

THE STRUCTURE OF THE *ARBOR SCIENTIAE*

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In the Prologue to the *Tree of Science* Ramon Llull gives vent to his discouragement about the fact that he can't get people to listen to him, that they don't value his books, and that he is considered foolish.¹ The monk to whom he tells his troubles replies that his problem is that people know neither him nor his books well enough, and suggests that to remedy this situation he write »a book general to all sciences, one which would be easy to understand, and by which one could be helped to understand his *Ars generalis* [...] which is too difficult to understand.« Notice how the word »understand« (*intelligere*) appears three times in this sentence.² Clearly the Art, with its alphabet, figures, and tables was a major stumbling-block, one which perhaps could be overcome if Llull wrote a work that used and explained all the fundamental structures of the Art,³ without those elements of mechanization which made it appear so forbidding.³

¹ Since this congress is in part to celebrate the completion of the monumental edition of the work for the *ROL XXIV-XXVI* (CCCM 180 A-C), I will cite from the Latin text of this edition. »Et etiam sum desolatus, quoniam illud pro quo annis triginta laboravi ad finem deducere non potui, item quia mei libri modicum appetantur. Et dico vobis, quod plures me tenent pro fatuo, quia de huiusmodi negotio me intromitto« (*ROL XXIV*, pp. 5-6, lin. 40-43). The complaint about finding no one to help him reappears in the »leaves« of the *Arbor imperialis*.

² In the original it appears four times. In the following quote I have italicized the words having to do with difficulties (or ease) of understanding, to show the insistent nature of the passage. »Multum placuit monacho, quia Raimundum inuenit; cui dixit, quod ipsum diu quaesivit, ut unum librum componeret ad omnes scientias generalem, qui *leuiter intelligi* posset, et per quem *Ars sua generalis*, quam composuerat, *faciliter intelligi* posset, quia *nimis subtilis* uidetur ad *intelligendum*, et etiam quia ceterae scientiae, quas antiqui sapientes inuenerunt, ita sunt *difficiles* et ita *longum tempus requirunt*, quod *difficiliter* aliquis potest ad finem debitum peruenire, et etiam *plura dubia* sunt, quae quidam sapientum contra alios habent sapientes. Quare rogauit ipsum, quod unum librum faceret generalem, qui ad alias scientias *intelligendum* iuaret.« (ib., p. 5, lin. 22-32).

³ To call the *Tree of Science* a »popularizing« work, as many critics have done, is true in the sense that Llull wanted it to be more digestible than the Art itself. Yet whether or not the resultant work is as »easy to understand« as the hermit requested in the Prologue, I think might be belied by Charles Lohr's analysis of the *Arbor elementalis*, as well as Lola Badia's of the *Arbores exemplificalis* and *quaestionalis*. The term is probably meant as »no more difficult« than a contemporary work of (natural) philosophy, and, of course, without the initial hurdle of the figures and combinatorics.

The trees of the *Arbor scientiae*:
(with the letters of the corresponding Subjecta)

The parts of each tree:

- I. elemental (I)
- II. vegetalis (H)
- III. sensualis (G)
- IV. imaginalis (F)
- V. humanalis (E)
- VI. moralis (K)

- 1. Radices (roots)
- 2. Truncus (trunk)
- 3. Branchae (branches)
- 4. Rami (twigs)
- 5. Folia (leaves)
- 6. Flores (flowers)
- 7. Fructus (fruit).

- IX. caelestialis (D)
- X. angelicalis (C)

- VII. imperialis
- VIII. apostolicalis

- XIV. divinalis (B)

- XI. aeviternalis
- XII. maternalis
- XIII. Jesu Christi

- XV. exemplificalis
- XVI. quaestionalis.

The alphabet of the Art

	Figura A	Figura T	Quaestiones	Subjecta	Virtutes	Vitia
B	bonitas	differentia	utrum?	Deus	justitia	avaritia
C	magnitudo	concordantia	quid?	angelus	prudentia	gula
D	duratio	contrarietas	de quo?	caelum	fortitudo	luxuria
E	potestas	principium	quare?	homo	temperantia	superbia
F	sapientia	medium	quantum?	imaginatio	fides	accidia
G	voluntas	finis	quale?	sensitiva	spes	invidia
H	virtus	majoritas	quando?	vegetativa	caritas	ira
I	veritas	aequalitas	ubi?	elementativa	patientia	mendacium
K	gloria	minoritas	quo modo? cum quo?	instrumentativa	pietas	inconstantia

However much he may or may not have succeeded in this enterprise of simplification, what he gave us was a work which displayed his vision of the structure of the world. Lull wanted to show us its *modus essendi*, over which, in other works, he had laid the tracing paper of the *modus cognoscendi* of his Art.⁴ If the Art was essentially combinatorial, this was because it had been constructed to describe a world that was, in Lull's eyes, essentially relational.⁵ And it was this relational structure which he set out to describe in the *Tree of Science*, and which I would like to analyze here.

