Niklaas Görsch:
“Tree Blossoms”

in: Eric Hounshell, Ruth Amstutz (eds.):

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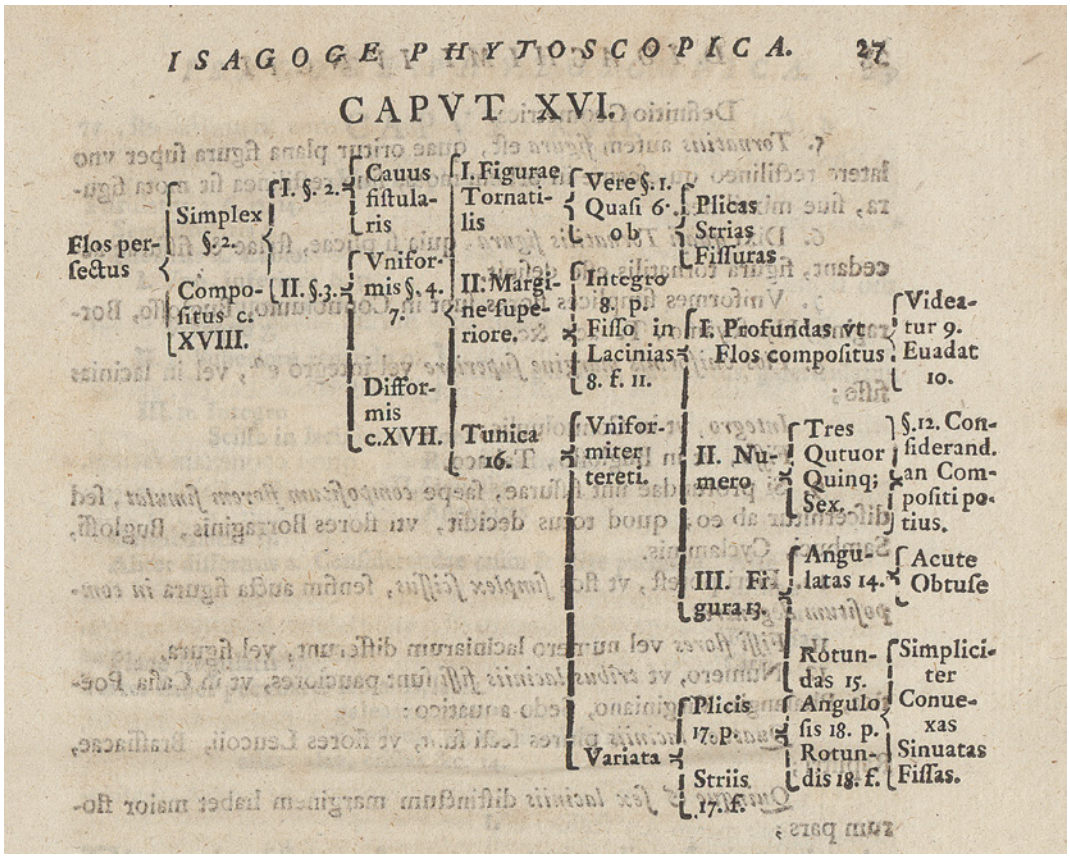
SHADOW OF THE TREE

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Niklaas Görsch

TREE BLOSSOMS Jungius's Decision Tree

This chapter deals with analogies between seventeenth century dichotomous diagrams, also known as Ramist diagrams or synoptic tables, and contemporary plant identification apps. Joachim Jungius (1587–1657) made a far-reaching methodological decision in his investigations of plant morphology. He decided to apply mostly dichotomous diagrams. Though he was neither the first naturalist to do so nor the last, he was the first to apply them from the perspective of morphology. Nowadays he requires some introduction, but in former times the polymath Jungius was a famous scholar known by Leibniz (considered by some the first "computer scientist" without computer), Goethe, and Humboldt. The naturalist Jungius's morphology of plants, explained in his *Isagoge Phytoscopica* (1678), was a fruitful contribution in early modern botany. Jungius's published predecessor of the decision tree and identification keys marks a systematization of plant organs but not a classification of plants themselves.



