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Variantology 4

On Deep Time Relations of Arts, Sciences and Technologies In the Arabic-Islamic World and Beyond

Edited by Siegfried Zielinski and Eckhard Furlus
in cooperation with Daniel Irrgang and Franziska Latell

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Frontispiece: The Brothers Quay

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SIEGFRIED ZIELINSKI
& ECKHARD FÜRLUS

Introduction: *Ex Oriente Lux*

In the beginning there was simply incredulous amazement. It was like the amazement one experiences when one reads the famous collection of stories *The Arabian Nights* for the first time, and encounters the anthropomorphic, artificial figures that can sing and the instruments that play by themselves; in “The Story of the Magic Horse” one immediately meets with three different “living” automata. If our reading matter is from the West, we are similarly amazed when we study Geoffrey Chaucer’s *The Canterbury Tales* from the fourteenth century. Or, if we immerse ourselves in the deep time of Indian and Chinese stories about artificial worlds and in the Chinese canon of Buddhist texts known as the *San-Tsang*, translated from Sanskrit and Pali into Chinese in the sixth century and continually expanded since then, where we find a parable about an ingenious wood sculptor who practises a deception upon his friend, a painter. The wood carver presents a moveable figure of a beautiful woman to his artist friend who falls so madly in love with the figure that he attempts to spend the night with her. Disappointed because the figure is wooden and artificial, the painter takes revenge the next day by sending the sculptor a self-portrait in which the artist is hanging lifelessly from the roof with a rope around his neck. The sculptor is horrified when he sees the realistic portrait of his dead friend; the artist then visits him to prove he is still alive, and both renounce the riches of the world in which people defraud each other, and start to live a life of piety.¹

The three brothers Jaʿfar Muḥammad, Aḥmad and al-Hasan, who have gone down in the history of science and technology as the Banū Mūsā, as the sons of Mūsā bin Shākir, we knew from brief mentions in literature; for example, in connection with the archaeology of automatic music instruments. In the *House of Wisdom (Bait al-ḥikma)* in Baghdad, which was founded by the young Caliph al-Maʾmūn (813–833), they diligently studied mathematics and its divers

¹ We cite this story as re-narrated by Herbert Heckmann in *Die andere Schöpfung* (Frankfurt am Main, 1982), p. 23f. Heckmann took the story from Alfred Chapuis’ treatise *Les automates dans les oeuvres d’imagination* (Neuchâtel, 1947).

applications, and they engaged with philosophy, music, and the design and construction of technical appliances. In the texts by Eilhard Wiedemann, we had read about a curious, continuously playing flautist, which the brothers had developed in the tradition of Hellenistic music automata. From the works by Donald Routledge Hill, the three brothers were known to us as a superb team of thinkers and inventors. Then we stood in the rooms of the Institute for the History of Arabic-Islamic Sciences, which the Istanbul scholar Fuat Sezgin has built up with his team at the Johann Wolfgang Goethe University in Frankfurt am Main over the course of 40 years, and saw a reconstruction of this legendary musical device.² One look at the mechanical heart of the artefact sufficed to appreciate the radical way in which Mūsā bin Shākir's three sons had taken the concepts of classical authors and expanded them in the ninth century A.D., and in this way we became vividly acquainted with the inner secret of a very special *black box*.

“The instrument, which plays by itself (*al-alat illati tuzammir binafsiba*)”,³ is the name the Banū Mūsā gave their device, thus emphasising its character as an automaton. Also, the title evidences that they ascribed universal meaning to their technology. Apparently, they wanted their invention to be understood independently of any specific form of realisation, such as the flute player. Birds and flautists, powered by water and moved by pneumatics are known from Chinese literature as well as from Ancient Greek authors. With regard to the mechanisms, the technologically most advanced solutions are attributed to Apollonius. Apollonius had already developed a hydraulic-pneumatic mechanism of such complexity that his anthropomorphic figure could play the flute endlessly—as long as provided with a constant flow of water. Due to a circular construction, whereby a second water container filled up while the first was emptying and pressing out air for the flautist, the automaton had a constant inflow of energy in the directest sense.⁴ The three academic princes of Baghdad built a complete music automaton, which could not only vary the rhythm of the music; it was even possible to feed it with any melody. In his English translation of parts of the manuscript George Henry Farmer quotes the intention of the Banū Mūsā: “We