Let us begin, however, by showing the relationship between the *Tree of Science* and the Art. First of all, there is the outward ordering of a progression of the sixteen trees displayed on the accompanying chart. Omitting for the moment the last two trees, which are supplementary to the basic structure of the work, we can easily see the relationship between the first fourteen trees and the fourth column of the alphabet of the Art in the Ternary Phase:

Notice how Lull has just expanded the nine Subjecta by adding the *Imperial* and *Apostolic Trees* (VII-VIII) along with the *Eviternal*, *Maternal* and *Christological Trees* (XI-XIII).⁶ The only slight complication is the *Moral Tree* (VI) which corresponds to the last rung of Instrumentativa (K) in the column of Subjecta, under which heading Lull usually discusses the Virtues and Vices displayed in the last two columns of the Alphabet.⁷

When we start with the roots of the first tree, we discover that they are taken from the components of Figures A and T of the Art. Lull says at the beginning of the *Elemental Tree* that »Per suas radices intelligimus principia Artis generalis, quae sunt«, and then he goes on to enumerate all eighteen, with no distinction whatever between the two figures, which is, in effect, how they are treated throughout the Ternary Phase of the Art.⁸

⁴ See JOSEP M. RUIZ SIMON, »De la naturalesa com a mescla a l'art de mesclar (sobre la fonamentació cosmològica de les arts lul·lianes)«. In: *Randa* 19 (1986) 89-91.

⁵ See my article »Ramon Lull: relació, acció, combinatòria i lògica moderna«. In: *SL* 34 (1994) 51-74.

⁶ The trees corresponding to Subjecta are aligned to the left in the chart, followed by the corresponding letters of the alphabet of the Art in parentheses.

⁷ In works of the Art these last two columns add two virtues and two vices, to fill out the number of nine, but these are usually absent from works where they are not needed for combinatory symmetries.

⁸ The distinction between »absolute« and »relative« principles one finds so frequently in the literature, seems to be an invention of Renaissance commentators. In this phase of the Art, neither is the Figure A referred to that of God, nor its principles as »dignities«. All eighteen are treated by Lull simply as principia (començaments in Catalan). See my article »Més sobre el mot i el concepte 'dignitats' en Ramon Lull«. In: *Estudis de Llengua i Literatura Catalanes XXXII. Miscel·lània Germà Colon*, Montserrat, 1996, pp. 5-14. As I point out there, at this stage of the Art the word dignitates is reserved for the Divine attributes, which why it does not appear in the *Tree of Science* until Lull discusses the roots of the *Arbor divinalis*. And even there they include six from Figure T (see n. 19 below)!

Of the Alphabet of the Art, then, the only column not used is the third one of Questions and Rules,⁹ and even that makes a fleeting appearance, as we will see later, at the end of the *Tree of Science*. Therefore, with this one exception, it should be clear that the structural foundations of the *Tree of Science* and those of the Art are almost identical.

Not only that, but the eighteen roots are defined exactly as the principles are in the corresponding sections entitled »De definitionibus« of the Art. For instance in the *Elemental Tree*, Lull says of the second root: »Greatness is that by which goodness, duration, power, etc. are great«¹⁰ which is a verbatim reproduction of the corresponding definition in the *Tabula generalis*.¹¹ And so it goes for the remaining roots.¹² Notice too how the relational organization of the Art is already apparent in this definition, which is explained in terms of all the other components of the Figure A. And if this is the relation of each ad extra, then its relation ad intra is provided by the correlatives, which as Charles Lohr will show, act as corner-stones for this, and hence for subsequent, trees.

Now if we start looking into successive trees, we will see how they are systematically related to one another. Starting with the roots, the second tree, the *Arbor vegetalis*, has the same eighteen roots as the *Arbor elemental*; but now they are double, since each one contains a general elemental nature in addition to a specifically vegetable nature.¹³ Similarly the roots of the *Arbor sensualis* are triple: elemental, vegetable and sensual. »Like a tree,« Lull explains, »which is of three species, like an apple tree grafted onto a pear tree, and an apricot onto a peach tree, thus the vegetative is grafted onto the elementative, and the sensitive onto the vegetative.«¹⁴

⁹ They were conceived as an investigative tool for our *modus intelligendi*, and hence appear in every work of the Art from the *Tabula generalis* on, as well as in the *Logica nova*, where they play a crucial role; but they had little to do with the *modus essendi* explained in the *Tree of Science*.

¹⁰ »Magnitudo est illud per quod bonitas, duratio, potestas, etc. sunt magna, ambiens omnes extremitates essendi« (*ROL XXIV*, p. 14, lin. 45-46). Similarly the third root is defined as: »Duratio est proprietas, per quam durans bonitas, magnitudo, potestas, etc.« (*ib.*, p. 15, lin. 66-67).

¹¹ See *MOG V*, ii, 6 (226).

¹² With only occasional, unimportant variations in wording, no greater than those from one work of the art to another. Even some of the subsequent explanations are remarkably similar.

¹³ »Radices *Arboris uegetalis* sunt bonitas, magnitudo, duratio etc, quas diximus in *Arbore elemental*. Et quaelibet istarum radicum est duplex, in quantum in se continet naturam elementalem et uegetalem, generalem et specialem. Generalis est elemental, specialis est uegetalis, et insimul sunt una radix composita ex ambabus naturis, quae bona est sub ratione bonitatis.« (*ROL XXIV*, p. 117, lin. 2-8).

¹⁴ »Et est triplex, uidelicet consistit ex potentia elementatiua, uegetatiua et sensitua. Vnde, sicut si una arbor fuisset ex tribus speciebus facta, sicut si pomerium esset in piro insertum, et persicus in pomerio, ita inserta uegetatiua in elementatiua et sensitua in uegetatiua reddunt unam arborem« (*ib.*, p.131, lin. 4-9).

