SUBJECTIVE NATURE: GRAPHICAL DERIVATIONS FROM THE SCIENTIFIC IMPRINT OF TROPICAL TREE SEEDLINGS THROUGH PARAMETERISED TECHNOLOGICAL INTERFACES

Anne Heyvaert and Antía Iglesias Fernández

INTRODUCTION

Science, thought and art meet within the limits of reality, in how reality is understood and represented.. This is where the art-techne binomial materialises graphics, which in turn facilitate the faithful or fictionalised reproduction of our environment. The vocation of science is to advance explanations of the world through a supposedly objective gaze, and the vocation of art is to broaden this understanding by evoking other sensitive and unexpected perspectives. Given the historical relationship between printmaking and the dissemination of knowledge in all fields and the natural sciences in particular, we would like to present the graphic derivations of a collaborative experience between a printmaking artist-cum-researcher and a researcher in forestry science.

Figure 1

The experience: *A multidimensional approach to the plant: An art and science project* started at the end of 2021 when the author, Antía Iglesias, an art student from the interdisciplinary PhD programme in Creativity, Social Innovation and Sustainability (Universidade de Vigo, Spain) *(Fig. 1)* collaborated with another student, Marion Boisseaux, a PhD student in Tropical Ecology (Université de Guyane) during a research stay in French Guyana. The two students began a joint project to analyse and represent tropical tree seedling species (that Marion had selected in her DRYER project, which observed the effect of drought due to climate change) using their respective technical, numerical and graphical languages, and to provide multiple representations of the plants.

This paper aims to present this common experience through the description and analysis of the process that was followed, from a botanical illustration to obtaining graphic digressions from these plants. We will now focus on the derivations obtained from the digital biomimetic record, laser engraving, and printing experimentation.

We intend to delineate the path that runs along the limits of both disciplines and thereby highlight the possibilities of interpenetration between them. We would like to show how this cross-pollination can give rise to processes and results that may be of interest in the field of art, that are capable of modifying our general understanding of the environment, and that make visible that which we do not normally perceive.

We can thus observe how the scientific method, when applied to the direct register of the object through parameterised technological interfaces, can open up new perspectives for the printed image, based on the understanding of the record as a territory of the encounter between art and science. This allows us to approach the idea of the engraved image and the botanical imprint from both perspectives (Fig. 2).

The Dx5 digital and graphic art research group, of which both authors are members, is not only interested in what happens at the frontiers of technical processes and their conceptual motivations, but also in the encounter with other disciplines, especially the unstable grounds of art-science.

'The relationship and dialogue between art and science, between "intuitive knowledge and scientific knowledge", provides us with new ways of working

Figure titles and information:

Figure 1: *Flora of French Guiana*. 2022. Photograph. Antía Iglesias.

to construct expanded meanings of a knowledge constantly injected with new contributions from different fields' (Soler, 2016, pp. 226).

1. THE RELATIONSHIP BETWEEN ART AND SCIENCE

This research is framed within a concrete and conventional botanical study, which recalls former times when knowledge was not so fragmented and artists were considered objective observers of nature who participated in scientific expeditions *(Fig. 3).*

However, art and science gradually drifted apart throughout history, resulting in the fragmentation of knowledge at the end of the 19th century. Charles Pierce Snow, in his paper "The Two Cultures and the Scientific Revolution" (Cambridge, 1959), explains how, over time, the interdisciplinary figures that proposed a more rounded knowledge had been lost, leading to an ever greater division and specialisation of the disciplines: a 'hyper-specialisation that closes in on itself without easily allowing its integration into a global problematic or a conception of the object as a whole, of which it is not accustomed to considering more than one aspect or part' (Alsina, 2007, p. 15). The author invokes a new multidimensional knowledge that fulfils our eagerness to grasp the complexity inscribed in reality and proposes transdisciplinarity as 'the product of a dialogic vision of interconnected processes, where different forms of knowledge contaminate, merge, influence and hybridise with each other' and where art is 'a form of social construction of reality that connects with collective imaginaries' (Snow, 1959, cited in Alsina, 2007, pp. 15–17).