² The reconstruction is now in the Museum of Islamic Science and Technology in Gulhane Park, near Topkapi Palace, which Fuat Sezgin played a leading role in initiating and which opened in 2008.

³ The manuscript, which contains this description, was found by Henry George Farmer “in the Library of the Three Moons College of the Orthodox Greek Church at Beirut, Syria”. The manuscript is singular; see H.G. Farmer, *The Organ of the Ancients* (London, 1931), p. 87.

⁴ See Eilhard Wiedemann, Über Musikautomaten, in: *Sitzungsberichte der physikalisch-medizinischen Sozietät in Erlangen*, ed. Oskar Schulz, vol. 46, 1914 (Erlangen, 1915), translated for this volume by Baruch Gottlieb.

wish to explain how an instrument [...] is made which plays by itself continuously in whatever melody [...] we wish, sometimes in a slow rhythm [...] and sometimes in a quick rhythm, and also that we may change from melody to melody when we so desire.”⁵

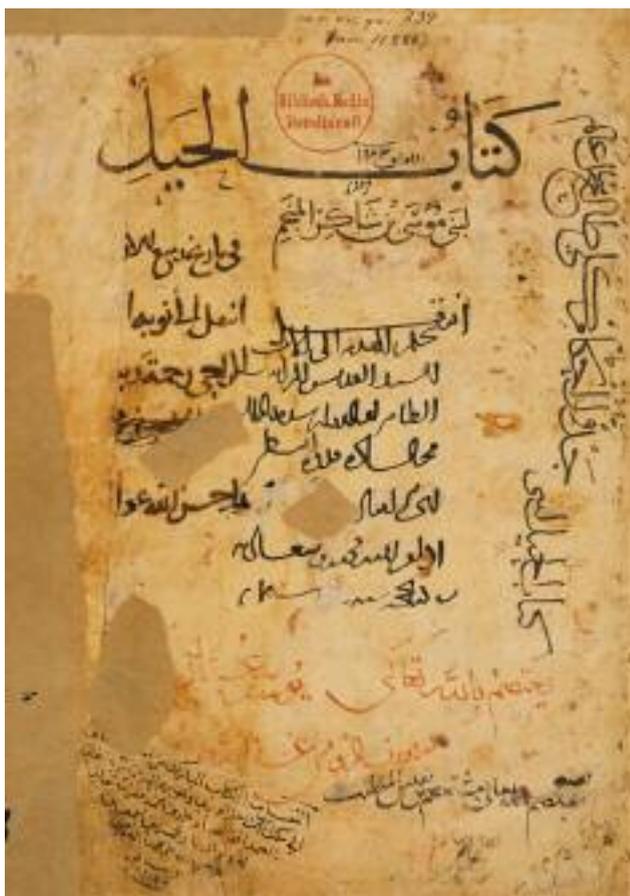


Fig. 1: Banū Mūsā Ibn-Šākīr; *Kitab-al-hiyal* (Book of Ingenious Devices), collection of the Staatsbibliothek zu Berlin C Preußischer Kulturbesitz, Oriental Department, MS or. quart. 739, frontispiece.

⁵ Quoted in Farmer, *Organ*, p. 88; the words in Arabic that Farmer included in parentheses have been omitted.