With the *Arbor imaginalis*, rather than continuing with a mere adding process, Lull explains that its roots are »semblances« or »images« (similitudines) of those of the previous three trees.¹⁵

The roots of the *Arbor humanalis* are once more double, composed as they are, for instance, of bonitas corporalis and bonitas spiritualis, with the first in turn being quadruple, since this tree is composed of the principles of the previous four trees.¹⁶ The *Arbor moralis* in fact consists of two trees, one corresponding to the virtues and one to the vices. The roots of the first are »semblances« or »images« of the *Human Tree*, that is to say that »moral goodness is the semblance of real goodness,« etc.¹⁷ The second *Moral Tree* is the contrary of the first, and therefore 4 of its basic 18 roots are the contraries of the corresponding roots of the first tree, which can be schematicized thus: bonitas-> malitia, sapientia -> stultitia, veritas -> falsitas, virtus -> privatio finis. These combine with the remaining 14 roots (malitia for instance with magnitudo) to produce their negative effects.¹⁸

The roots of the *Arbor imperialis* are in turn based on those of the *Arbor moralis*, and so it goes for the remaining trees, We won't comment on them, except to say that with the final *Arbor divinalis* Lull explains that the tree structure is now merely metaphorical. The dignities of God, for instance, which

¹⁵ »Radices Arboris imaginalis sunt similitudines radicum realium, de quibus in *Arbore elementali vegetali et sensuali* dictum est sicut similitudo bonitatis, magnitudinis, durationis, potestatis et ceterarum radicum «(ib., p. 176, lin. 2-5). The previous little prologue to this tree begins with a passage (omitted in OE I, 608, but included in the *Corrigenda* in II, 1401) where this mechanism is explained in greater detail, and even with the introduction of the Lullian correlatives: »Arbor ista est de similitudinibus et impressionibus[...] Et est de similitudinibus Arboris elementalis, uegetalis et sensualis, quoniam, in quantum est generalis, in illis est inserta et cum illis mixta, sicut uegetalis in elementali, et sensualis in uegetali, et similitudines ex quibus est sunt masculinae et femininae. Masculinae sunt per bonificatium, magnificatium et ceteras formas. Et est ex similitudinibus femininis per bonificabile, magnificabile et ceteras materias. Et propter hoc in se continet imaginatium et imaginabile et imaginari, quod est similitudo bonificare et magnificare, et ceterorum actuum« (ib., p. 175, lin. 3-13).

¹⁶ »Radices Arboris humanalis sunt duplices, scilicet bonitas corporalis et bonitas spiritualis, et ex ambabus bonitatibus efficitur una radix, quae est bonitas composita ex ambabus, et fit compositio, in quantum quaelibet alteri suam dat similitudinem. Idem est de magnitudine, duratione et potestate et ceteris radicibus. [...] Bonitas corporalis uenit ad spiritualem cum quattuor naturis arboris, de quibus dictum est, et bonitas spiritualis ipsam accipit in uno numero tertio, quod est corpus, ita quod ex ipsis quattuor naturis efficitur una bonitas corporis in una bonitate naturali et substantiali animae rationalis« (ib., p.197, lin. 2-20).

¹⁷ »Radices Arboris moralis sunt similitudines radicum Arboris humanalis, sicut bonitas moralis, quae est similitudo bonitatis realis, et magnitudo moralis, similitudo magnitudinis realis, et perseuerantia moralis, similitudo durationis realis [...]«(ib., p.255, lin. 2-5).

¹⁸ »Radices uitiorum sunt quattuor, scilicet malitia, stultitia, falsitas et priuatio finis. Et ad ista quattuor se habent magnitudo, duratio, potestas, uoluntas, delectatio, differentia, concordantia, contrarietas, principium, medium, maioritas, aequalitas et minoritas. Magnitudo se habet ad malitiam, in quantum malitia est magna, et se habet ad stultitiam, quae contraria est sapientiae, in quantum stultitia est magna [...]« (ib., p.298, lin. 2-10). Notice in this list the less declared substitution of delectatio for gloria.

can be considered metaphorically as roots of the tree, consist of fifteen of the original principles, omitting contrariety, majority and minority as inappropriate for the Divinity.¹⁹

The trunks of the trees are where the matter brought in by the roots is united and forms a whole in which is usually »sown« the seeds of the various individual components of any one particular tree. With the *Elemental Tree* it forms the chaos in which the seeds of all the various species are sown.²⁰ With the *Arbor sensualis* it constitutes the »common sense according to which the particular senses can make their judgements.«²¹ Notice too how succeeding trunks, like the roots, include those which have preceded them. Thus, for instance, »the trunk of the *Sensual Tree* is triple in that it is composed of three natures, that is to say an elemental, vegetable and sensual nature, just like the body of a man or of a horse, which is a trunk composed of the three aforementioned natures.«²² Even with the Apostolical trunk he explains how it »is a general person, called Pope« who combines the trunks of the *Elemental*, *Vegetable*, *Sensual*, *Imaginative*, and *Human Trees*, along with the *Rational Tree* and the first part of the *Moral Tree*.²³

The next two portions of the trees, the branches and the twigs, are dedicated to the subdivisions specific to each tree. In the branches of the *Elemental Tree* we find the four elements, in the *Sensual Tree* the six senses, and so on. The twigs are where these components achieve their effective existence: with the *Elemental Tree* it is in the four compound elements, and in the *Sensual Tree* in the internal organs (heart, liver, etc.) in which the functioning of the senses originates. But even here, Llull explains for instance how the twigs of the *Sensual Tree* need the components of the previous *Elemental* and *Vegetable Trees* to function.

