



HAL
open science

Variations on a tree

Pascale Kuntz, Bruno Pinaud

► **To cite this version:**

Pascale Kuntz, Bruno Pinaud. Variations on a tree. European Journal of Combinatorics, inPress, pp.103808. 10.1016/j.ejc.2023.103808 . hal-04227314

HAL Id: hal-04227314

<https://hal.science/hal-04227314>

Submitted on 3 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Variations on a Tree

Pascale Kuntz^a, Bruno Pinaud^b

^aUniversity of Nantes, LS2N UMR 6004 CNRS, France

^bUniversity of Bordeaux, LaBRI UMR CNRS 5800, France

Abstract

The family tree is like an inherited “object” that has been passed down through many generations, with many and varied definitions which distort the tree both as a combinatorial object and in its visual representations. Moreover, whether used by amateur genealogists or academic researchers, it is always contextualized by both validated exogenous knowledge and by implicit knowledge. In this paper, we explore introducing certain contextual information that is associated with a locally defined dissimilarity between individuals of the same generation. We propose a new heuristic based on a radial representation of a node-link model which seeks to preserve local proximities in the layout. This heuristic is applied in an original form, which is that of Pierre Rosenstiehl’s “scientific family tree”.

1. Introduction

What is a family tree? Unwittingly, the basic definition used in various articles tends to come to mind: a rooted binary tree. Human lives, however, can distort even the most rigorous of mathematical models. If we take the example of ‘natural’ children, a fairly common phenomenon, how does one go about including them in such a model? It is worth noting that, in late 19th-century France, almost 9% of all births were natural children, most often from an unwed mother and an unknown father (Maksud and Nizard, 1977). One would also need to take divorces into account: from 1884 on, when divorce was reintroduced in France, the number of divorces increased steadily with just a few noticeable fluctuations due to wars, which, although preventing applications and judgments while in progress, were followed by significant increases: the divorce rate reaching 21.9 per 100 marriages in 1946 (Sardon, 1996). There is also the question of endogamous marriages and their resulting births, with these representing at least 3% of all marriages –and up to double that amount for certain years– in late 19th-century France (Sutter, 1968). French law also permits marriages between sisters- and brothers-in-law, and between cousins, as well as between aunts or uncles and their adopted nephews or nieces. A ‘true’ family tree, therefore, often strays from the binary format, and, depending on the family, may not even entirely be a tree!

In addition to its definition as a combinatorial object, a family tree is intrinsically linked to its representation, in other words, its ‘taxiplanie’ as Pierre Rosenstiehl would have expressed

Email addresses: `pascale.kuntz@univ-nantes.fr` (Pascale Kuntz), `bruno.pinaud@u-bordeaux.fr` (Bruno Pinaud)

it (Rosenstiehl, 2006). Starting from our ancient heritage of the Roman aristocracy’s *stemmata*, it took over fifteen centuries for what the historian C. Klapisch-Zuber, author of a landmark book on the history of family trees, considers to be the first ‘family tree’ to appear (Klapisch-Zuber, 2000). The tree of the Babenbergs, a noble dynasty who ruled Austria until the end of the 13th century, surfaced in 1491 within the Habsburg Empire where genealogy was a long-standing tradition. It is “one of the oldest images to perch real individuals, living people or their ancestors in the branches of an actual tree”. The historian also specifies that “the internal organization of the ‘genealogy’ is not at all obvious at first glance (...). Only upon close examination is one able to follow the path of the tendrils leading from a father to his sons. This deciphering work reveals how the artist carefully weighed the significance of each of his lines between the medallions: if we exclude any errors in restoration, these lines correspond to real, historically proven family ties”. It is, therefore, considered to be the representation –on a flat surface (in this case, an enormous painting)– of a graph, wherein the vertices are individuals and the edges are family relationships. Over time, the tree began losing its ornamental attributes, becoming more of a diagram and thereby more closely resembling contemporary family trees.

The relationship between the combinatorial object and its graphic representation is thus part of a much bigger historical picture. Digital technology allows us today to include exogenous information contextualizing the ties of filiation that form the tree. The medallions that spread throughout medieval Christian Europe to the Ottoman world already carried a great deal of heterogeneous information. Recent progress in digital humanities, however, has thoroughly overhauled the ways in which we are able to access exogenous knowledge and allows us to create embeddings in ‘semanticized spaces’ where the relationship between vertices no longer comes down to presence/absence but to semantic proximity. In this paper, we explore introducing contextual information that is associated with a locally defined dissimilarity between individuals of the same generation. We propose an heuristic based on the radial representation of a node-link model which seeks to preserve local proximities in the representation.

This article is structured as follows: Section 2 goes over several important stages in the history of family trees that we deem useful in terms of grasping both the ambiguities surrounding their definitions and the legacy constituting our modern imagination. Section 3 presents an overview of the information visualization literature, which is very limited. Section 4 discusses the notion of contextualizing family trees, and, in Section 5, we describe our new heuristic. In Section 6, this heuristic is explored in an original form, which is that of Pierre Rosenstiehl’s “scientific family tree”.