2. FROM THE DRAWN APPROACH TO DIRECT REGISTERING: IMAGE AND OBJECTIVITY

'The idea or essence (of an object or reality) is constructed from the notion of aspect, understood as the constitution of a reality (...). It is within this dualism of reality and graphic-conceptual configuration that science, thought, and art undoubtedly meet' (Samaniego, 2014, p. 37).

Graphical experimentation was initiated to produce an objective representation of species, much like the representations created by historical botanists such as the Bauer brothers or R. Hooke. 'To record things as they appear, only an honest hand and a faithful eye are needed' (Hooke, no date, cited in Samaniego, 2014, p. 53). But is mimetic illustration (or illustrated representation) objective? Are gaze and action of the hand neutral? Does thought influence them? These are the questions asked by the botanist, to which Antía adds, is it possible to mimetically reproduce the internal characteristics of plants from the perspective of a human eye?

Denise Najmanovich seems to have the answer: 'Our image of the world is not a representational copy. Our perception and our knowledge depend on the peculiar relationship we have with the world, which is by no means reduced to geometrical optics' (2012, cited in Soler, 2016, p. 211).

While Antía is making progress in her direct pencil and watercolour

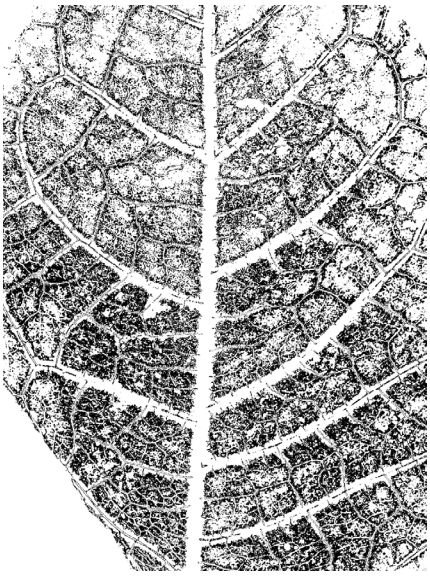

Figure 2

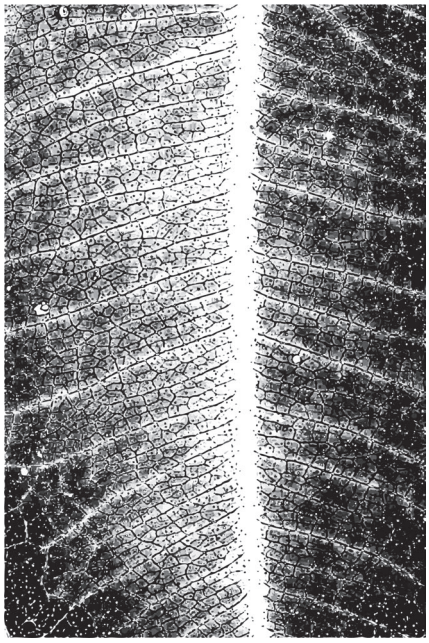

Figure 3

Figure 2: *Digital Matrix (3).* 2022. Leaf Scan ampliation Antía Iglesias.
Figure 3: *Digitalization of Eperua falcata leaves.* 2022. Leaf scan and vectorization. Antía Iglesias.

representations from life-nature, as well as in her questioning, Marion, on the other hand, is using the scanner to observe the venous system of the leaves of each species and determine growth periods and water retention mechanisms. It is at this point that the scanned image is perceived as the first “objective” graphic reproduction of the individual seedling.

Antía then decides to reorient her work from the direct records produced by scanning, seeking a greater visual and processual interaction with scientific research. She reflects on how to extract from these archives interesting visual images that complement the scientific meanings, both conceptually and symbolically. To do so, she intends to establish a guided work methodology that interferes as little as possible with the objectivity of the results and eliminates any subjective interpretation.