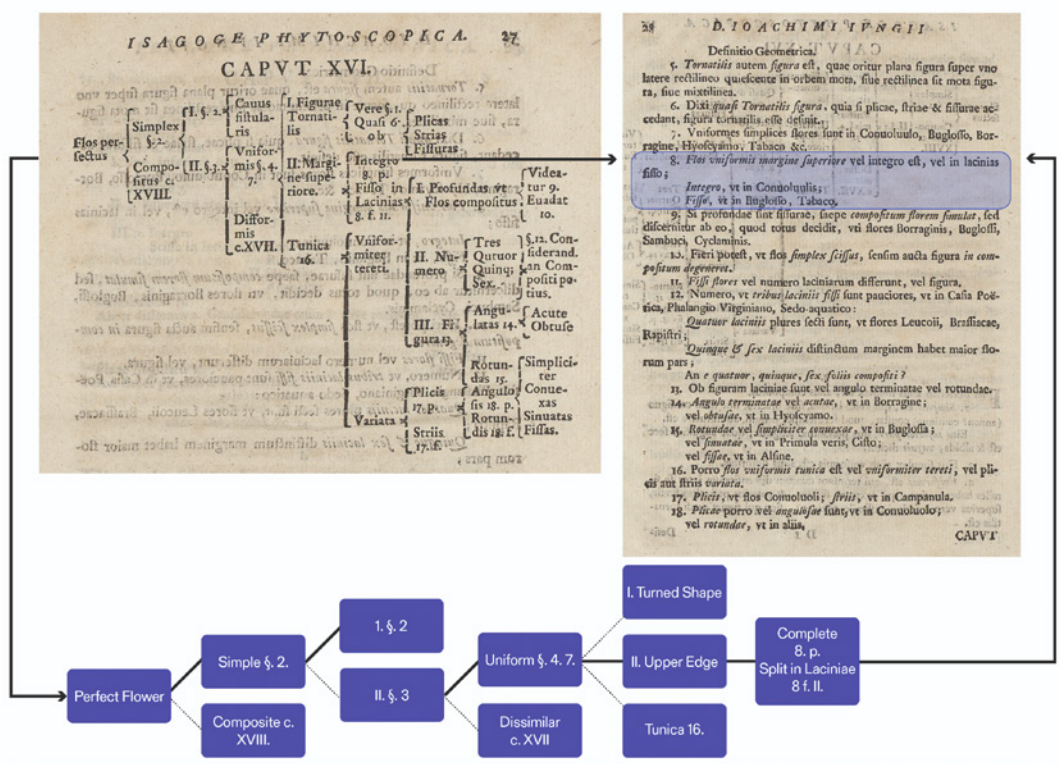
Joachim Jungius: *Isagoge Phytoscopica*, republished by Johann Sébastian Albrecht, Coburg: Georg Ottonis (1747).
Original edited by Johannes Vagetius, Hamburg: Pfeifferus (1678).
Online: https://www.e-rara.ch/zut/content/titleinfo/5896696.

Jungius's classification of tobacco in the *Isagoge Phytoscopica* illustrates the method of the decision tree.
The diagram is read from left to right. The tobacco plant flower is at the end of the following path: *Flos perfectus –> Simplex –> Uniformis –> Margine superiore –> Fisso in Lacinias –> ut in Buglosso, Tabaco.* The path is readable like a sentence: tobacco has got a perfect flower that is simple and uniform with an upper edge that is split in laciniae. The flower will be dissected into pieces. Therefore, a first decision is necessary as to whether the tobacco flower is "perfect," meaning that the flower has a perianth, a stamen, and a pistil. This blossom is perfect, so it goes into the subordinated category within the perfect flower. One asks another question to further narrow it down.



Nicolás Monardes: *Simplicium medicamentorum*, translated by Carolus Clusius, Antwerpen: Christophorus Plantinus (1579). Online: https://www.e-rara.ch/zuz/content/titleinfo/9431271.

One of the oldest printed images of a tobacco plant. Jungius held a later edition of Monardes's book in his library, so he probably had this image of a tobacco plant in mind or had seen a real specimen. If Jungius indeed knew the plant only from seeing it in a book, we have here an interrelation of books and their information provided via image or text. Writing a text from that which has been seen is a transcription that is only possible with certain terms that are understood by everyone. Defining things with simple terms is one of Jungius's most important approaches. He also aspired to enable his students to draw plants on the basis of these simple terms alone.



How to read Jungius's diagram. Schematic elucidation of Joachim Jungius: *Isagoge Phytoscopica*, republished by Johann Sébastian Albrecht, Coburg: Georg Ottonis (1747). Original edited by Johannes Vagetius, Hamburg: Pfeifferus (1678).
Online: https://www.e-rara.ch/zut/content/titleinfo/5896696.