2. From the roots up

The spread of the family tree, which emerged as such at the turn of the 15th century, was facilitated by recent printing techniques. However, as C. Klapish-Zucker points out, “its meteoric rise within the Renaissance culture and its continued rule during the modern era is not enough to make us forget the sluggishness and uncertainty of its progress. It took centuries to develop and settle upon a diagram that today seems so familiar and self-evident”. Its genesis prompts one to examine the interconnection of two aspects: the system of relationships which it models, and the tree metaphor for its spatial representation, that became rather rife in the Middle Ages and the Renaissance when treed figures positively blossomed. In those days, a tree had a trunk, sometimes with bark, with straight or gnarled branches, leaves or flowers, and it could even take root against a rural backdrop under skies enlivened by birds. Then, towards the end of the Renaissance, as if reconnecting with the graphic style of Late Antiquity’s art of memory, the tree lost “the elegance

and verdancy of the previous century: it was often merely a rigid and symmetrical placeholder”! Surprisingly –although perhaps because this object might be overlooked due to its obviousness in the landscape–, research into the history of family trees is scarce, and it is difficult to draw any conclusions from it in terms of an inventory of its definitions as a combinatorial object and its visual representations, since these aspects are constantly intermingled (Butaud and Piétri, 2006). It seems, however, that the tree structure for representing a system of family ties arose both from the usages of this system and from the usages of the tree in other fields. Below, we endeavor to identify certain significant stages in this evolution, some of which still appear to resonate with us today. Let us note that these representations are restricted to trees from European culture alone, without questioning this choice (see Schneider (1984)’s critique).

According to the anthropologist J. Goody, a specialist in both the history of the family and in social transformation though the development of writing and schema, the symmetrical bilateral forms of representation “emerged in the context of the calculation of prohibited degrees of marriage” (Goody, 1983). Roman jurists attempted the visual representation of family relationships in order to settle matters of inheritance based on calculations of distance (gradus) between generations. However, it was rather the metaphors of flows and humors –blood and sap– that guided those representations. Even though their legal usage was carried forward over the centuries, this only concerned a tiny fraction of the population for whom this graphic also served to frame and revere their dynasty. This spacialisation of family chronology also made it possible to account for the passage of time. The hierarchical layout which used Ego, placed in a central position separating the ancestors –of which the most distant occupy the highest spatial position– from the descendants, met the criteria for these different uses. This diagram became known as the ‘tree of law’ (arbor juris) at the end of the Late Middle Ages, although it would require other influences in order for it to become a ‘family tree’.

The Trees of Jesse that flourished upon the stained-glass windows of churches are certainly one of the major sources of tree imagery. The tree’s form makes it possible to sketch a single consolidated unit, which fundamentally distinguishes it from linear textual narratives, with its timeline running from Jesse as the root to Christ as the summit. However, as the historiographer A. Watson pointed out, “It is not of the essence of this imagery that (...) the tree should have an explicitly genealogical motif” (Watson, 1934). In the Early Middle Ages, the term ‘arbor’ also referred to classification diagrams, and, more generally, to scientific presentations. These diagrams were used to describe and steer analyses. They became educational tools for the scholasticism that developed in medieval universities. This burgeoning role of images finally led to what was dubbed ‘visual exegesis’ (Collard et al., 2018) in the Late Middle Ages. Diagrams, which represent the interdependent relationships between the components of a system, can be found in numerous fields: “consanguinity trees, diagrams of astronomical or natural history themes, images of the human being as a microcosm, of the earth’s circle and the like. More pervade the literature and display an often astonishingly high level of drawing skills” (Melville, 1987). The tree became one of the preferred methods for modelling a system of relationships. In the 15th century, the combinatorial object broke away from its religious imagery and its plant metaphor to more broadly represent ‘real’ genealogies. The standardization of the symbols representing the sexes, as well as the distinction between conjugal and filial ties, are much more recent additions and are due to the work of geneticists in the first part of the 20th century, followed by that of anthropologists and sociologists.

3. Digital visualization of family trees

Surprisingly, despite the lengthy history of family trees and their ever-increasing popularity of late due to the rise of archive digitization, relatively few works have been published in the information visualization and graph drawing communities, and, as Bahl wrote, “new academic visualizations are fairly rare” (Ball and Beck, 2017). The list of a dozen or so publications can be organized into two main viewpoints:

- representing the set of ancestors/descendants of a given person (*i.e.*, individual-centric perspective);
- representing an entire family with several generations and the ties between them (*i.e.*, family-centric perspective).

Roughly speaking, resolving the first challenge often consists in visualizing a tree (Keller et al., 2010) and various representations were explored. The second challenge resorts to approaches developed in large network visualization (von Landesberger et al., 2011).

3.1. Individual-centric perspective

Most of the visualizations consider an idealized family tree with one marriage per individual only, no endogamy and the same father for children from the same sibling. The latter can be defined by a rooted binary tree (Borges, 2019; Keller et al., 2010) –also called a “pedigree chart” or an “ancestor tree”–, which represents the direct ancestors or descendants of the central individual associated with the root. It can be visualized with *e.g.*, a typical, layered node-link diagram or with concentric circles organized into a fan chart.