All graphic results obtained — botanical illustrations, engraved drifts, biomimetic representations, photographs — are collected in dialogue with the scientific data of each plant in an interdisciplinary publication that will soon be published by the Universidade de Vigo.

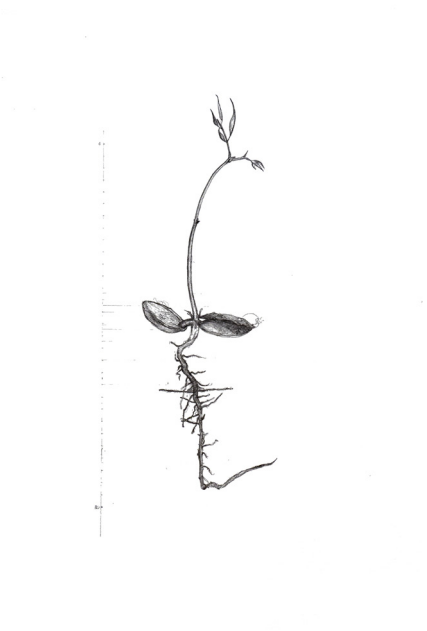

Figure 4

3. PATTERNED GRAPHIC PROCESSES AND TECHNOLOGICAL INTERFACES

The traditional scientific method used in research provides a clear and concise overview of the steps to be followed when carrying out a project and evaluating it. The main guidelines of the method, as it was conceived by its creator Galileo Galilei,are: ‘systematic observation, measurement, experimentation, hypothesis formulation, analysis, and modification of the hypothesis’.

This method is based on a rigorous, objective, progressive, rational, verifiable and replicable process. It reminds us, in some way, of the methodical and rigorous steps of engraving and printing techniques, such as the progressive realisation of matrices or the printing of an edition, in which all prints are made homogeneous by following a stipulated working pattern. As printmakers, we are very interested in the subject of sequenced and deferred times, whose intervals facilitate re-evaluation of the project and technical experimentation. The final image will be a derivation (or consequence) of this processual work, which is often different from the initial approach.

Therefore, in the end, we decided to produce images using engraving and printing techniques, based on the scanned imprint of the leaves. To do this, a rigorous, guided route is established in advance, with as little subjective intervention as possible:

– Sample collection. The leaves of the individuals previously collected by Marion are used. The selection is random.

– Scanning/first image (a direct record)
- Digital adjustments/simplification of the image (footprint

Figure 4: *Illustration of Eperua falcata.* 2022. Drawing. 35x50cm. Antía Iglesias.

scheme) *(Fig. 4).*

– Creation of a matrix by laser cutting
- Selection of speed and power parameters of the laser cutter/ (variable results according to cutting times)
- Generation of the xylographic matrix/hollow engraving of a wooden plate

– Direct printing without ink (transfer of ashes from the laser engraving process to paper and embossing)

The use of machines (scanner, computer, laser cutter) seeks to reduce the artist's subjective manual intervention and interpretation by shifting the weight of creation to the technological interfaces. Well-defined protocols enhance the relationship between the proposal and the result (Heyvaert, 2020, p.35). Marco Moreira delves into this theme in his doctoral thesis, demonstrating how an interactive gadget, with its inherent interactivity, operates in the production of a work of art by connecting the viewer with the author through the physical manifestation and the procedural memory of the technical process.

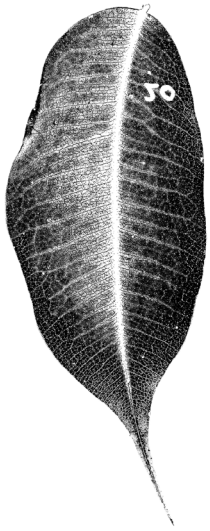

Figure 5

Although the decisions regarding some steps, such as the simplification of the image or the choice of cutting times, for example, may seem subjective, these decisions are nevertheless motivated by the process itself, such as the need to simplify the image to send it to the laser cutter. In any case, the rigorousness of the procedure, with precise, predefined guidelines for all images, facilitates their repetition and replication at all times, like in any scientific research process, thereby guaranteeing a certain objective uniformity of the final images. In our case, this process is a path to follow rather than a corpus of preconceived rules and principles (Leal, 2010).