Schematic elucidation by NG showing the path that starts on the left with *Flos perfectus* (perfect flower) and ends within the corresponding text passage about *Tabaco* (tobacco) on the right. This method works with an either-or principle between the paths and an "if A and if B then C" principle moving on prescribed paths. When the reader's eyes compare the reference in the diagram to a passage in the text, they must now consult the index to find the plant name in question. In seeking the passage about the plant in the text, the reader uses the text according to the diagrammatic structure. Thus, the text becomes an extended branch of the tree-like diagram and can be seen as part of the diagram. The plants that can be found in the text contain the features of the corresponding path. Furthermore, the reader can walk the path in both directions, though within a section there are sometimes more than one species. In this case, tobacco and *Anchusa* pertain to the category "split in laciniae," but belonging to the same category says nothing about the natural relatedness of both plants. This is consistent with Jungius's aim to provide morphological propositions, although he also made notes about the relatedness of plants in his *Doxoscopiae physicae minores* (1662) and in his unpublished manuscripts.

"In its binary organization, as anyone who knows computer programming sees immediately, the Ramist dichotomized outline is in fact nothing other than a computer flow chart. One can, however, hardly have a successful computer operation until one has a computer. This neither Ramus nor Zwinger had, but there can be little doubt that both would have welcomed one."

Walter J. Ong: *Interfaces of the Word: Studies in the Evolution of Consciousness and Culture*, Ithaca, N. Y.: Cornell University Press (1977), p. 177.

Ong saw early modern dichotomous diagrams like those by Jungius as predecessors to the computer flow chart.

