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(*b.* Ciutat de Mallorca [now Palma de Mallorca], ca. 1232; *d.* Ciutat de Mallorca [?], January/March [?] 1316)

polymathy.

A Catalan encyclopedist, Lull invented an “art of finding truth” which inspired Leibniz’s dream of a universal algebra four centuries later. His contributions to science are understandable only when examined in their historical and theological context. The son of a Catalan nobleman of the same name who participated in the reconquest of Mallorca from the Moors, Lull was brought up with James the Conqueror’s younger son (later crowned James II of Mallorca), whose seneschal he became. About six years after his marriage to Blanca Picany (1257) he was converted from a courtly to a religious way of life, following a series of visions of Christ crucified. He never took [holy orders](#) (although he may have become a Franciscan tertiary in 1295), but his subsequent career was dominated by three religious resolutions: to become a missionary and attain martyrdom, to establish colleges where missionaries would study oriental languages, and to provide them with “the best book [s] in the world against the errors of the infidel.”¹

Lull’s preparations lasted a decade; his remaining forty years (from 1275, when he was summoned by Prince James to Montpellier, where he lectured on the early versions of his Art) were spent in writing, preaching, lecturing, and traveling (including missionary journeys to Tunis in 1292; Bogie, Algeria, in 1307; and Tunis late in 1315), and in attempts to secure support from numerous kings and four successive popes for his proposed colleges. During Lull’s lifetime only James II of Mallorca established such a foundation (1276, the year of his accession); when he lost Mallorca to his elder brother, Peter III of Aragon, the college at Miramar apparently was abandoned (*ca.* 1292). In Lull’s old age his proposals were finally approved by the Council of Vienna (1311–1312); and colleges for the study of Arabic, Hebrew, and Chaldean were founded in Rome, Bologna, Paris, Salamanca, and Oxford after Lull’s death. Pious tradition has it that he died after being stoned by Muslims in Bogie (January 1316[?]), although his actual death is variously said to have occurred in Bogie, at sea, or in Mallorca; modern scholars doubt the historicity of his martyrdom. As for his third resolution, it led to the various versions of Lull’s Art—and all his scientific contributions were by-products of this enterprise.

James the Conqueror’s chief adviser, the Dominican Saint Ramon de Penyafort, dissuaded Lull from studying in Paris, where his age and lack of Latin would have told against him; he therefore studied informally in Mallorca (1265[?]-1273[?]). His thought was thus not structured at the formative stage by the Scholastic training which molded most other late medieval Christian thinkers; this fostered the development of his highly idiosyncratic system by leaving his mind open to numerous non-Scholastic sources. These included cabalism (then flourishing in learned Jewish circles in both Catalonia and Italy), earlier Christian writers discarded by Scholasticism (for instance, John Scotus Eriugena, whose ninth-century *De divisione naturae* influenced Lullian cosmological works, notably the Liber chaos either directly or indirectly—and hence also his Art), and probably also Arabic humoral medicine and astrology. The Augustinian Neoplatonism of the Victories also proved important, partly because of its continuing prominence but mainly because its marked coincidences with both Islamic and cabalistic Neoplatonism favored the creation of a syncretistic which was firmly grounded in doctrines equally acceptable to Christians, Jews, and Muslims.

This fusion occurred after the eight years Lull spent in Mallorca studying Latin, learning Arabic from a slave, reading all texts available to him in either tongue, and writing copiously. One of his earliest works was a compendium of the logic of al-Ghazali in Arabic (1270[?]); it has since been lost, although two later compendia with similar titles survive—one in Latin, the other in Catalan mnemonic verse. In all, Lull wrote at least 292 works in Catalan, Arabic, or Latin over a period of forty-five years (1270–1315); most of them have been preserved, although no Arabic manuscripts have yet been traced and many Catalan and Latin works remain unpublished. His initial awkwardness in Latin, coupled with his desire that knowledge be made available to non-Latin-speaking sectors of society, made Lull the first person to mold Catalan into a literary medium. He used it not only in important mystical works, poetry, and allegorical novels (none of which concerns us here) but also to deal with every learned subject which engaged his attention: theology and philosophy; arithmetic, geometry, and astronomy (often mainly astrology), which, together with music, formed the quadrivium (the higher division of the seven [liberal arts](#)); grammar, rhetoric, and logic (the trivium); law; and medicine. Thus, Lull created a fully developed learned vocabulary in Catalan almost a century before any other Romance vernacular became a viable scholarly medium. Almost all Lull’s works in such nonliterary fields were connected in some way with his Art, because the “art of finding truth” which he developed to convert “the infidel” proved applicable to every branch of knowledge. Lull himself pioneered its application to all subjects studied in medieval universities—except for music—and also constructed one of the last great medieval encyclopedias, the *Arbor scientiae* (1295–1296), in accordance with its basic principles.