¹⁹ In the little prologue to the *Arbor divinalis* Llull says: »Per primam partem dignitates Dei metaphorice consideramus, secundum quod consideramus radices arboris« (lin. 9-10). In the following *De radicibus Arboris divinalis* he explains: »Dignitates Dei appellamus suam essentialem bonitatem, magnitudinem, aeternitatem, potestatem, sapientiam, uoluntatem, uirtutem, ueritatem, gloriam et distinctionem personarum et concordantiam illarum, principium, medium, finem et aequalitatem« (*ROL XXV*, p. 645, 2-6). Notice how six of the concepts of Figure T are included among the dignities.

²⁰ »Per truncum omnium rerum corporalium congregationem intelligimus, unde sequitur siue resultat unum corpus confusum, quod dicitur chaos, quod complet totum spatium, quod est sub Luna diffusum, in quo species rerum sunt seminatae siue diffusae, et dispositiones et habitus earum« (*ROL XXIV*, p. 11, lin. 16-20).

²¹ »Qui quidem truncus sensualis est sensus communis, natura cuius eius sensus particulares faciunt iudicium« (ib., p. 135, lin. 12-13).

²² »Truncus *Arboris sensualis* est triplex, in quantum est de tribus naturis, uidelicet de natura elementalī, uegetali et sensuali, sicut corpus hominis aut equi, quod est truncus ex tribus antedictis naturis constitutus« (ib., p. 134, lin. 2-5).

²³ »Truncus apostolicalis est persona generalis, quae dicitur apostolicus. Et in hoc truncō ponit truncus elementalī partes, quae ad corpus pertinent, et *Arbor uegetalis*, *sensualis*, *imaginalis* et *humanalis* suo modo sicut elementalī. Et *Arbor rationalis* ponit in illa persona generali partes, quae ad animam spectant. Et officium apostolicalē ponit generalitatem personae cum prima parte *Arboris moralis*« (*ROL XXV*, p. 381, lin. 2-8).

The leaves are used to show systematically how the nine²⁴ Aristotelian accidents (quantity, quality, relation, etc.) apply to each of the trees.

Of the last two portions of the trees, the flowers are the means or instruments by which the final result, the fruits, are produced. Here again we find Llull using his correlatives, as when in the *Elemental Tree* he tells us that, just as the flowers are nearer to the fruit than to the other parts of the tree, »so the instrument is nearer to the *operatum*, which instrument we call *operari*, and which comes *ex operante et operabili*.«²⁵ But even here he frequently reminds us of the relation to preceding trees. In the *Sensual Tree*, for instance, before explaining that the flowers are the sense organs (eyes, ears, nose, etc.) and the fruits are the things seen, heard, etc., he tells us how both the flowers and the fruit are triple, and dependent on the two preceding trees.

So the *Tree of Science* has a relational structure both in a vertical sense (the organic growth of each tree from its roots to its fruit) and in a horizontal sense (how the corresponding parts of each tree are related to and grow out of one another). We have also seen how each root, by its definition, is related *ad extra* to the other roots, and how its correlative structure establishes a fundamental relation *ad intra*.

In addition to these, Llull uses yet another relational device: his combinatorial mechanisms. One might be surprised by their presence in a work that pretends to shun methods of the Art, but we should remember that these mechanisms can be present in works of a similar semi-popularizing nature or that otherwise avoid methods of the Art, such as the *Book of the Gentile and the Three Wise Men*, the *Tree of Philosophy of Love*, or the sermons written in Majorca in 1311.²⁶ Here they appear in the branches of the two *Moral Trees*, where Llull introduces binary combinations of virtues to show »how one is concordant with another«,²⁷ and then does the same with vices.

More important, in the flowers of the *Arbor Jesu Christi* and of the *Arbor divinalis* Llull announces that he will make combinatory *camerae* (so-called because in the Art such combinations were often written inside rectangular compartments or »chambers«) to generate maxims and proofs of the

²⁴ Or eight, since in the *Tree of Science* Llull always treats the reciprocal action and passion as a single accident.

²⁵ »Flores arboris comparamus ad naturalia instrumenta. Et hoc facimus, quoniam sicut flos est fructui proximior quam folia, brancae uel rami aut radices, sic instrumentum est proximius operato. Quod quidem instrumentum uocamus operari, quod est ex operante et operabili« (ROL XXIV, p. 55, lin. 2-6).

²⁶ For this last work, see the combinatory tables presented by the editor, FERNANDO DOMÍNGUEZ, on p. lxxvii of the introduction to ROL XV. For Llull's general use of combinatorics see the article cited in n. 5 above. Llull even recommends using combinations of dignities for contemplation in the *Art of Contemplation* which follows the *Book of the Lover and the Beloved* in *Blaquerna*.

²⁷ After defining and explaining the seven virtues, he says: »Dictum est de uirtutibus moralibus. Modo dicendum est, quomodo una uirtus cum alia habeat concordantiam. Et hoc est, ut habeatur doctrina, quomodo cum quibusdam uirtutibus aliae possunt haberi, et quomodo uitiis, quae sunt eis contraria, possit contradici.« (ROL XXIV, p. 270, lin. 275-279).

