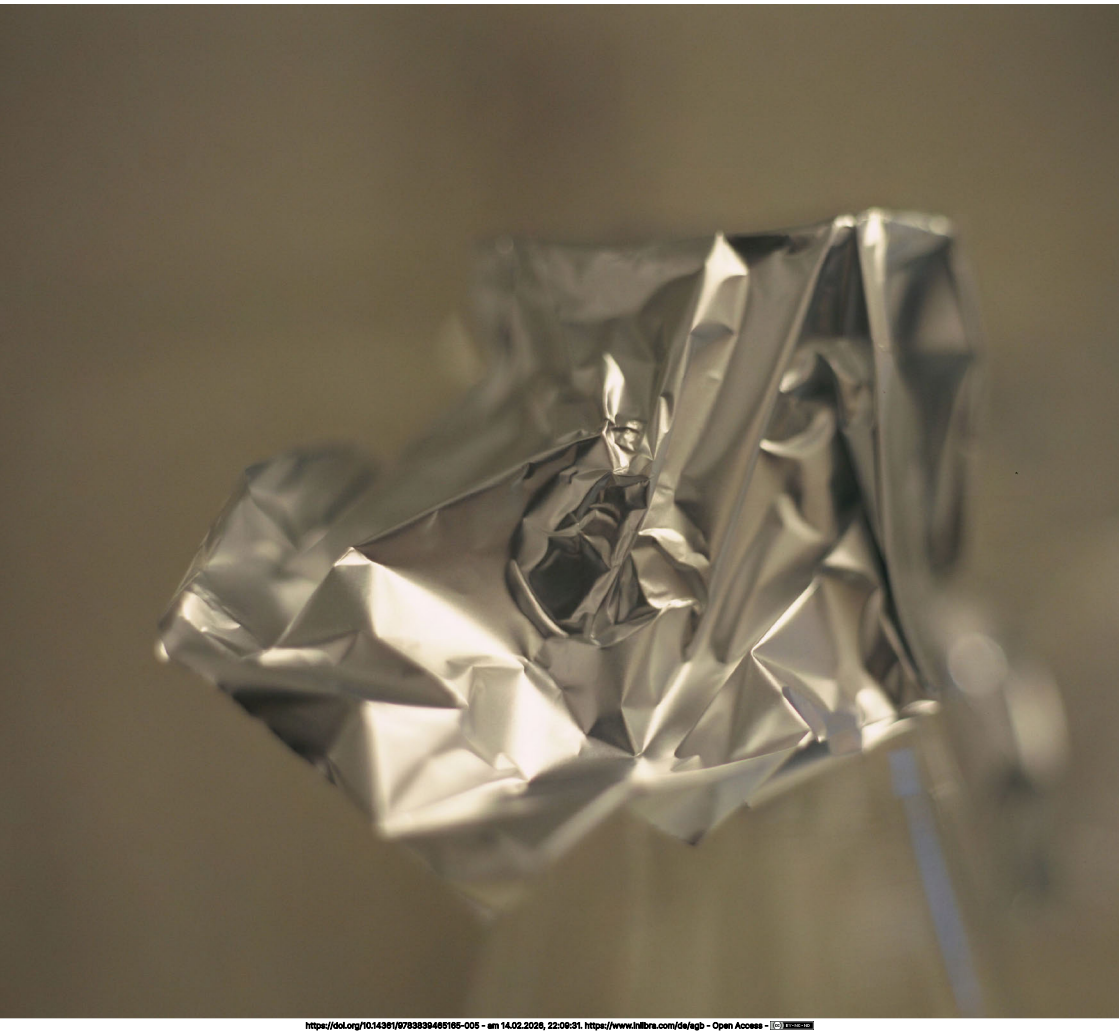


“...THE LAB SUDDENLY TURNED INTO A SPACE FILLED WITH SCULPTURES, INSTALLATIONS, AND PERFORMANCES, SIMPLY BY ALLOWING FOR AN ARTISTIC POINT OF VIEW TO BE INCLUDED.”