Yet the Art can be understood correctly only when viewed in the light of Lull’s primary aim: to place Christian apologetics on a rational basis for use in disputations with Muslims, for whom arguments de *auctoritate* grounded on the [Old Testament](#)—widely used by Dominicans in disputations with the Jews—carried no weight. The same purpose lay behind the *Summa contra gentiles* of Aquinas, written at the request of his fellow Dominican Penyafort, whose concern for the conversion of all non-Christians (but particularly those in James the Conqueror’s dominions) thus inspired the two chief thirteenth-century attempts in this direction; the *Summa contra gentiles* was finished during the interval between Lull’s discovery of his own calling and his interview with Penyafort. But whereas Aquinas distinguished categorically between what reason could prove and that which, while not contrary to reason, needed faith in revelation, Lull advanced what he called necessary reasons for accepting dogmas like [the Trinity](#) and the Incarnation. This gave his Art a rationalistic air that led to much subsequent criticism. Lull himself described his Art as lying between faith and logic, and his “necessary reasons” were not so much logical proofs as reasons of greater or lesser congruence which could not be denied without rejecting generally accepted principles. In this respect they were not appreciably more “rationalistic” than Aquinas’s “proofs” that the truths of faith were not incompatible with reason. But the differences between the two apologetic systems are far more striking than their resemblances.

Lull regarded his Art as divinely inspired and hence infallible (although open to improvement in successive versions). Its first form, the *Ars compendiosa inveniendi veritatem or Ars maior*² (1273–1274[?]), was composed after a mystical “illumination” on Mount Randa, Mallorca, in which Lull saw that everything could be systematically related back to God by examining how Creation was structured by the active manifestation of the divine attributes—which he called Dignities and used as the absolute principles of his Art. Examining their manifestations involved using a set of relative principles; and both sets could be visualized in combinatory diagrams, known as Figures A and T. The original Figure A had sixteen Dignities, lettered *BCDEFGHIKLMNOPQR*; the original Figure T had five triads, only three of which (*EFG + HIK + LMN*) were strictly principles of relation, the others being sets of subjects (God + Creature + Operation, *BCD*) and possible judgments (Affirmation + Doubt + Negation, *OPQ*). All early versions had a proliferation of supplementary visual aids, which always included diagrams showing the four elements, and—with the obvious exception of Figure T—most features of the system were grouped into sets of sixteen items, lettered like the Dignities.

This quaternary base seems to provide the key to the origins of the Art’s combinatory aspect, apparently modeled on the methods used to calculate combinations of the sixteen elemental “grades” (four each for fire, air, water, and earth) in both astrology and humoral medicine. A major simplification in the *Ars inventiva* (*ca.* 1289) eliminated the elemental features, reduced the diagrams to four (unchanged thereafter), reduced Figure T to the nine actual relative principles

(Difference + Concordance + Contradiction, Beginning + Middle + End, and Majority + Equality + Minority) and the sixteen original Dignities to the nine shown in Figure 1. In still later versions the symbolic letters *BCDEFGHIK* acquired up to six meanings that were ultimately set out in the gridlike “alphabet” of the *Ars generalisultima* and its abridgment, the *Ars brevis* (both 1308), from which Figure 2 is reproduced. The traditional seven virtues and seven vices have been extended to sets of nine, to meet the requirements of the ternary system; the last two of ten *quaestiones* (a series connected with the ten Aristotelian categories) had to share the same compartment, since the set of fundamental questions could not be shortened and still be exhaustive.