A key concern is the readability of the different generations. Concentric circles of the fan chart are well-adapted to this purpose: from a central node associated to the root, a first larger concentric circle is divided into two sectors and is added to its parents, then sectors associated with each parent are surrounded by a new sector that is divided in two for each ancestor, and so on. Moreover, with a dual-tree (McGuffin and Balakrishnan, 2005) both descendants and ancestors can be represented simultaneously, with an upward tree representing the ancestors and a downward tree representing the descendants. Radial diagrams were also developed in order to estimate the age difference between individuals more precisely: nodes are arranged on concentric circles representing years, and thus the age difference between two individuals (Keller et al., 2010). To show all the children of a family in their birth order, McGuffin and Balakrishnan (2005) suggested connecting the first child to his/her parent only via a specific node representing their union, and then connecting the second child to the first one, and so on. To handle “real life patterns”, more complex structures such as multi-trees were also explored by McGuffin and Balakrishnan (2005).

However, these node-link tree representations face certain well-known limitations. The number of considered generations has to be limited in order to maintain a readable visualization and the tree has to be well balanced to remain visually appealing, as well as for its efficient placement in the given space. Consequently, visual alternatives for large genealogies with thousands of individuals, wherein missing data may also easily occur, were explored. Space-filling curves turned out to be quite promising. H-Trees were able to highlight that part of the genealogy where data was missing, while using space efficiently (Tuttle et al., 2010). Generalization to hierarchical directed acyclic graphs, where nodes are arranged in vertical or horizontal layers, also made it possible to add generations: Marik (2017) proposed a simple and efficient algorithm for partitioning nodes into layers, based on a non-directed spanning tree on the original graph.

3.2. A family-centric perspective

The family-centric perspective focuses on the family unit, as opposed to only on the ancestor and descendant set for a given individual. On this scale, it is possible to adapt several large network visualization algorithms (Ball, 2017). In parallel to the popular node-link paradigm, matrix-based visualizations were explored. GeneaQuilts (Bezerianos et al., 2010) was proposed for studying large genealogies with up to several thousand nodes. It is a diagonally-filled matrix where rows are individuals, columns represent a family, and generations are arranged in blocks on top of one another. To follow temporal evolution specifically, Plaisant et al. (1996)’s seminal work led to the creation of a time line paradigm: two lines overlapping on the same x -coordinate indicate two contemporary people. This proposal was hybridized with a node-link tree diagram by Ball (2017). Lines may also “converge/diverge” to indicate marriage/divorce and edges may be added between lines to indicate children (Kim et al., 2010). It is worth noting that, beyond the academic literature, representations of large genealogies also led to art exhibitions for a much broader public (Xiang et al., 2020).

4. Contextualization of trees

To our knowledge, there is no existing reference work on the uses of the family tree. The status of its use in the academic field, despite the fact that it is to be found in most disciplines of the humanities and social sciences, is difficult to assess. It is but a mere component of “genealogical science”, which in turn is considered in the academic classification as “auxiliary” to history. Anthropology contributed to its codification, but usage deviated from the initial definition: as F. Weber notes, “[The anthropology of kinship] developed a powerful analytical tool, the kinship schema, which proved sufficiently flexible to be detached from the classical models that had generated it” (Weber, 2013). Outside of the academic field, increased accessibility to digital archives has seen a substantial growth in amateur genealogists: in France “more than 60,000 enthusiasts are active members of genealogical associations, and more than 6 million people have carried out family requests (...) and genealogy is the third most popular leisure activity in Brittany according to Internet searches” (Mergnac et al., 2013). However, these digital-age practices are also poorly documented. By empirical observation, one can nevertheless deduce that the family tree –whether used by amateur genealogists or academic researchers–, cannot be reduced to an n -ary relationship for a group of individuals. Not only it is embedded in a geometric space that affords it a graphic representation, but it is also always contextualized by both validated exogenous knowledge through the historian and by implicit knowledge, as well as individual and collective imagination.

From a functional point of view, there is still much debate surrounding the definition of contextualization. A database of over 150 definitions of the term ‘context’ in various disciplines (computer science, philosophy, economy, etc.), compiled some fifteen years ago by P. Brézillon, attests to the difficulty of the task. The definitions reflect the multi-dimensionality inherent in the concept, and various taxonomies were put forward in an attempt to identify the diverse dimensions involved (Brézillon and Gonzalez, 2014). Moreover, the many and varied definitions of a family tree and the lack of surveys regarding its uses makes direct application of the state-of-the-art challenging. We thus decided to settle for Winograd’s definition (2011): “Context is a set of information; this set is structured and shared; it evolves and furthers interpretation”. Although not entirely functional, this definition contains the ingredients for a contextualization of family trees based on their intrinsic link to their visual representation.

A few simple examples of family tree contextualization in information visualization were put forward. The visualization of vertices was enriched with graphic glyphs to represent dates of birth and death, or marriage (Borges, 2019). The alignment of each individual with a timeline was also developed (Nobre et al., 2019). Generally speaking, contextualization can be included through the use of two complementary approaches: adding exogenous textual or visual information to the tree’s components, or via the tree’s diagram by integrating additional information into its representation. The first approach is at the crossroads of knowledge engineering and information visualization. It consists in identifying, organizing and integrating contextual elements in (at the vertices and edges) and around the drawing. The second approach involves integrating the information that complements the definition of the binary relationship into the modeling of the drawing issue. Introducing a dissimilarity into the set of vertices seems to be a promising approach, as The Encyclopedia of Distances by Deza and Deza (2013) reveals by identifying the wealth of possibilities that this offers.