Incarnation and Trinity, respectively.²⁸ In the first case we have 137 ternary compartments made up of binary combinations of the roots of the tree, each of which is combined with the single concept of Incarnation. In the second case we have 51 mainly quaternary (although occasionally ternary) combinations of the 18 roots.²⁹

To these basic structures of the first fourteen trees, Llull added lists of related concepts. To give only a few examples, the *Arbor imperialis*, has in the branches a list of the ten class of leaders on whom society is dependent.³⁰ The twigs are the seven virtues a prince should have.³¹ Then before presenting the leaves, Llull gives us a list of »the forty principle and general forms of law.«³² In the *Arbor apostolicalis* we get similar lists of the Church hierarchy, the Ten Commandments, the Articles of Faith, etc.; in the *Arbor caelestialis* we get astrological lists (planets, metals, etc.), and so on.

no frames But by far the most important list is that of the Hundred Forms, which makes its first appearance here in the *Tree of Science*, and which Llull normally uses to present a host of general subjects external to his system, but which are

²⁸ It should be noted that Llull has already offered proofs of the Trinity and Incarnation among his proofs of the Articles of Faith in flowers of the *Arbor apostolicalis*, but there not in combinatorial form. It might be worth comparing these two sets of proofs with those of the *Apostrophe* or *Liber de articulis fidei* written right after it, for which see n. 51 below.

²⁹ »Et, quia radices, secundum earum definitiones et naturas, flores habent in ramis, miscere uolumus radices inuicem quasdam in aliis siue cum aliis secundum naturas earum definitionum, ut maximas et conditiones ex ipsis faciamus, cum quibus flores intelligamus et probationes de incarnatione Filii Dei ostendamus [...] Processus, quem tenere proponimus, est uidelicet quod unam cameram faciamus de bonitate et magnitudine, et aliam de bonitate et aeternitate, et sic per ordinem usque ad cameram aequalitatis et minoritatis, iuuando tamen cameram cum illis radicibus, cum quibus facere possemus maximam de camera, per quam significabitur benedicta incarnatio Filii Dei« (*ROL* XXV, p. 594, lin. 8-20). »Et in hoc passu cameras facere proponimus de formis huius libri, cum quibus diuinas productiones probabimus, quae sunt per generationem et spirationem.« (ib., p. 685, lin. 8-10).

³⁰ »Brancae *Arboris imperialis* sunt decem: prima est barones, sicut sunt comites, duces, marchiones et uicecomites; secunda est sicut sunt milites unius scuti; tertia est sicut sunt burgenses; quarta est sicut sunt consilarii siue consilium; quinta est sicut sunt procuratores; sexta est sicut sunt iudices; septima est sicut sunt aduocati; octaua est sicut sunt sagiones et nuntii; nona est sicut sunt inquisitores; decima est sicut est confessor discretus. Omnes istae brancae debent esse habitatae et indutae primis branccis *Arboris moralis*« (*ROL* XXIV, p. 337, lin. 2-10).

³¹ »Et etiam ad principem spectat habere inter alia septem ramos, uidelicet iustitiam, amorem, timorem, sapientiam, potestatem, honorem et libertatem. Quoniam sine istis ramis princeps non potest habere bonos flores nec bona folia, nec de ipso fructus bonus colligi potest« (ib., p. 344, lin. 5-9).

³² »Considerauit Raimundus in formis primariis generalibus scientiae iuris, nominando quadraginta, sub quibus stare possent omnia particularia scientiae iuris ciuilibus. Quae siquidem formae sunt istae: emptio, uenditio, commodatum, solutio, depositum, promissio, probatio, confessio, negatio, dubitatio, statutum, procuratio, ablatum, legatum, accusatio, excusatio, permutatio, perditio, inuentio, datio, conditio, tormentum, uituperium, deceptio, diffamatio, furtum, luxuria, proditio, homicidium, blasfemia, inobedientia, mendacium, indigentia, fortuna, uoluntarium, ignorantia, obliuio, libertas, seruitus et praesumptio« (ib., p. 351, lin. 31-40).

explainable using its mechanisms and formulations.³³ Here they are introduced at the end of the *Elemental Tree*, where he says that »since we want to investigate the first causes and forms sown in [the *Elemental Tree*], we choose some of them, that is a hundred which we want to investigate through what we know about them, and so that by means of them we can know others, which are many in number, and so that through them we might better know the other trees.«³⁴ And in fact, each one here is explained in terms of the *Elemental Tree*, such as, for instance, Form no. 50, which says: »Production is a general principle of the *Elemental Tree*, like production in goodness, greatness, and in the other roots of the tree.«³⁵

The Hundred Forms reappear at the end of the *Arbor sensualis* under a heading which refers to their »Application and Practice«, in which he states how important they are for investigating other areas of knowledge, and where he tells us that »just as we give this example in the *Sensual Tree*, so it could be given in any of the others.«³⁶ Here, in effect, he explains each one in terms of the *Sensual Tree*, but with an important difference. Now they are grouped in pairs (unity / plurality, simplicity / composition, form / matter, etc.) or in triplets (generation / corruption / privation, power / object / act, firstness / secondness / thirdness, etc.).³⁷ The Hundred Forms reappear one last time in the *Arbor humanalis*, under the spiritual branch of the Intellect, again in the same binary and ternary groupings.

³³ It reappears in the *Logica nova*, in the *Ars generalis ultima* and *Ars brevis*, and finally in the *Ars consilii*. Except for the *Ars brevis*, whose Hundred Forms are identical to those of the *Ars generalis ultima*, these lists vary in content. The *Introductorium magnae Artis generalis* or *Liber de universalibus* also has a list of a Hundred (or more) Forms, but as LOLA BADIA has said, this work is surely not authentic, but a para-Lullian pastiche of genuine material.