A hydraulically driven cylinder which rotates inside is the centrepiece and actually the mysterious component of the automaton. On the surface of the cylinder were bands of wood and metal, which carried small protruding pins of various lengths. Depending on how these pins were positioned on the bands and how the bands were arranged, a mechanical translation opened or closed the valve of a flute, the single pipe of an organ, or moved another sound-producing element. The way the pins were arranged on the cylinder formulated the musical instructions, the *programme* of the instrument. The hardware is virtually identical to the revolving cylinders with pins that were used 500 years later in the European glockenspiel of the late Middle Ages, even later in the mechanical organs of the Renaissance, and for writing automata and automatic music instruments in the Age of Enlightenment.

The most famous manuscript by the Banū Mūsā is the *Book of Ingenious Devices* of ca. 850, of which only three copies survived that are nearly complete: one is in the Vatican Library, one in the Istanbul Topkapi Library, and one copy, which dates from 1260, is shared by the oriental manuscripts section of the Forschungsbibliothek Gotha (70 folios) and the Staatsbibliothek Berlin (75 folios). The manuscript contains descriptions of one hundred different mechanical models (*shakl*), among which are a number of further automata (we define automaton as an artificial device that is automotive). At the end of this compendium we find a visual analogue to the perpetually playing music automaton: a lamp that burns continuously.⁶ This artificial eternal light is an adaptation from Heron of Alexandria's (ca. 10–70) theatre of automata.

The exact surveying and cartography of the Earth, the construction of the bird's eye perspective as a means of orientation in the vast land expanses and for navigation on the seas and oceans was also a study focus at the House of Wisdom in Baghdad. Originally designated a sacred discipline, in this way Caliph al-Ma'mūn began to develop the secular uses of geography. "Geography developed extensively as actual observations of various parts of the world", writes Seyyed Hossein Nasr in his book on Islamic science with unusual illustrations, and cites the map by a cartographer of the period named Ibn Hawqal, which obviously served as the model for the magnificent illustration we include here as

⁶ For an exact description of the trivial automaton in English see Donald R. Hill's translation and commentary of the *Book of Ingenious Devices* (Dordrecht, 1979), p. 234f.

⁷ Seyyed Hossein Nasr, *Islamic Science* (Lahore, 2000), quotation p. 40; the illustration referred to is Plate 17, which follows p. 40. The book is unusual in that after it was printed, the faces of human figures and legends were obliterated with white paint (see, for example, p. 96, a section on calculating the calendar).



Fig. 2: Self-feeding lamp of the Banū Mūsā, Model No. 96 in the Manuscript MS 559/9, Staatsbibliothek zu Berlin C Preußischer Kulturbesitz, Oriental Department. At the centre is the gear wheel, which maintains the supply of oil to the wick; at the top left above the circle is the opening where the oil is poured in.

Figure 2.⁷ The hand-made copies of the maps in Ibn Hawqal's *Kitāb al-masālik wa l-mamālik* (Livre des routes et des royaumes) are some of the most beautiful examples of early map-making.⁸ Fuat Sezgin mentions the map of the world by

⁸ Several magnificent examples of manuscript from the fifteenth and sixteenth centuries were presented in the exhibition “L'âge d'or des sciences arabes” (October 2005 to March 2006) at the Institut du monde arabe (IMA) in Paris; see the catalogue of the same title (Paris, 2005), pp. 134–136.

al-Idrisi of 740 AH (1340 CE) from which he concludes that the first rounding of the Cape of Good Hope in Africa, and thus the possible discovery of the New World on the other side of the Atlantic, probably took place earlier than is currently thought and neither feat was performed first by Europeans. The exquisite map by al-Idrisi in dark blue and bright yellow of which many later variants exist, is reputed to have been adapted from maps of the world and geographic sketches dating from the era of al-Ma'mūn, the first three decades of the ninth century.⁹