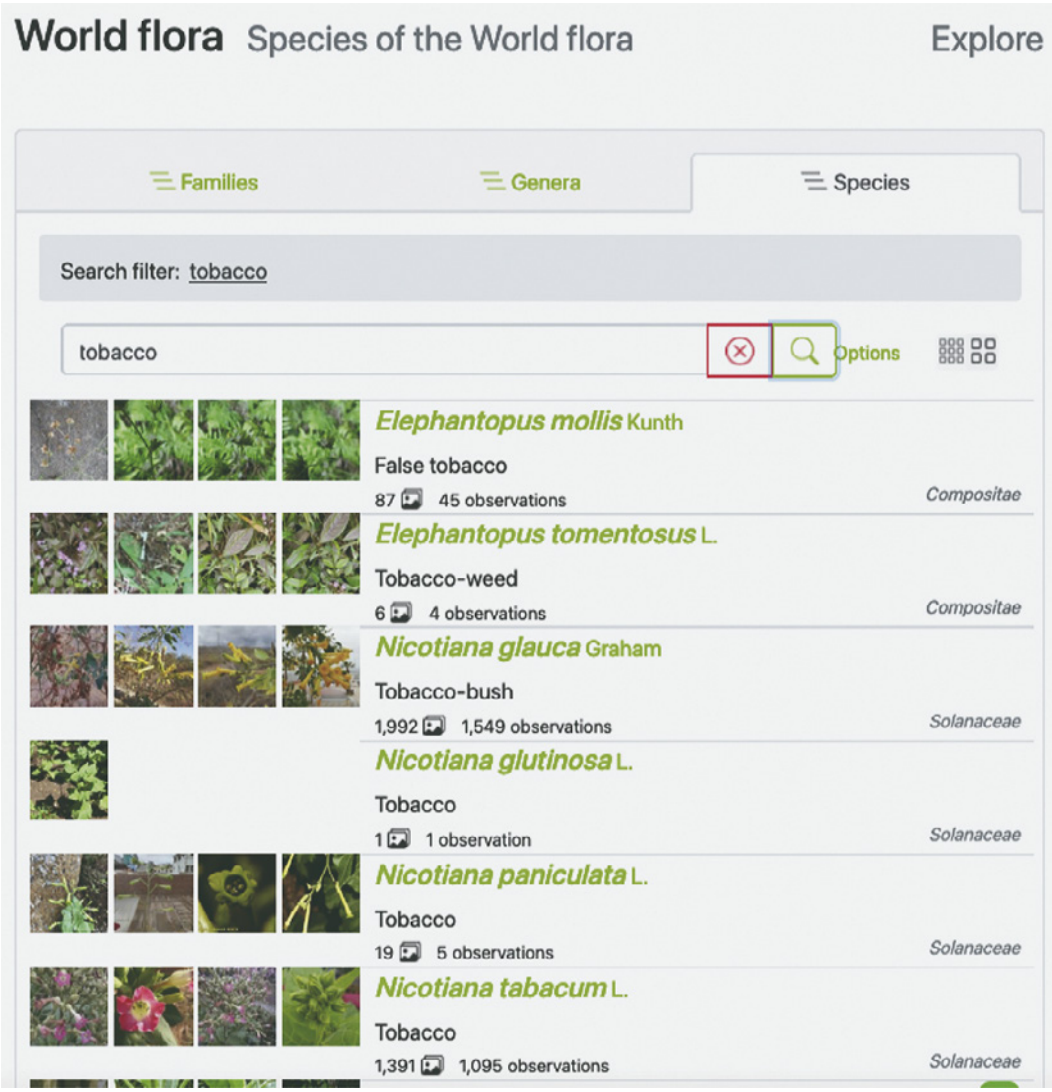
TREE BLOSSOMS Republic of Pictures

In ambiguous cases, an old-fashioned field guide uses the concept of an identification key in order to determine a specific plant. It allows you to compare as many descriptive attributes as needed such as color, whereas the machine behind a present-day app makes the decision that gains the most information, if possible, with zero impurity or pure leaf nodes. If the impurity is higher than zero it becomes more difficult to identify a specific plant part or plant. Texture classification and feature extraction are quite common techniques for current plant identification apps. These apps include, for instance, *Seek*, *Flora incognita,* or *PlantNet*. The latter is an open-source application working with an image database and image-recognition techniques with a handful of decision trees. These trees and the *PlantNet* community help the user make decisions about the plant species based on the images captured.
Decision trees can serve to classify objects, to tell what kind or category of object it is. That sounds easy, but one basic problem is to decide beforehand which categories shall exist. To get the best possible classification, one needs to know what is the right feature, what type of question one can ask, and at what point within the tree. The best question is the one that reduces uncertainty the most in order to climb, speaking in botanical terminology, from the roots along the branches to the leaves. In the case of plant identification apps, different decision trees could be implemented to use the concept of the random forest, where many decision trees are combined. A certain decision tree as well as Jungius's diagram both depict parts of a greater whole. *PlantNet's* decision tree supports the search for individual plants within the huge world of plants. Jungius explained plant parts as a subworld of the whole world of knowledge in order to identify plant species as well.

"Compare your sighting with books only after the notes are made. Having the book at hand during the note-taking will only interfere with the process. Many possibly good and valid records have been tarnished because the observer consulted a book before finishing the notes. As a result, the description often is that of the picture in the book, not of the actual live bird seen."

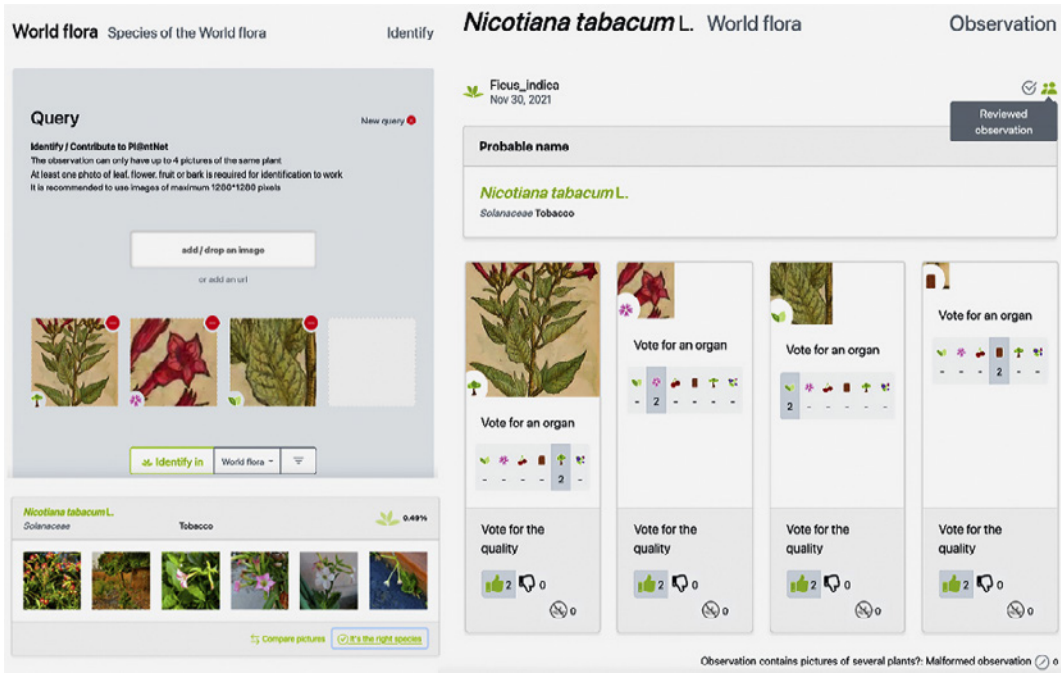
Chuck Bernstein: "Details on Details: Describing a Bird", in: *Western Tanager* 50/6 (1984), p. 2.