³⁴ »Dictum est de *Arbore elementali* et de partibus eius. Et quia primas causas et formas in illa seminatatas proponimus inuestigare, aliquas ipsarum eligimus, ut de illis cognitionem habeamus et ut per illas alias, quae plures sunt, cognoscere ualeamus, et etiam ut per illas alias arbores cognoscere possimus« (ib., p. 57, lin. 24-28).

³⁵ »Productio in *Arbore elementali* est principium generale, sicut productio, quae est in bonitate et ceteris radicibus arboris« (ib., p. 86, lin. 699-700).

³⁶ »In hoc passu datur doctrina, quomodo homo sciat applicare formas naturales ad substantias indiuiduatas; et secundum quod in hac *Arbore sensuali* damus exemplum dari potest in aliis. Et quoniam applicatio multum est utilis et necessaria ad habitus scientiarum, et est sustentatio intellectus in quantum se sustinet in formis, et ad earum exempla recurrit, ut suum obiectum inquirat, idcirco ponimus hunc tractatum, qui est de applicatione, in hac *Arbore scientiae*« (ib., p. 150, lin. 2-9).

³⁷ This last triplet (*prioritas, secundioritas et tertioritas*) is identical in name at least (it might be worth investigating what coincidences there are in content) to a central doctrine of CHARLES PEIRCE. See his essay on »The Principle of Phenomenology«. The previous triplet of power/object/act is, of course, one of the principle formulations of Lull's correlative doctrine.

It is worth noting that this relational grouping, although implicit in presentations of the Hundred Forms in other works, is only here made explicit.³⁸

We have now studied the basic structures of the fourteen trees which form the body of the work, but there are still two more – the *Arbor exemplificalis* and the *Arbor quaestionalis* – which are intended to help the reader understand what he has read in all the previous trees and to see how it is applicable to other fields. In the first of these, Lull travels through the previous fourteen trees horizontally, as it were, first basing his examples on the roots, then on all fourteen trunks, and so on.³⁹ As a result, this tree proceeds like the preceding ones, systematically from the roots up to the fruit. Moreover, as he explains in the little prologue to the *Arbor exemplificalis*, he carries this out in two ways: »The *exempla* we give here are divided in two sorts, that is to say in stories [*narrationes* in Latin, *recontaments* in Catalan] and proverbs.«⁴⁰ Jordi Rubió and Robert Pring-Mill have already called attention to this placing of *narrationes* and proverbs together under the heading of *exempla*.⁴¹ Here, he alternates *narrationes* and proverbs in a symmetrical structure, with the exception of the numerically central fourth part of the tree, the twigs, where he mixes the two, with the device of having the proverbs originate in the midst of *narrationes* with phrases such as »And then the woman said the following words«, or »These conditions are as follows«. ⁴² Perhaps this symmetrical distribution of *narrationes* and proverbs can be best seen in the following diagram:

³⁸ It is this idea of grouping related ideas that is perhaps one of the origins of Lull's essays in symbolic geometry several years later in Paris, as a way of visually illustrating these groupings. In the *De quadratura et triangulatura circuli* and *Liber de geometria nova*, and implicitly in the *Principia philosophiae*. It was probably from a mixture of these sources that le Myésier derived his long lists of binary, ternary and quaternary groupings of concepts; see *Breviculum seu Electorium parvum Thomae Migerii (le Myésier)*, ed. CHARLES LOHR, THEODOR PINDL-BÜCHEL, WALBURGA BÜCHEL, *ROL, Supplementum Lullianum I* (CCCM 77), Brepols: Turnhout, 1990, pp. 212-225.

³⁹ The only exception is the first part on the roots, where he only deals with those of the first *Elemental Tree*. This is perhaps because of too great a similarity between the roots of all the trees.

⁴⁰ »Exempla, quae dabimus, in duas partes diuidimus, uidelicet in narrationes et proueria« (*ROL XXV*, p. 709, lin. 22-23). It should be noted that this is the first appearance in Lull's work of proverbs, a form to which he became quite addicted in the next ten years.

⁴¹ Each being a »breu proposició que conté en si molta sentència« (*ORL XIV*, 1). Of JORDI RUBIÓ I BALAGUER see »La *Rhetorica nova* de Ramon Lull«. In: *EL 3* (1959), p. 265 and »L'expressió literària en l'obra lul·liana«. In: *OE I* (1957), pp. 105-7, both reprinted in his *Ramon Lull i el lul·lisme*, Publicacions de l'Abadia de Montserrat: Barcelona, 1985, where the relevant passages can be found on p. 223 and pp. 311-313. For ROBERT PRING-MILL see »Els 'recontaments' de l'Arbre exemplifical de Ramon Lull: la transmutació de la ciència en literatura«. In: *Actes del Tercer Col·loqui Internacional de Llengua i Literatura Catalanes*, Oxford: Dolphin, 1976, p. 313ff., reprinted in his *Estudis sobre Ramon Lull*, Curial/Publicacions de l'Abadia de Montserrat: Barcelona 1991, p. 309ff.

⁴² Another curious detail: many of the proverbs are in rhymed couplets or tercets. See CARRERAS I ARTAU's notes in *OE I*, p. 1045.