In addition to the binary relationship defining the set of edges, let us consider a dissimilarity on the set of vertices. Basically, the issue lies in embedding the tree in a geometric space while preserving, in this representation of it, an easy understanding of its hierarchical structure, which is a major factor when considering interpretability. Using geographical information in genealogy is a common practice. The dissimilarity can thus be a distance between places associated with individuals (*e.g.*, places of birth or death). The wide range of semantic similarities –of which the monograph by Harispe et al. (2015) lists several hundred– also opens up the way for other dissimilarities that could account for the affinities between concepts associated with the tree, such as an those between individuals’ chosen professions.

5. A layered radial drawing with local dissimilarities

In the following, we consider an individual-centric family tree. In order to preserve the mental map of the genealogist, we favor a bi-dimensional layered drawing where the layers represent the successive generations. Additional contextual information is introduced via a local dissimilarity that is defined on each vertex subset associated with each layer. In the application presented in Section 6, the local dissimilarity is a geographical distance.

Our family tree representation was inspired by the processor diagram of “Le labyrinthe des jours ordinaires” (Rosenstiehl, 2013) which combines time and space. Herein, we consider a radial drawing where the root v_0 is placed at the origin, and where layers are visualized with concentric circles centered on the origin. Specifically, the layered tree $T = (V, E, \phi)$ consists of a set of vertices $V = \{v_0, \dots, v_{n-1}\}$, a set of edges E and a function $\phi : V \rightarrow \{0, 1, \dots, k-1\}$ that maps each vertex to an integer between 0 and $k-1$. Let $L = \{L_0, \dots, L_{k-1}\}$ be the set of k layers where each layer L_i contains the vertices of value i for $\phi : L_i = \{v_j \in V; \phi(v_j) = i\}$. The radially layered drawing of T on a set of k concentric circles $C = \{C_0, \dots, C_{k-1}\}$ is such that each vertex v_j of L_i is drawn as a point of circle C_i . The radius of C_{i+1} is assumed to be greater than the radius of C_i . Additionally, we consider a series of local dissimilarities $\delta_1, \dots, \delta_{k-1}$ defined between the vertex pairs of each layer L_1, \dots, L_{k-1} .

The objective is to combine, as much as possible, the following three aesthetic and semantic requirements: (i) minimizing edge crossings on the radial drawing, (ii) maintaining layering, and (iii) preserving an isometry between the local dissimilarities δ_i and the angular distances between the neighbouring vertices on the circles C_i . The specific problem depends on the chosen criterion for evaluating the isometry. However, to our knowledge, it has not been tackled in the

graph drawing literature to date. In practice, since common aesthetics (i) is renowned for being with respect to achieving readability (Purchase, 1997), and the constraint (ii) is closely associated with the family tree interpretation, we herein consider a simpler version of the problem where the isometry is relaxed. We present a new heuristic which approximately preserves the order between the distance values: for each layer L_i , vertex pairs with small δ_i values are placed close together on the circle C_i and far from the vertices with high δ_i values. The heuristic can be decomposed in four sequential steps illustrated by Fig. 1 for the first three and Fig. 2 for Step 4:

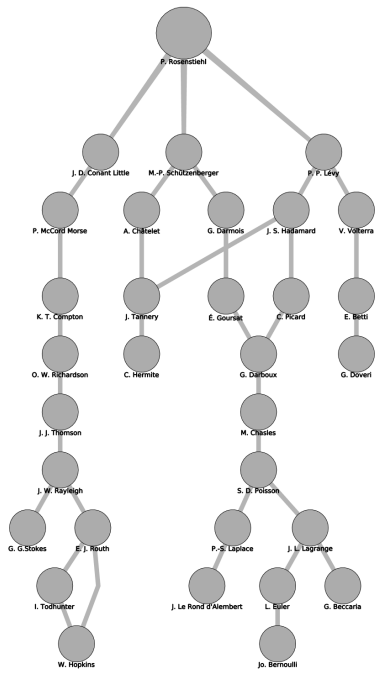
Step 1. The mapping ϕ of the vertices of V to an integer associated to a layer is determined from an initial layout built with the Sugiyama’s heuristic (Sugiyama et al., 1981). It is worth noting that this heuristic firstly assigns vertices to layers in order to minimize the length of the longest edge –an edge between two vertices in adjacent layers L_i and L_{i+1} has a length equal to 1. It then orders the vertices in each layer to reduce the number of edge crossings. Let $\Pi_i : L_i \rightarrow \{1, 2, \dots, |L_i|\}$ be the left-to-right order of the vertices of L_i deduced from the Sugiyama’ drawing.

Step 2. For each layer L_i , vertex pairs whose δ_i dissimilarity is below a given threshold τ are grouped together to form a meta-vertex. Several meta-vertices can be defined on the same layer, but their intersection is empty. Let M_i denotes the set of meta-vertices of L_i , and let $Q(T)$ be the resulting quotient graph: each vertex of $Q(T)$ is either a free vertex of V that has not be re-grouped or a meta-vertex, and each edge is either an edge between two free vertices adjacent in T or an edge between a meta-vertex and a free vertex adjacent to a vertex of this meta-vertex in T . An edge is added between each vertex of a meta-vertex and its adjacent vertex in T . This trick makes it possible to maintain close vertices for δ_i close in the final radial embedding. From the perspective of the de-grouping phase for the final result, a size is associated to each meta-vertex: it is equal to the Euclidean diameter between its vertices in the Sugiyama’ layout.