simple solutions for complex problems

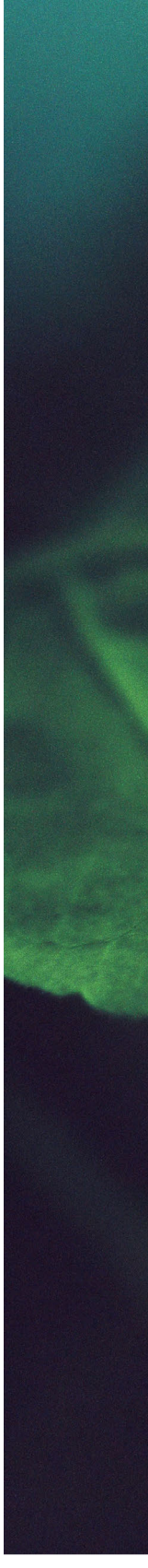
the absence of hands

“I ALSO TOOK A NUMBER OF ‘TRADITIONAL’ PHOTOGRAPHS FOCUSING ON REMARKABLE OBJECTS, TOOLS, AND GESTURES, AIMING TO HINT AT THE DEVOTION AND INTENSITY THAT IS REQUIRED IN THIS LINE OF WORK.”



spontaneous sculpture

"SIMPLE GESTURES, SUCH AS WATERING A PLANT OR INJECTING THAT SAME PLANT WITH A FLUID CONTAINING BACTERIA, DEFINE OUR AMBIGUOUS RELATIONSHIP WITH THESE LIVING BEINGS."



performance for plant and pipette

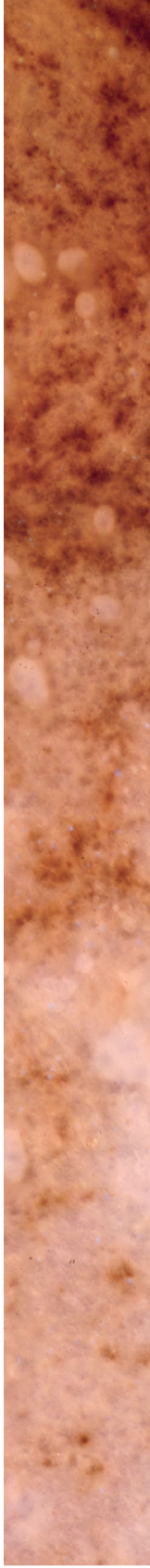
quest for a cure

cook, artist, or scientist?