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| 1. Narr. (roots) | 7. Narr. (fruit) |
| 2. Prov. (trunks) | 6. Prov. (flowers) |
| 3. Narr. (branches) | 5. Narr. (leaves) |
| 4. Narr. & Prov. (twigs) | |

The structure of the *Arbor quaestionalis* is similarly horizontal, but it now also includes the corresponding sections of the previous *Arbor exemplificalis*, so that it begins with questions on all fifteen of the previous roots,⁴³ then proceeds to the fifteen trunks, and so on, until more than four thousand questions have been asked.⁴⁴

The addition of these two supplementary trees referring to all the previous ones, makes for an unusual situation where, in order to investigate how Lull treats any single topic in the *Tree of Science*, one has to look in four or five different places. If, for instance, we want to see what he has to say about the seven virtues, we will find them presented in the branches of the first *Moral Tree*,⁴⁵ but then there is also an allegory based on them in the branches of the *Arbor exemplificalis*, questions on their initial presentation in the *Arbor quaestionalis*, and finally in the same tree questions on the allegory of the previous tree⁴⁶. The Hundred Forms are presented in five places: the three already mentioned, with separate sets of questions in the last tree on their first two appearances.⁴⁷ Nor should one imagine that these supplementary treatments are of minor importance; as Lola Badia will show, one can find there a wealth of new information explainable, in theory at least, by what has gone before. All this, as should be abundantly clear by now, weaves a truly impressive network of relations.

The *Tree of Science* ends with ten general questions on the »habit of this science«, which turn out to be those of the third column of the Alphabet of the Art displayed at the beginning of this paper, here applied generally to the work as a whole. In addition to answers on how to use the *Tree of Science*, under the question of *quando* he gives the dates when the work was written, and under that of *ubi* he says »the city of Rome«.

I would like to end with five observations on this general structure of the *Tree of Science*.

(1) First of all, there are the surprising proportions of the work. Contrary to what one might imagine, the longest tree, and this by a considerable margin, is the *Arbor quaestionalis*, which occupies an astonishing 41% of the entire work!⁴⁸ Yet this is by no means exceptional with Lull. In fact, every work central to his

⁴³ And not just those of the *Elemental Tree* as in the previous *Arbor exemplificalis*.

⁴⁴ Sometimes in the form a hermit asking one of the concepts personalized, as for instance »The hermit asked *affatus* [...]« or his directly asking »Ramon«.

⁴⁵ *ROL* XXIV, p. 261 ff.

⁴⁶ *ROL* XXV, p. 746, and *ROL* XXVI, P. 924, 1047 respectively.

⁴⁷ *ROL* XXVI, p. 1328 and p. 1374.

⁴⁸ This and other percentages are based on page counts of the edition in *OE*.

questions

system contains an important final section dedicated to formulating questions based on the previous body of the work. To give statistics on the space occupied by questions in four works chosen more or less at random, we have: *Logica nova*, 20%; *Ars generalis ultima*, 25%; *Ars demonstrativa*, 54%; *Tabula generalis*, 62% of the entire work. This is a fact that has gone almost totally unstudied, and this in spite of Llull's repeated assertions that one of the main points of the Art is its ability to answer questions. And it is with these questions that he shows how the Art is applicable to many specific fields apparently extraneous to the generalities of the system itself. In this connection, however, there is another important point which should be investigated. This is the possibility that insofar as the Art, as Ruiz Simon has pointed out,⁴⁹ has its methodological origins in the dialectical techniques of the Topics of Aristotle, Cicero and Boethius, then the questions would show the reader how they can be solved by finding the appropriate loci within the Art itself. In the little prologue to the *Arbor quaestionalis* Llull states that one of the methods of solving any question is to find the appropriate locus in the main body of the work which will lead to the solution, and another involves doing so »through maxims conditioned according to the nature of the trees«. ⁵⁰ Since loci and maxims are the two basic tools of the medieval topics, it seems to me that Llull's questions are an attempt to reformulate them in terms of his Art.

missing

The second longest section of the *Tree of Science* is the *Arbor exemplificalis*, which occupies 9% of the work. If we add this to the 41% of the *Arbor quaestionalis*, it becomes clear that the two trees usually considered as supplementary to the main body of the work occupy exactly 50% of the entire text. This would confirm the idea that in many works of the Art, or in those related to it like the *Tree of Science*, what we call the »main body of the work« is not so much a body as the foundational basis and methodological skeleton of Llull's system, while these so-called »supplementary« parts give us the organs, flesh, blood and skin which fills it out into a real body of thought.

One last statistic: of the remaining fourteen trees, the longest is the *Arbor apostolicalis*, which occupies 7.5% of the *Tree of Science*, and this is because the flowers of this tree, which present proofs of the Articles of Faith, occupy 5% of the entire work.⁵¹ This not only fits in with the hopes expressed in both the Prologue and Epilogue of presenting the work to the Curia, but also to the central role of proofs of the Articles of Faith in Llull's general endeavor.

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(2) As for Llull's use of the tree symbolism here, as is well known, he uses it in other works, but not always with the same intent. In the *Book of the Gentile and the Three Wise Men* he does not really use the structure of the tree at all; he only uses the flowers to make the binary combinations of his system more agreeable and less alarming to the reader. In his two logical works, the *Logica Algazelis*

⁴⁹ JOSEP MARIA RUIZ SIMON, *L'art de Ramon Llull i la teoria escolàstica de la ciència*, Barcelona 1999.

⁵⁰ ROL XXVI, p. 844.