The most distinctive characteristic of Lull’s Art is clearly its combinatory nature, which led to both the use of complex semimechanical techniques that sometimes required figures with separately revolving concentric wheels—“volvelles,” in bibliographical parlance (see Figure 3)—and to the symbolic notation of its alphabet. These features justify its classification among the forerunners of both modern [symbolic logic](#) and computer science, with its systematically exhaustive consideration of all possible combinations of the material under examination, reduced to a symbolic coding. Yet these techniques taken over from nontheological sources, however striking, remain ancillary, and should not obscure the theocentric basis of the Art. It relates everything to the exemplification of God’s Dignities, thus starting out from both the monotheism common to Judaism, Christianity, and Islam and their common acceptance of a Neoplatonic exemplarist world picture, to argue its way up and down the traditional ladder of being on the basis of the analogies between its rungs—as becomes very obvious in Lull’s *De ascensu et descensu intellectus* (1305). The lowest rung was that of the elements, and Lull probably thought that the “model” provided by the physical doctrines of his time constituted a valid “scientific” basis for arguments projected to higher levels. Since this physical basis would be accepted in the scientific field by savants of all three “revealed religions,” he doubtless also hoped that the specifically

Christian conclusions which he drew in the apologetic field would be equally acceptable. It even seems likely that what hit him with the force of a divine “illumination” on Mount Randa was his sudden recognition of such a possibility.

There is no evidence that Lull’s Art ever converted anybody, but his application of the combinatory method to other disciplines (begun in the four *Libri prouticipiontm*, *ca.* 1274–1275) was followed by numerous later Lullists; the Art’s function as a means of unifying all knowledge into a single system remained viable throughout the Renaissance and well into the seventeenth century. As a system of logical inquiry (see Lull’s *Logica nova* [1303] for the strictly logical implications, disentangled from other aspects), its method of proceeding from basic sets of preestablished concepts by

the systematic exploration of their combinations—in connection with any question on any conceivable subject—can be succinctly stated in terms taken from the *Dissertatio de arte combinatoria* (1666) of Leibniz, which was inspired by the Lullian Art: “A proposition is made up of subject and predicate; hence all propositions are combinations. Hence the logic of inventing [discovering] propositions involves solving this problem: 1. given a subject, [finding] the predicates; 2. given a predicate, finding the subjects [to which it may] apply, whether by way of affirmation or negation.”²

Recent research has concentrated on the clarification of Lull’s ideas, the identification of their sources, and the nature of their influence on later thinkers— especially [Nicholas of Cusa](#) and [Giordano Bruno](#). Major advances in all these fields have taken place since the 1950’s, but much more research is still required. The specific origins of Lull’s doctrines regarding the elements, whose importance has been fully recognized only since 1954 (see Yates), are particularly significant. A proper exploration of the antecedents of his *Opera medica* is a prerequisite for establishing Lull’s final place in the history of Western science. In this connection it must be mentioned that although Lull himself was opposed to alchemy (but not to astrology, a “science” he sought to improve in the *Tractatus novus de astronomia* [1297]), his methods had obvious applications in the alchemical field-and they were so applied in a host of pseudo-Lullian alchemical works, most of them composed more than fifty years after his death. These works explain the traditional (but false) “scientific” view which made him “Lull the Alchemist.”

NOTES

1. *Vida coëтана*. The Latin (dictated by Lull [?], probably 1311) says “book,” which doubtlessly agreed with Lull’s original resolve; the plural, in the fourteenth-century Catalan text (modernized in *Obres essentials*, see I, 36), would better fit the series of “improved” versions of the Art itself, which first took shape almost ten years after Lull’s conversion.

2. References to an *Ars magna* in later centuries are usually either to the definitive *Ars magna generalis ultima* (1308) or to Lull’s system in general. The alternative title of the first version recalls [Roger Bacon](#)’s *Opus mains* (1267); the connections between Lull and Bacon have yet to be investigated, but many resemblances may well be due to common Arabic sources.

3. “Propositio componitur ex subiecto et praedicato, omnes igitur propositiones sunt combinationes. Logicae igitur inventivae propositionum est hoc problema solvere: 1. Dato subiecto praedicata. 2. Dato praedicato subiecta invenire, utraque cum affirmativa, turn negative” (G. W. Leibniz, *op. cit.*, [in text], no, 55, in *Sämtliche Schriften und Briefen*, 2nd ser., I [Darmstadt, 1926], 192).

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See also *Estudim Lulianos*, which began publication in 1957, and E. W. Platzeck’s comprehensive survey of research from 1955 to 1969 in *Atitonianum*, 45 (1970), 213-272.

R. D. F. Pring-Mill