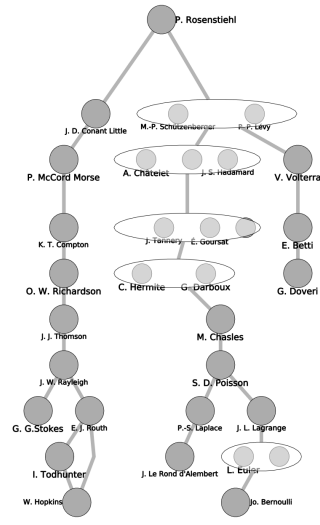
Step 3. The quotient graph $Q(T)$ is drawn with a radial graph drawing algorithm. We selected the MoireGraphs approach (Ma and Jankun-Kelly, 2003) which has two pertinent properties with respect to our particular application. Firstly, it is based on a spanning tree on $Q(T)$ that respects the vertex ordering from the Sugiyama’ drawing. Secondly, contrary to several algorithms that assign the same small size to all of the vertices, the MoireGraphs approach takes vertex size variations into account. Specifically, spaces proportional to their sizes are allocated to meta-vertices, thus avoiding vertex overlapping in the de-grouping phase. In addition, this algorithm computes area-efficient drawings where vertices are clearly spaced out with respect to one, regardless of the diameter of the circle.

Step 4. The meta-vertices are de-grouped in the $Q(T)$ radial drawing in order to visualize the original family tree T . More precisely, the de-grouping strategy is based on the left-to-right order Π_i of the vertices on each layer L_i . For any meta-vertex of M_i , its first vertex is placed at its coordinates on the circle C_i of the $Q(T)$ radial drawing, and the other vertices are then successively placed on C_i in clockwise direction, at a distance from the first one proportional to the sum of their Π_i rank and to the C_i diameter.

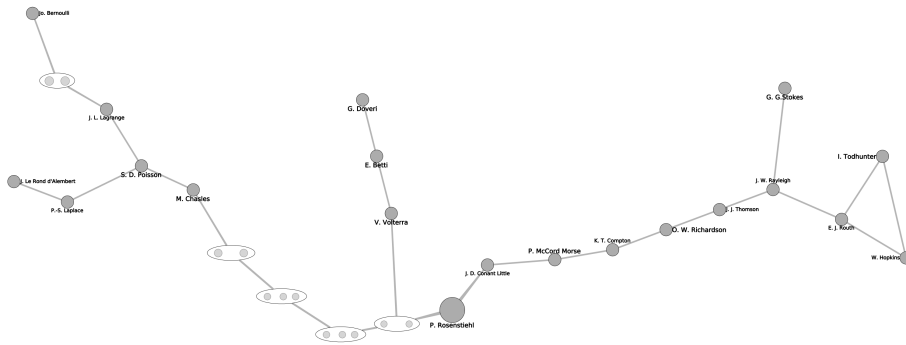
By combining a “smooth” δ_i preservation between the vertices of the meta-vertices, an area-efficient placement on each circle, and a layering from the Sugiyama’s heuristic, this new heuristic produces a readable family tree representation which integrates additional contextual information. Our application was carried out using the Tulip information visualization framework (Auber



(a) Step 1: Sugiyama' layout



(b) Step 2: Meta-vertex construction



(c) Step 3: Radial drawing

Figure 1: Illustration of the main steps of the heuristic

et al., 2017) with its Python API. This framework contains the Sugiyama and MoireGraphs algorithms as well as functionalities for adding information to each vertex.

6. Application: Pierre Rosenstiehl’s scientific family tree

Our application differs from standard family genealogies. We consider the “scientific family tree” of Pierre Rosenstiehl, built using the data from the Mathematics Genealogy Project (<https://genealogy.math.ndsu.nodak.edu/>). More specifically, taking Pierre Rosenstiehl as the root of the tree, we extracted the direct genealogy of the doctorate supervisors. For instance, Pierre Rosenstiehl had three supervisors: Marcel Paul Schützenberger, Paul Pierre Levy and John Dutton Conant Little. Each of them had one or several supervisors, and so on. A generation is a subset of supervisors at the same shortest path distance from the root.

When building a family tree, we are required to decide how many generations to consider. The psychologist Anne Ancelin-Schützenberger, wife of Marcel Paul, who contributed to the development of psychodrama and transgenerational analysis in France, advocated going back six or seven generations, “to the Revolution (in 1789, and particularly to 1793, the Reign of Terror and the Guillotine, even more vividly traumatic times than those of 1914 and of Verdun)” (Ancelin-Schützenberger, 2005). For the historian Fernand Braudel who founded the *Fondation de la Maison des Sciences de l’Homme* that shared occupation of the premises at 54 Boulevard Raspail in Paris with the EHESS, where Pierre Rosenstiehl was “directeur d’études”, “(...) the Old Regime, the French Revolution, such similar events, are almost contemporary ... if we reached out we would touch them. ” (Braudel, 1986). Owing to the data collected from the Mathematics Genealogy Project website, we are able to follow these guidelines, and were even able to trace the events back to the middle of the 18th century.

Let us note that a “scientific family tree” may not exactly be a tree: a supervisor and one of her/his former PhD students can oversee a PhD student together in a new generation. This situation is easily handled by applying the Sugiyama’ heuristic via the addition of “dummy” vertices in order to only have edges of length 1. Moreover, as the radial drawing is based on a spanning tree of the layered quotient graph computed from the Sugiyama’ heuristic, the layering structure is preserved.