4. RECORD, SCAN, AND IMPRINT

We aim to arrive at an essential and elementary representation of the study object, i.e., tree seedlings from the Amazonian rainforest. The image recorded by the scanner allows us to capture the formal characteristics of the plant in detail: outline, colour, texture, and the structure of the nerves.

Science tells us that this internal distribution of nerves makes up the vascular tissue of the leaf, which is composed of veins and pathways that describe the identity of each individual, like a fingerprint. Botany studies how the internal patterns of leaves either evolve or are maintained as an identity in some species. Therefore, the image of the veins — the botanical fingerprint of the leaves and buds in a state of growth — refers to the primordial identity of that plant.

By adjusting the digital scan file to make it suitable for laser engraving, the internal drawing of the nerves will be highlighted on a greyscale by modifying the focus and levels until a high-contrast black image is obtained.

Figure 5: *Digital Matriz (2).* 2022. Scan. Antía Iglesias.

In this way, the image is simplified and all superfluous information is eliminated, achieving the synthetic appearance of a footprint, or a structural map *(Fig. 5)*.

It is curious to observe how the initial scanned image, photographic in appearance and collected by light in contact with a flat surface, now seems to be generated by pressure as a direct imprint.

Didi Huberman, in the book "La ressemblance par contact", underlines that the imprint is nothing but a simple sample, an "extraction" of reality, which produces a resemblance to the referent but not an optical representation. It is opposed to the distancing of the gaze since it is generated by contact; Didi Huberman questions its status as a "non-work" because it does not include the subjectivity inherent to art. However, he recalls that many artists have made use of the technical resource of the imprint for its heuristic, plastic, and allegorical value.

Ana Soler reminds us that the concept of "im-printing", understood as a complex anthropological fact for the generation of images in the "age of technical and digital reproducibility", is directly related to the following ideas: footprint-fingerprint, trace, and memory. The latent image, the intangible matrix, is the footprint of the invisible (Soler, 2016 p. 222).

Didi Huberman finally rescues from the imprint its auratic quality and authenticity, precisely because of the initial contact with the original referent. The footprint is the survival of a referent that is no longer there but is related to it, that is, to the origin/the original. We are approaching a more scientific understanding of the leaf imprint and its pattern of veins.

Figure 6

5. LASER ENGRAVING OF THE MATRIX

The latent image of the digital file can be considered an intangible matrix since it can be multiplied through digital printing or can be shared virtually. However, in this project, the authors decided to further investigate other aesthetic and material possibilities by creating a physical matrix via a laser engraving of the scanned and adjusted image on wood.

To do this, we opened the file in the RDworks interface so that we could launch it on the laser cutter. After carrying out several tests on a 1.1 scale, we decided to investigate the composition of the image by bringing the point of view closer and changing the scale, opting for larger format matrices. By readjusting the selection through cropping and image enlarging, we not only obtained shapes of great plastic value, wherein the relationship with the referent is surpassed (or transcended) but also observed other interesting (or suggestive) connotations, related, for example, to the landscape or cartography *(Fig. 6).*

For the matrices, 4 mm pine plywood sheets were chosen due to their organic relationship with the subject matter, and because plywood is an

Figure 6: *Invisible Paths.* 2022. Non-inked xilography. 50x35cm. Antía Iglesias.

ideal material for laser engraving. The laser beam concentrates light at a point on the surface of the target material and raises its temperature until the material evaporates. The heat erodes the material, leaving an almost imperceptible trail of ash that will be of great interest when printing.