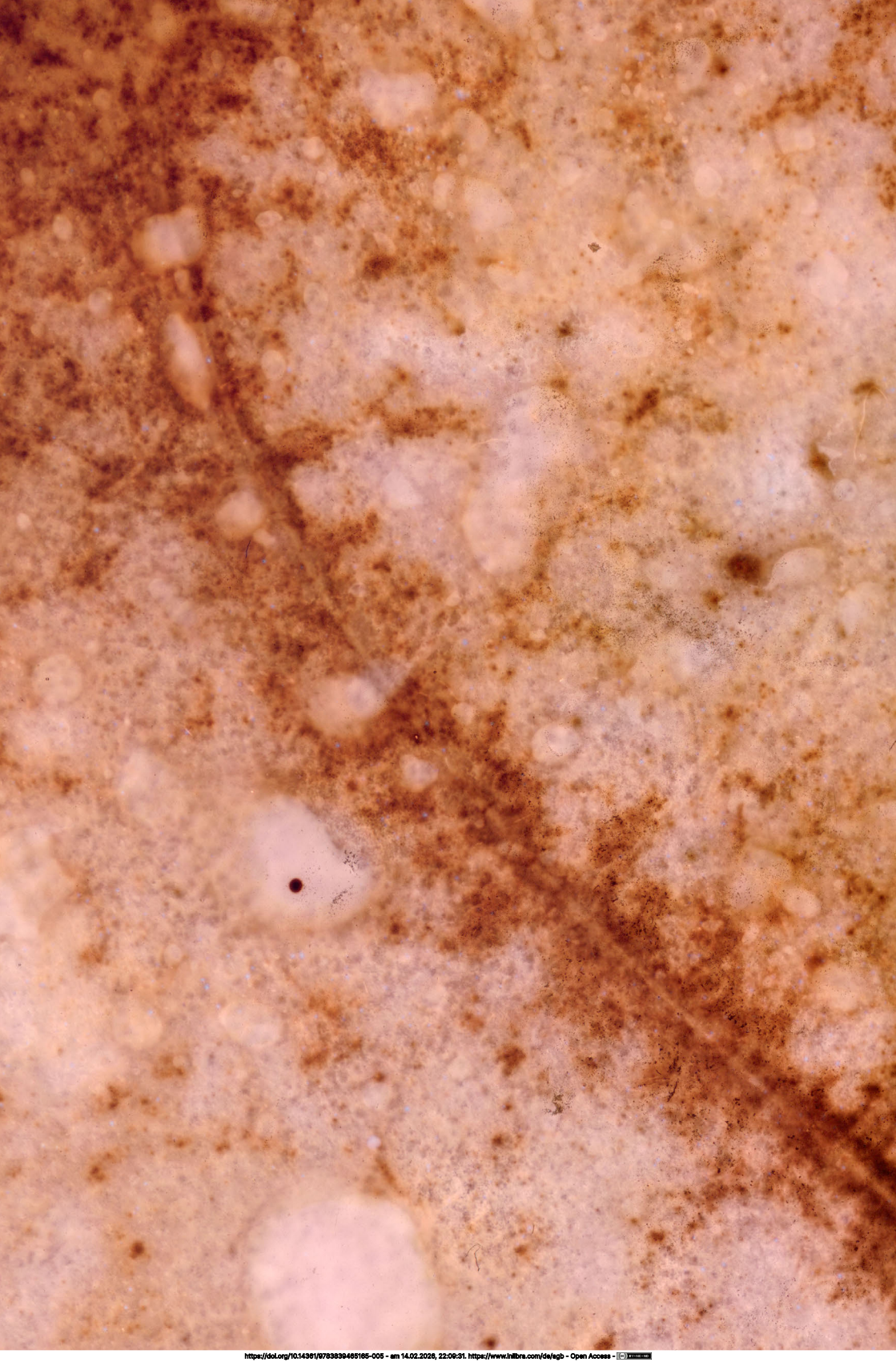
self portrait by *Nicotiana tabacum*

"FINALLY, I PHOTOGRAPHED A FLOWERING TOBACCO PLANT AND DEVELOPED THE ROLL IN THE JUICES OF THIS VERY SAME PLANT. AFTER TAKING THE PHOTOGRAPHS, THE FLOWERS WERE USED TO MAKE A STRONG 'TEA'. BY ADDING VITAMIN C AND SODA TO THIS LIQUID, I CREATED A WORKABLE PHOTOGRAPHIC DEVELOPER. THE RESULTING 'SELF-PORTRAIT' HAS AN OMINOUS QUALITY, IMBUING THE PLANT WITH A HITHERTO UNDISCLOSED FORM OF POWER."

"...I USED MATURE NICOTIANA TABACUM LEAVES, PREPARING THESE IN A VITAMIN C AND SODA SOLUTION. THE PRIMED LEAVES WERE THEN PRESSED ONTO PHOTOGRAPHIC EMULSION FOR SEVERAL HOURS. THE RESULTING IMAGE SHOWS THE STRUCTURE AND CHEMICAL MAKE-UP OF THE LEAF, BUT SIMULTANEOUSLY HAS A PAINTERLY QUALITY, RESEMBLING ABSTRACT EXPRESSIONIST PAINTINGS."