In addition to the supervision links, the local dissimilarity δ is here the geographical distance between the birth places of the PhD supervisors of a same generation. Although travel times or distances based on the communication routes of each period would have been far more relevant than our rough estimates from Google Maps, calculating them would have been a mammoth task even for historians, thus extending far beyond the objectives of this paper. Our data thus serve merely to provide proof of concept. Figure 2 shows the result obtained over nine generations. The flag displayed on each node corresponds to the birth nationality of each scientist. Despite the historical errors in the distances, the drawing reveals the different mathematical groups that have shaped Pierre Rosenstiehl’s tree on a European scale, and beyond, including immigration to the United States of America.

7. Conclusion

In the collective work “Lieux de mémoires” directed by P. Nora, from the chapter dedicated to genealogy, one notes the following stipulation concerning the tree: “this iconographic solution seems quite natural to us today because we have assimilated the underlying metaphor so

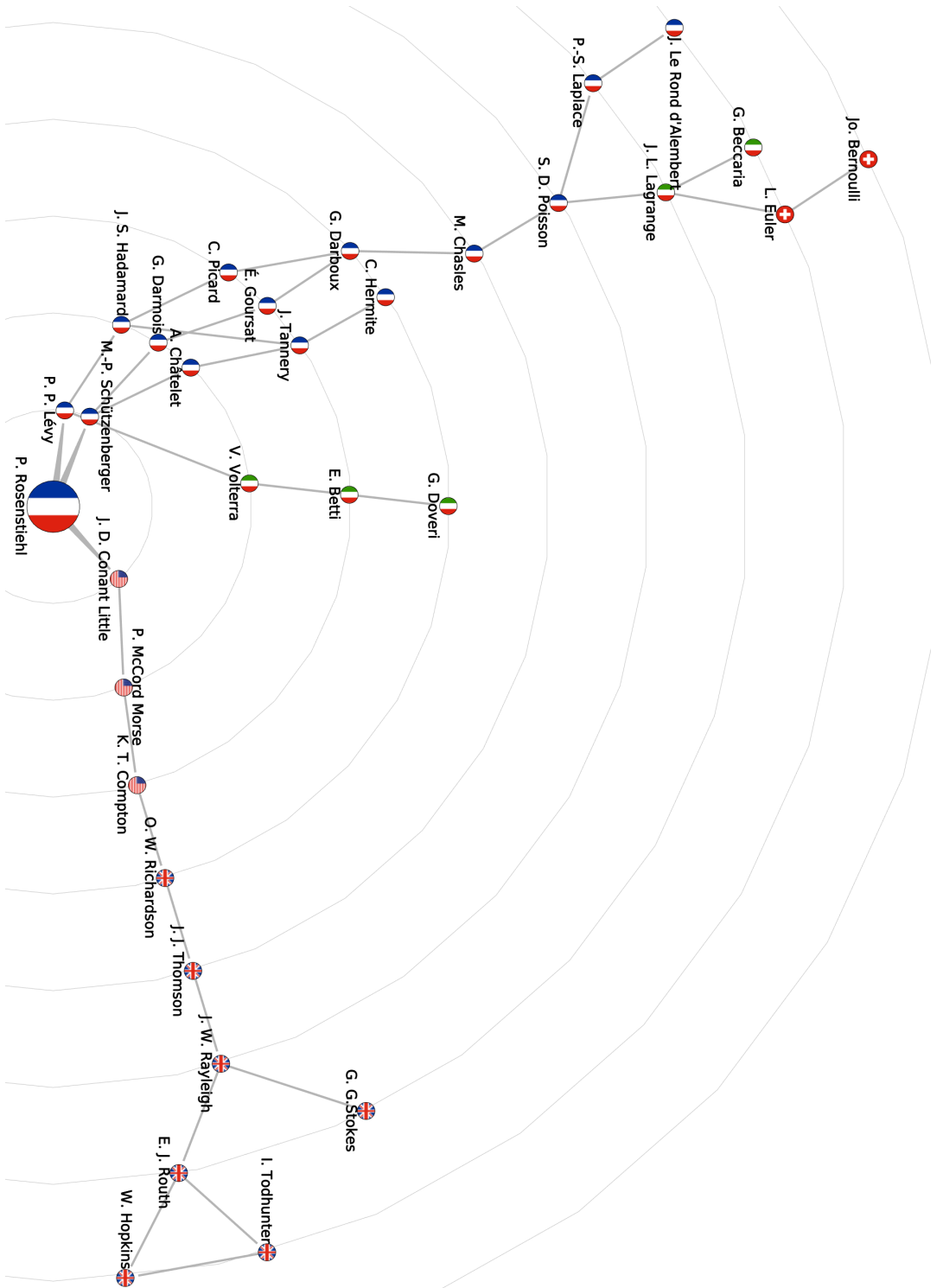


Figure 2: Pierre Rosenstiehl's Scientific family tree where each generation represents the PhD supervisors of the previous one – Drawn with Tulip (<https://tulip.labri.fr>) using the data from the Mathematics Genealogy Project (<https://genealogy.math.ndsu.nodak.edu/>).