By varying the amount of information in the digital file, we will have variable engraving times, which can last for more than 8 hours. When we stopped the engraving process before the end and re-engraved another plate with the same file, we noticed that the machine had taken a different route after restarting. If we stop the process and repeat it, we will always obtain different temporary designs. Hence, the machine determines the design by favouring the appearance of interesting intermediate "possible states" of the matrix *(Fig. 7)*. The artist Enrique Leal highlights a creative co-authorship linked to the technical processes in many contemporary graphic projects, which he calls a 'confluent reciprocity between matter, machine, and ideation' (Leal, 2018, p. 246).

Figure 7

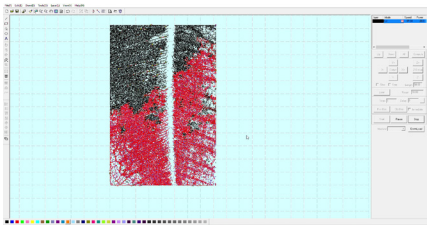

Figure 8

Figure 9

6. PRINTING/THE FINAL IMAGE

Once the woodcut matrix has been obtained, it is printed and the search for the final images begins. We decided to start by investigating some embossed prints without ink. We were surprised to see that, by using damp paper, the remains of the ashes from the heat engraving process of the laser cut remained stuck to the paper *(Fig. 8).*

The image gains presence thanks to the tactile quality of the embossed image — the counter form of the matrix — that is enhanced by the discreet tones of the residual ash, which also refer to the matrix-making process. This contact by pressure between surfaces — the act of printing — and the exchange of properties between them (Guzzeti, 2021, cited in Penone, 2021) allow us to make a tactile reading of the matrix object (Fig. 9).

The ash trace is ephemeral, volatile to the touch, and sensitive to environmental changes on paper. The embossing, however, is long-lasting; the texture that is barely visible, but touchable, remains and speaks to us of perenniality, through a literal — scientific — interpretation of the internal structure of the plant leaf and the physicality of its veins.

Giuseppe Penone says his prints and frottages of plants and trees at the exhibition "Sève et pensée" at the BNF in France 'make visible the tactile memory' of the elements (Penone, 2021). We are very interested in this dimension of his work, at once material, poetic and spiritual, and its close connection with nature.

The process finally reveals a sequencing of matrices and traces: image-fingerprint, intangible matrix/physical woodcut matrix/tactile imprint on the print, and final image.

Figure 7: *Landscape abstraction.* 2022. Laser cutting on wood. Antía Iglesias.
Figure 8: *paths-ways of a laser.* 2022. Capture of software Roadworks. Antía Iglesias.
Figure 9: *Detail of Invisible paths (leaves).* 2022. Non-inked xilography. 50x35cm. Antía Iglesias.

7. CONCLUSION

This experience of art and science led us to verify that the established methodologies of scientific research are similar to those in engraving and printing systems, thus facilitating the reformulation of initial objectives in relation to the results obtained. Jesus Pastor talks about the potential of the system in contemporary multiple arts, which allows us to reflect on the production of works from phenomenological foundations and extend their limits.

Our intention in maintaining as much "scientific" objectivity as possible, by using technology and machinery and seeking to limit the subjectivity of the hand, has led us to graphic results that are loaded with symbolism and great communicative power.

Technological devices and the innate morphogenetic properties of matter generate unforeseen results, making possible a poetic evocation of unprecedented meanings, questioning the subject/object binomial, and instrumentalising the creative process (Leal, 2018, p. 246).

On the other hand, the obtained images, which have been simplified and interpreted by the machines, broaden our understanding of the internal structures of the leaves more effectively than the mimetic appearance made by hand, complementing scientific analysis. Their materiality enables us to actively learn about their characteristics through the tactile and tangible experience of embossing. Previous theoretical concepts, usually represented by simple graphics or flat images, are now manifested in a physical dimension (Fig. 10).

Penone insists on the need for art to astonish, surprise, and evoke emotion to understand the world in a more intentional, conscious, and sensorial manner.

Figure 10

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Figure 10: *Atelier.* 2022. Photography. Antía Iglesias.