The wisdom of crowds: as James Surowiecki writes on the intelligence of groups, an important factor of a crowd's intelligence is that the individual member of a group does not get "corrupted" before making a decision or sharing an opinion.[1]



Screenshot by the author of search return for "tobacco," *PlantNet* World flora, https://identify.plantnet.org/k-world-flora/species?search=tobacco.

The *PlantNet* website makes it easy to search for families, genera, and species of plants. In this case, the English name for *Nicotiana tabacum,* tobacco, was entered to search for an existing database for this plant species. For the identification and classification of plants, an unambiguous nomenclature as well as a clear distinction between families, genera, and species are extremely practical, as one can see on the *PlantNet* website. Both things Jungius did not have in his time. John Ray, Joseph Pitton de Tournefort, and Carl Linnaeus later took the necessary steps for handling the mass of plant data.



Screenshot by the author of online form for identification of *Nicotiana tabacum L.* parts in illustration by Nicolás Monardes (1579) by vote, *PlantNet* Identify, https://identify.plantnet.org/the-plant-list/observations/1012357427.

Here, the illustration of a tobacco plant, published by Nicolás Monardes more than four centuries ago with a medical intention, becomes its own and searchable data set. On the left side is the input area for images representing specific plant parts. On the right is the vote of the *PlantNet* community. The combination of characters like the flower, leaf, fruit, or bark improves the probability of the identification of the plant. *PlantNet's* community may also help you to find the correct species.

If we assume that Jungius did not primarily try to classify plants themselves, the binary way of decision-making as well as the distinction of features or characters to identify objects are the important similarities between those seventeenth century diagrams and current decision trees in machine learning. The principle of relating features within a path-like structure with if-then linearized rules has become a common tool today, for instance, to estimate the probability of outcomes in a situation with multiple causes and factors. If the machine has learned enough, it even can predict future events. Jungius was not searching for predictions. His primary aim was to find the smallest parts of plants to understand the meaning of nature by arranging the elements together afterwards. But this difference is not surprising since the aims of decision trees vary widely. The method itself is a contribution to science in the sense that you can end up with results that the initiator did not have in mind at the beginning. Although the objectives are different, the functionality of the early modern naturalist's diagram shares similarities with contemporary tools in computer science, as Walter J. Ong already pointed out. On the one hand, there is this observation and analysis tool, on the other the observed objects. In both times, some people knew to bring them together in a similar way: with trees and paths within trees and visualizations of correlations or relatedness. Jungius's botanical work would not have been possible without his network, his students, and worldwide trade. The former Republic of Letters has become a human collaboration

working with effective engines and many pictures of plants as a kind of citizen science. There is another story behind this: Jungius, John Ray, and other naturalists tried to find solutions for storing and comparing information, as predecessors of identification keys. All those approaches are completely done by human brainpower and skills for distinguishing characteristics of plants. In contrast, present engines made by humans calculate similarities, and human beings support them if necessary. The next probable step is an engine that at some point will have learned enough to no longer require humans.

Notes

1 James Surowiecki: *The Wisdom of Crowds: Why the Many Are Smarter than the Few and how Collective Wisdom Shapes Business, Economies, Societies and Nations,* New York: Doubleday (2004).

Further Readings

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John Law, Michael Lynch: "Lists, Field Guides, and the Descriptive Organization of Seeing: Birdwatching as an Exemplary Observational Activity", in: *Human Studies* 11/2–3 (1988), pp. 271–303.

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Staffan Müller-Wille: "Botanik und weltweiter Handel: Zur Begründung eines natürlichen Systems der Pflanzen durch Carl von Linné (1707–78)", in: *Studien zur Theorie der Biologie* 3 (1999).

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Jürgen Schmidhuber: "Gottfried Wilhelm Leibniz: Der erste Informatiker", in: *Frankfurter Allgemeine Zeitung* (19.05.2021).

Plant identification apps (selection):
Flora incognita, https://floraincognita.com.
PlantNet, https://plantnet.org.
Seek, https://www.inaturalist.org/pages/seek_app.