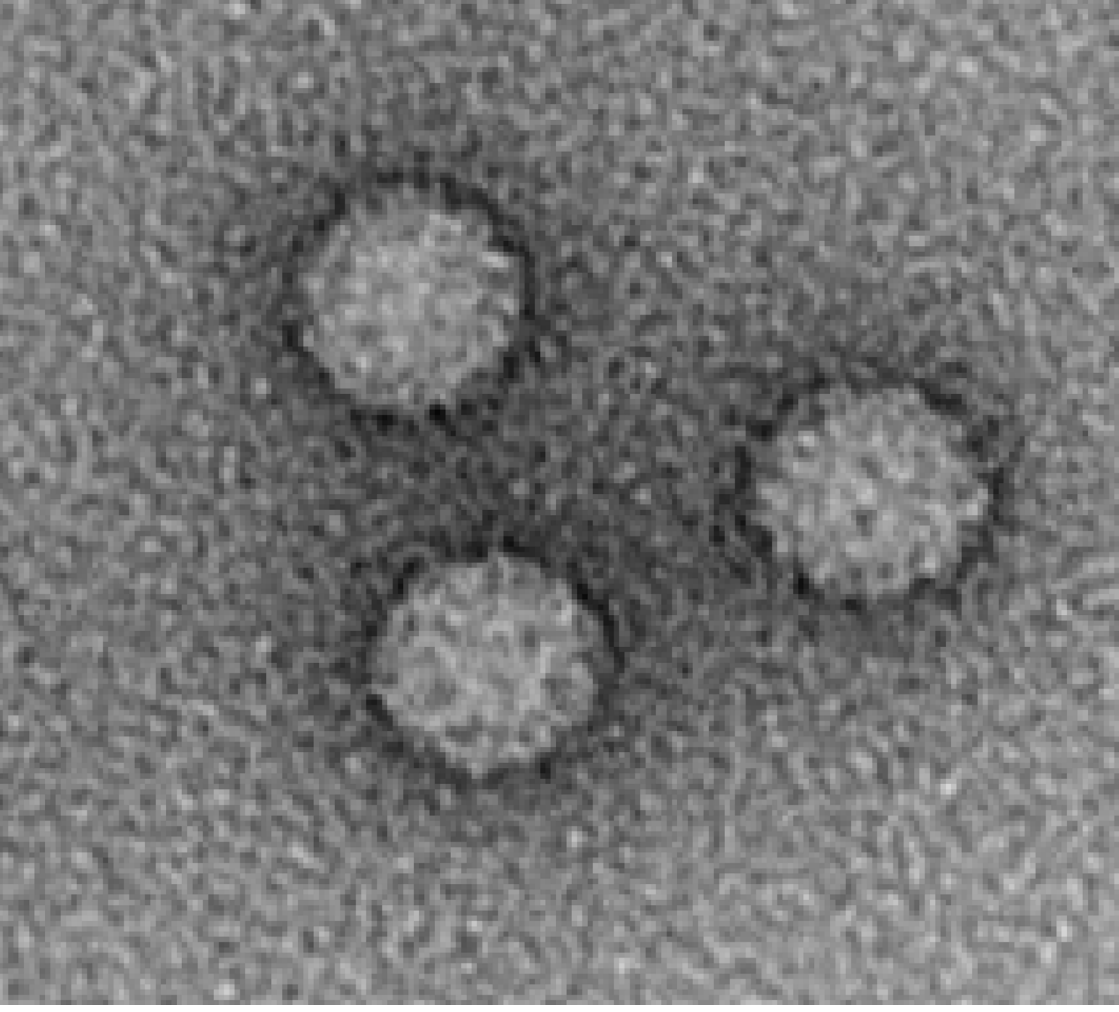


phytography revealing the vein of a leaf

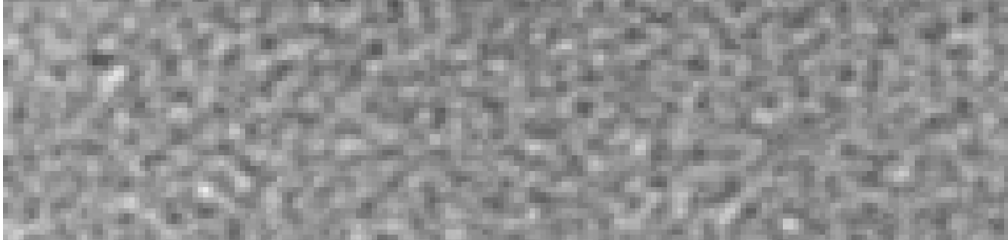


"I USED A PRIMED TOBACCO LEAF INSTEAD OF USING THE REQUIRED SECOND DEVELOPER. THE RESULT IS A SUPERIMPOSITION, A COMBINATION OF A CAMERA IMAGE AND A PHYTOGRAM, A DREAMY, ALMOST SURREAL IMAGE OF A SLEEKLY DESIGNED TECHNICAL TOOL."

plate washer with droplet reflecting the lab



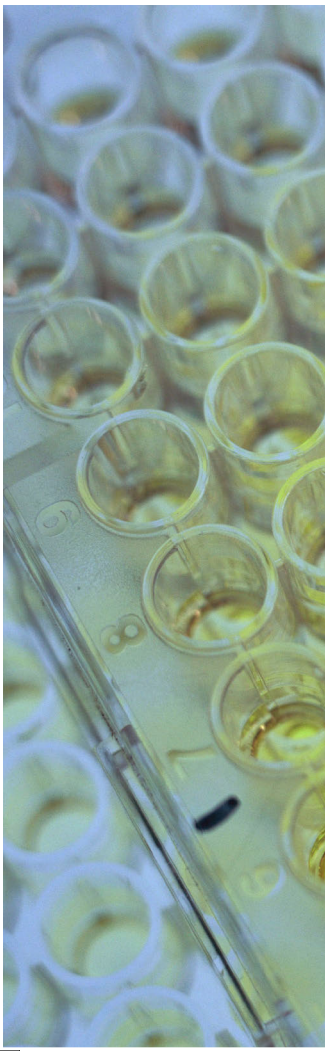
“…I LOOKED CLOSELY AT A NUMBER OF CRYO-ELECTRON MICROSCOPY IMAGES, IDENTIFYING A PATTERN IN A SEEMINGLY RANDOM DISTRIBUTED PROTEIN SWARM.”