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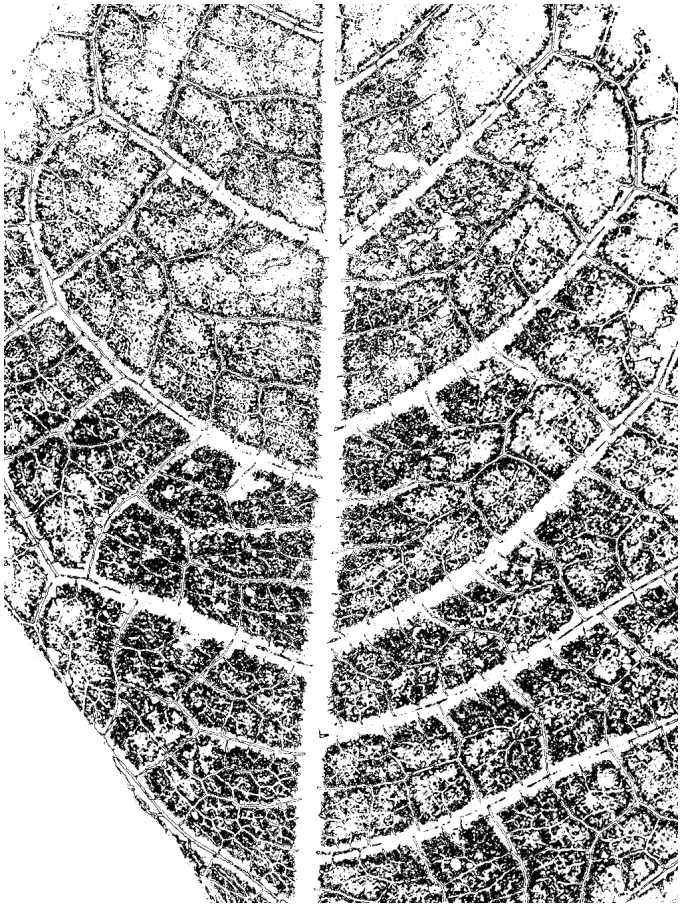
IMAGE GALLERY



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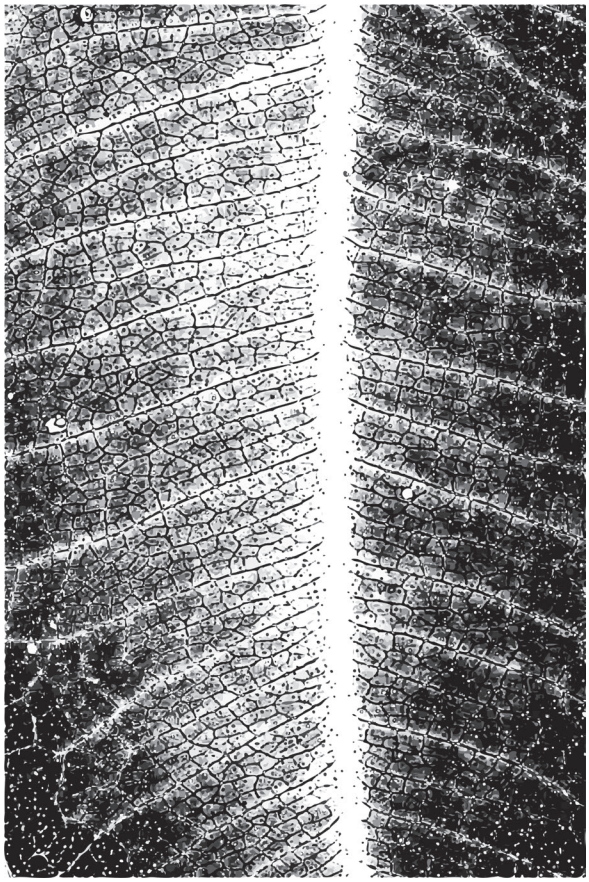