well that we no longer feel the need to question it. This figure, however, only came to the fore in its final form in the 16th century, after a long series of sketches and trial runs in which various representations of time, heredity and family order were expressed” (Nora, 1997). Digital technology allows us to experiment with many embeddings in quick succession, which was not possible in the times of medieval clerics and Renaissance artists. This opens the way for new representations of time and family order that are able, in daring to surpass academic disciplinary boundaries to include a wide range of vernacular or more universal criteria. However, from the mathematician’s point of view, these new experimental prospects do not offer much in the way of change when it comes to the fundamental issues of graph drawing. This task remains a difficult one with only the ruse, that Pierre Rosenstiehl held so dear, being able to weave the threads of the graph on its visual medium so as to reveal the structuring hidden behind the combinatorics. In his preface to the symposium on “l’A-peu-près”¹, he wrote “it seems that science does not progress as much in terms of classification, launching so-called new disciplines or with general methodological discussions, as it does in terms of well-thought-out problems concerning details that one can attempt to resolve.”

By using these well-thought-out problems as starting point, he attempted to address one of his greatest questions: “How, from the intuitive chaos of our minds, are we able to extract a linear order?” (Rosenstiehl, 2013). In the context of our contribution, this question echoes the analysis of one of the French pioneers in clinical sociology, V. de Gaujelac: “genealogical order registers the individual as part of humanity, in order words a group that forges relationships between humans (...). Establishing a genealogical order transforms the threat of a family muddle into an orderly system (...). In accepting to be narrow-minded, individuals escape their delusion and accede to limiting the playing out of their fantasies to their inner theater (de Gaujelac, 1999).”

Are we able to draw a parallel with the symbolic genealogical order of thesis supervisions? This question would need to be correctly rephrased, but the authors of this article -who are “thesis daughter and grandson”, respectively, of Pierre Rosenstiehl- are well aware that they cannot escape the fertile heritage of their ancestor who gently brought them around to the need for chaos in order to think outside the box, and the need for rigor in order to extract a few ordered thoughts from it. They would also like to pay tribute to him for having registered them in his renowned genealogy that they discovered while working on this special issue.

References

- Ancelin-Schützenberger, A., 2005. Histoires de vie et choix théoriques en sciences sociales – Parcours de femmes. L’Harmattan. chapter Éléments d’histoire de vie et choix théoriques.
- Auber, D., Archambault, D., Bourqui, R., Delest, M., Dubois, J., Lambert, A., Mary, P., Mathiaut, M., Mélançon, G., Pinaud, B., Renoust, B., Vallet, J., 2017. TULIP 5, in: Alhaji, R., Rokne, J. (Eds.), *Encyclopedia of Social Network Analysis and Mining*. Springer New-York, pp. 1–28. doi:10.1007/978-1-4614-7163-9_315-1.
- Ball, R., 2017. Visualizing genealogy through a family-centric perspective. *Information Visualization* 16, 74–89. doi:10.1177/1473871615621592.
- Ball, R., Beck, P., 2017. Automatically recreating probabilistic history through genealogy, *Family History Technology Workshop*. URL: <https://fhtw.byu.edu/static/conf/2017/ball-recreating-fhtw2017.pdf>.
- Bezerianos, A., Dragicevic, P., Fekete, J.D., Bae, J., Watson, B., 2010. Geneaquilts: A system for exploring large genealogies. *IEEE Transactions on Visualization and Computer Graphics* 16, 1073–1081. doi:10.1109/TVCG.2010.159.

¹This colloquium was dedicated to Georges-Théodule Guibault, the creator of the “direction d’études” Méthodes mathématiques dans les sciences sociales of the EPHE’s 6th section, which presaged the CAMS that Pierre Rosenstiehl would direct from 1994 to 2001.