⁵¹ They are roughly the same length (some 20.000 words) as the entire *Liber de articulis fidei* or *Apostrophe* which was written immediately after it. See the Latin text (or texts) of this work in MOG IV, ix, pp. 505-561, and the recent critical edition of the Catalan text in NEORL III.

and the *Logica nova*, he displays the Tree of Porphyry, which is a classic of dichotomous classification. In the *Tree of Science*, on the other hand, the connections between all the parts of the tree correspond to the organic relations of the various levels of reality.⁵² It is important to keep these uses separate, and to realize that only in the work we are studying today are all the relational and structural aspects of the tree structure fully employed.]

(3) This point can help us understand the most essential difference between the *Tree of Science* and other contemporary (or even modern) encyclopedias. These last are usually large storehouses of information classified according to subject-matter, in which the reader can find up-to-date information about any given topic. Llull, however, is not interested in a mere data-bank; he is trying to do something more important and profound. He says that creation exists as a series of layered images of God, and if they all reflect the Creator, they must necessarily be similarly structured. These structures, set out in the trees of the *Tree of Science*, form a progression from the elements up to God. Llull's idea is to display and explain this chain of isomorphisms, which necessarily involves displaying and explaining its enormous web of relationships. For him, therefore, isolated bits of information are of little interest. In this work he is saying that if we have a sufficient understanding of the structure of the world, we can not only answer any question by finding the right locus in this structure, but in the process we can also discover the theoretical framework which justifies the sought-after detail being what it is and acting the way it does. This is, of course, a process essential to the Art, and in this sense the work could be called an *Arbor inventiva*, and in some places, such as his proofs of the Articles of Faith, it could even be called an *Arbor demonstrativa*. *solu ce caracte enciclopedi*

(4) We must take Llull's title literally. He presents us with sixteen trees, but he does not call the work *Arbores scientiae*, and although he shows how it is general to all sciences, he does not call it *Arbor scientiarum*, as some Renaissance commentators tried to rename it.⁵³ It is simply the *Arbor scientiae*, with both nouns in the singular. This implies two things. The first is that the carefully structured network of relations between the different trees is not an added curiosity; it is precisely this relationality that makes all the roots one root, all the trunks one trunk, and finally all the trees one tree. The second is that he is trying to say that all science, from that of the four elements to that of God, is a single science.

(5) This last point corresponds to an important reorientation of his thought between the quaternary and ternary phases of his Art. In the former, as Frances Yates and Robert Pring-Mill have so well shown, Llull's explanations are based largely on the use of metaphor. Something in medicine, for instance, can sym-

⁵² He does more or less the same thing in the *Arbor philosophiae amoris*, but with only a single tree, which he says is modeled on the *Tree of Science*. The tree of the *Arbor philosophiae desideratae*, on the other hand, is a curious hybrid, whose chief function is to decorate the opening pages of the work and to give a rapid vision of the organization of its material, after which it's not mentioned again.

⁵³ As for instance VALERIO VALIER in his *Opus aureum* printed at the end of the last three editions of Zetzner's anthology. See the reprint of the 1651 edition in *Raimundus Lullus Opera. Reprint of the Strasbourg 1651 edition*, Clavis Pansophiae. 2 vols., Frommann-Holzboog: Stuttgart-Bad Cannstatt 1996, p. 968 ff.

bolize something in the field of law, and so on.⁵⁴ In the ternary phase, on the other hand, this kind of metaphoric explanation is no longer basic to the functioning of the Art or to Llull's view of reality. It's not that he now spurns such devices (there are magnificent examples in the *Arbor exemplificalis* here), but they have become mere hermeneutic stratagems. His view of the world has changed from one in which one part merely symbolizes another, to one in which those same two parts are similarly structured or isomorphic; metaphorical analogies have become real relationships.⁵⁵

The most beautiful hymn that Llull dedicated to this vision was the *Tree of Science*, with its vast series of parallel and related structures which end up forming a single structure. In terms of modern logic and theory of relations, one could say that it forms an immense semantic network, one which reflected Llull's vision of the network of the world. Or to appropriate the title of Arthur Lovejoy's famous book, the *Tree of Science* is perhaps one of history's most notable attempts to describe *The Great Chain of Being*.

⁵⁴ Perhaps the locus classicus for this procedure is found in the *Principles of Medicine*, where, after affirming a mathematical truth, he says: »Now this metaphor shows you that, in the science of medicine, the greater the mixture of simple medicines in a drink you make, the less the assurance with which you can work. Now this medicinal metaphor denotes another in the science of law, for the more different laws and cases you want to make accord towards a single end, the more difficult it is to attain that end. Now this metaphor from the science of law denotes another from natural science [...] From degree to degree, from example to example, and from one principle to another, I could go on at great length discussing metaphor with you [...] The greatest virtue of this Art [...] lies in its metaphorical nature.« *SW* II, pp. 1129-1130.

⁵⁵ Even our understanding of the world is based on the fact that our »rational soul« is constructed in a manner similar to that of the world we want to comprehend. Or to put it another way, understanding is now based on another isomorphism, that between subject and object. See JOSEP M. RUIZ SIMON, (art. cit. not. 4) esp. pp. 88-91, as well as CHARLES LOHR, »Les fondements de la logique nouvelle de Raymond Lulle«. In: *Raymond Lulle et le Pays d'Oc*, Cahiers de Fanjeaux, 22, Privat: Toulouse 1987, pp. 233-248, esp. pp. 242-5.