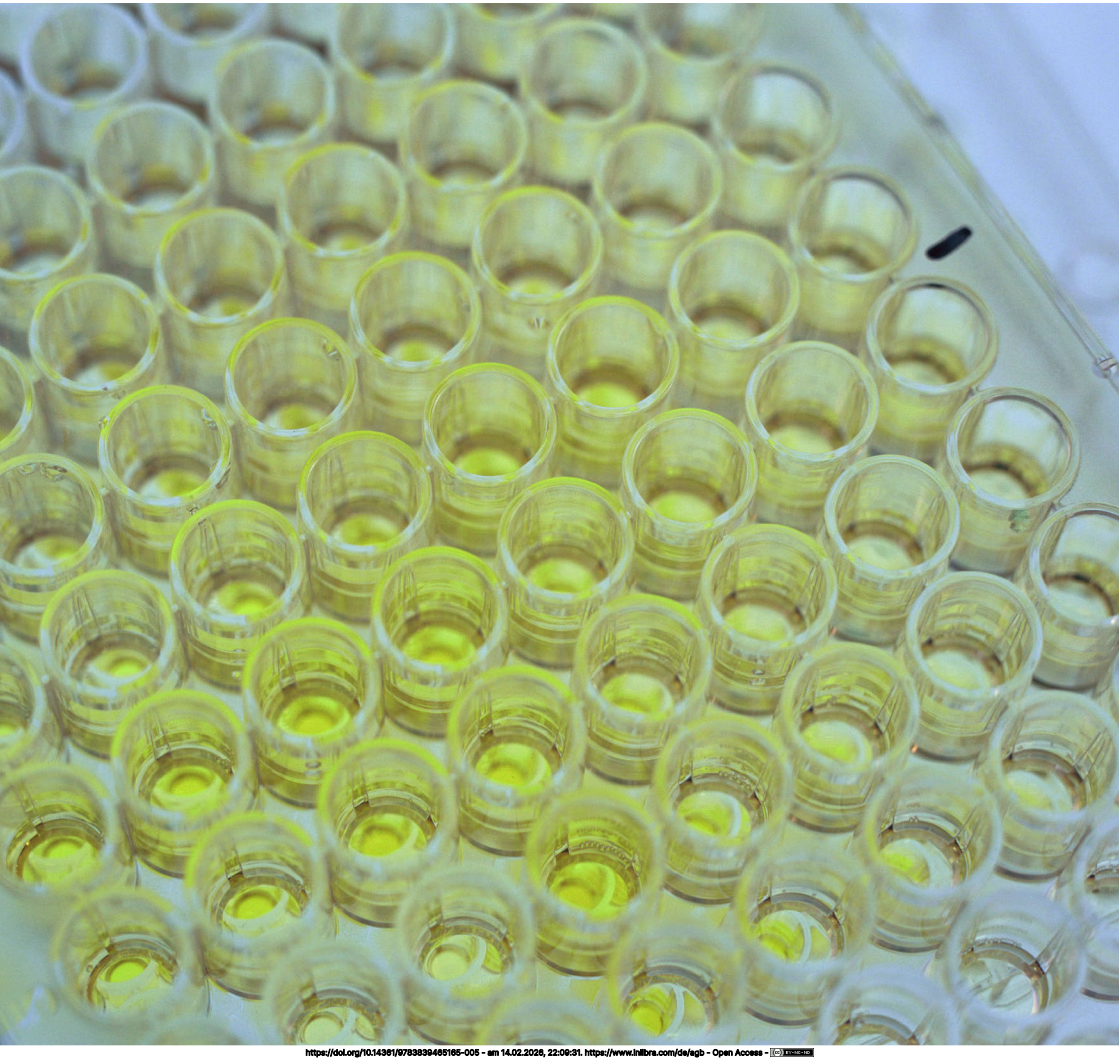
pareidolia in cryo-electron microscopy

“...I EXPLORED DOT BLOT AND GEL ELE<-TROPHORESIS BY ISOLATING AND ENLARGING THE BASI< SYMBOLS USED IN THESE PRO<ESSES. AN EVO<ATIVE IMAGE EMERGES BY <OMBIN-ING BOTH TOKENS.”

celestial blot plot and gel electrophoresis



sunrise on a stack of Elisa plates



"...I USED THE (MUCH SMALLER) LEAVES OF 'WILD TYPE' NICOTIANA BENTHAMIANA IN ORDER TO MAKE A PHYTOGRAM ON A LABORATORY HIGH SPEED FILM. BOTH THE FILM AND THE LEAVES ARE MUCH MORE DELICATE, RESULTING IN AN IMAGE RESEMBLING A CHINESE INK DRAWING."