- Borges, J., 2019. A contextual family tree visualization design. *Information Visualization* 18, 439–454. doi:10.1177/1473871619845095.
- Braudel, F., 1986. *L'identité de la France*, Tome 1. Artaud.
- Brézillon, P., Gonzalez, A.J., 2014. *Context in Computing – A Cross-Disciplinary Approach for Modeling the Real World*. Springer-Verlag New York. doi:10.1007/978-1-4939-1887-4.
- Butaud, G., Piétri, V., 2006. *Les enjeux de la généalogie (XIIe – XVIII e siècles): pouvoir et identité*. Autrement.
- Collard, F., Lachaud, F., Scordia, L. (Eds.), 2018. *Images, pouvoirs et normes – Exégèse visuelle de la fin du Moyen Age (XIIIe-XVe siècles)*. Classiques Garnier.
- Deza, M.M., Deza, E., 2013. *Encyclopedia of Distances*. Springer, Berlin, Heidelberg. doi:10.1007/978-3-642-30958-8.
- de Gaujelac, V., 1999. *L'histoire en héritage. Roman familial et trajectoire sociale*. Desclée de Brouwer.
- Goody, J., 1983. *The development of the family and marriage in Europe*. Cambridge University Press.
- Harispe, S., Ranwez, S., Janaqi, S., Montmain, J., 2015. *Semantic Similarity from Natural Language and Ontology Analysis*. Morgan & Claypool Publishers. doi:10.2200/S00639ED1V01Y201504HLT027.
- Keller, K., Reddy, P., Sachdeva, S., 2010. *Family tree visualization*. Technical Report. University of California, Berkeley. URL: http://vis.berkeley.edu/courses/cs294-10-sp10/wiki/images/f/f2/Family_Tree_Visualization_-_Final_Paper.pdf.
- Kim, N.W., Card, S.K., Heer, J., 2010. Tracing genealogical data with timenets, in: *Proceedings of the International Conference on Advanced Visual Interfaces*, p. 241–248. doi:10.1145/1842993.1843035.
- Klapisch-Zuber, C., 2000. *L'ombre des ancêtres – Essai sur l'imaginaire médiéval de la parenté*. Fayard.
- von Landesberger, T., Kuijper, A., Schreck, T., Kohlhammer, J., van Wijk, J., Fekete, J.D., Fellner, D., 2011. Visual analysis of large graphs: State-of-the-art and future research challenges. *Computer Graphics Forum* 30, 1719–1749. doi:10.1111/j.1467-8659.2011.01898.x.
- Ma, K., Jankun-Kelly, T.J., 2003. Moiregraphs: Radial focus+context visualization and interaction for graphs with visual nodes, in: *IEEE Symposium on Information Visualization*. doi:10.1109/INFVIS.2003.1249009.
- Maksud, M., Nizard, A., 1977. Enfants trouvés, reconnus, légitimés. les statistiques de la filiation en france aux XIXe et XXe siècles. *Population* 32, 1159–1220. doi:10.2307/1531393.
- Marik, R., 2017. Efficient genealogical graph layout, in: Cherifi, H., Gaito, S., Quattrociocchi, W., Sala, A. (Eds.), *Complex Networks & Their Applications V*, Springer International Publishing, Cham. pp. 567–578. doi:10.1007/978-3-319-50901-3_45.
- McGuffin, M.J., Balakrishnan, R., 2005. Interactive visualization of genealogical graphs, in: *IEEE Symposium on Information Visualization*, 2005, IEEE. p. 16–23. doi:10.1109/INFVIS.2005.1532124.
- Melville, G., 1987. *Geschichte in graphischer Gestalt. Beobachtungen zu einer spätmittelalterlichen Darstellungsweise. Vorträge und Forschungen: Geschichtsschreibung und Geschichtsbewußtsein im späten Mittelalter* 31. doi:10.11588/vuf.1987.0.16184.
- Mergnac, M.O., Buffetaut, Y., de Montjouvant, P., 2013. *La généalogie pour tous - La bonne méthode pour débiter et construire son arbre*. Autrement (Editions).
- Nobre, C., Gehlenborg, N., Coon, H., Lex, A., 2019. Lineage: Visualizing multivariate clinical data in genealogy graphs. *IEEE Transactions on Visualization and Computer Graphics* 25, 1543–1558. doi:10.1109/TVCG.2018.2811488.
- Nora, P. (Ed.), 1997. *Lieux de mémoire*, Tome III. Gallimard.
- Plaisant, C., Milash, B., Rose, A., Widoff, S., Shneiderman, B., 1996. Lifelines: visualizing personal histories, in: *Proceedings of the SIGCHI conference on Human factors in computing systems*, p. 221–227. doi:10.1145/238386.238493.
- Purchase, H., 1997. Which aesthetic has the greatest effect on human understanding?, in: DiBattista, G. (Ed.), *Graph Drawing*, Springer Berlin Heidelberg, Berlin, Heidelberg. pp. 248–261. doi:10.1007/3-540-63938-1_67.
- Rosenstiehl, P., 2006. Graphes et structures algébriques associées, labyrinthes, cartes, réseaux d'automates, systèmes acentrés, in: *Annuaire de l'EHESS*, pp. 108–109. URL: <https://journals.openedition.org/annuaire-ehess/17371>.
- Rosenstiehl, P., 2013. *Le labyrinthe des jours ordinaires*. La Librairie du XXIe siècle – Seuil.
- Sardon, J.P., 1996. L'évolution du divorce en france. *Population* 51, 717–749. URL: https://www.persee.fr/doc/pop_0032-4663_1996_num_51_3_6079.
- Schneider, D., 1984. *A critique of the study of kinship*. University of Michigan Press. doi:10.3998/mpub.7203.
- Sugiyama, K., Tagawa, S., Toda, M., 1981. Methods for visual understanding of hierarchical system structures. *IEEE Trans. Systems Man Cybernet.* 11, 109–125. doi:10.1109/TSMC.1981.4308636.
- Sutter, J., 1968. Fréquence de l'endogamie et ses facteurs au XIXe siècle. *Population* 23, 303–324. URL: https://www.persee.fr/doc/pop_0032-4663_1968_num_23_2_11841.
- Tuttle, C., Nonato, L.G., Silva, C., 2010. Pedvis: a structured, space-efficient technique for pedigree visualization. *IEEE transactions on visualization and computer graphics* 16, 1063–1072. doi:10.1109/TVCG.2010.185.
- Watson, A., 1934. *The early iconography of the Tree of Jesse*. Oxford University Press.

Weber, F., 2013. Penser la parenté aujourd'hui. La force du quotidien. Éditions Rue d'Ulm.
Xiang, F., Zhu, S., Wang, Z., Maher, K., Liu, Y., Zhu, Y., Chen, K., Liang, Z., 2020. Enhanced family tree: Evolving research and expression. Leonardo 53, 367–373. doi:[10.1162/leon_a_01921](https://doi.org/10.1162/leon_a_01921).