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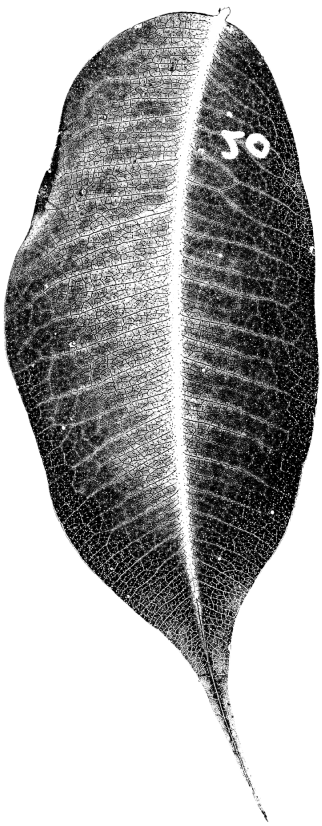

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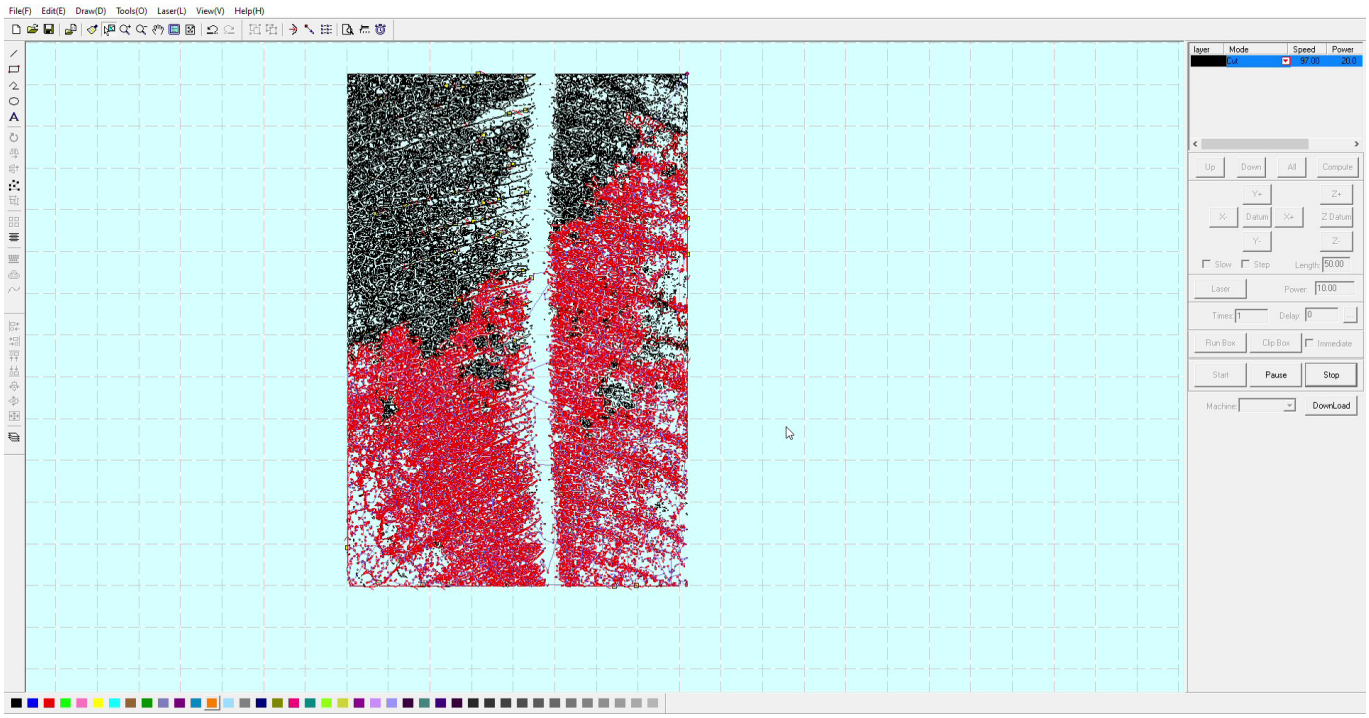

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