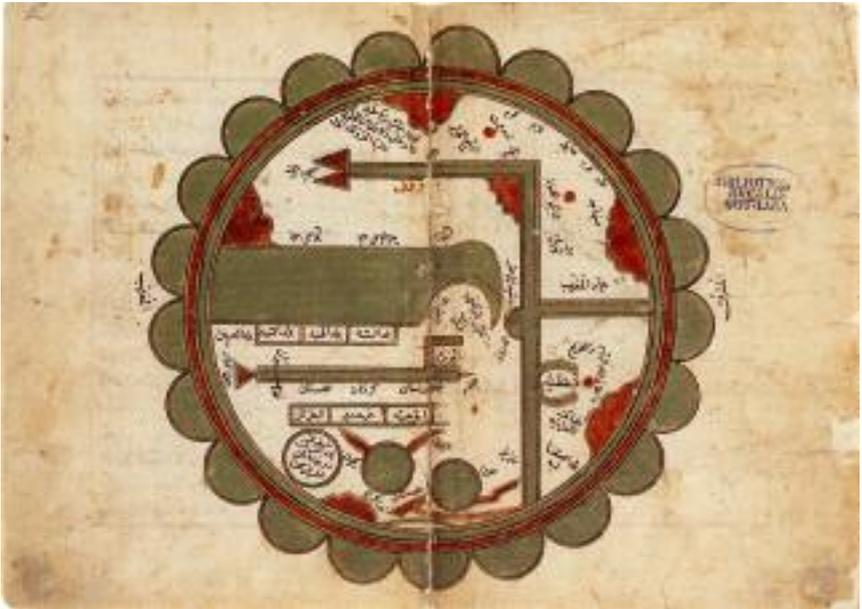


Fig. 3: Map of the world. MS orient. A 1514, Bl. 1b/2a. 19,5 x 27 cm. Pseudo-Ibn al-Wārdī: Haridat al-'aḡa'ib wa-faidat al-gara'ib. From the catalogue Orientalische Buchkunst in Gotha, p. 165.

The influence of Arabic-speaking culture and science on the Latin Middle Ages, and therefore on fundamental elements of the modern era in Europe, is today indisputed. Through translations into Arabic of works written in Greek,

⁹ See Fuat Sezgin, *Der Kalif al-Ma'mūn und sein Beitrag zur Weltkarte. Arabischer Ursprung europäischer Karten. Forschung Frankfurt. Wissenschaftsmagazin der Johann Wolfgang Goethe-Universität Frankfurt am Main* 18 (2000): 22–31.

which Syrian Christians brought to Baghdad, as of the eighth century the legacy of knowledge of earlier civilisations was studied, developed and built on, and passed on to Christianity-oriented Latin culture by Arabs.

In a process that was highly complex the Arabs exerted a decisive influence on the Western world in the Middle Ages and the Renaissance in virtually all fields of knowledge—astronomy, biology, chemistry, cartography, mathematics, medicine, metaphysics, music, optics, and philosophy—and made a fundamental contribution to the development and diversification of the sciences which continues today. The better-known philosophers are Ḥāḍ ḡ (776–868), al-Kindī (ca. 800–870), al-Fārābī (ca. 870–950), Avicenna (Latinised Ibn Sīnā) (980–1037), Averroës (Latinised Ibn Rushd) (1126–1198), Ḡ ā ī (1058–1111), and Ibn Arabī (1165–1240). Discussing the work of the Catalan monk, writer, theologian, missionary, and inventor of text-generating devices Ramon Llull (Raimundus Lullus), who has accompanied us since the beginning on our Variantological expeditions, Charles Lohr refers to Llull as a “christianus arabicus”,¹⁰ an Arabic Christian.

The most important sources on the history of Arabic-Islamic sciences are, as Mohammed Abattouy has established, the original works in Arabic from the thirteenth to the sixteenth century,¹¹ the majority of which have not yet been translated into other languages.

Arabic is not only of especial importance because it is the common language of various countries in the Middle East and North Africa. Georges Tamer, while at the Seminar for Semitic and Arabic Studies of the Freie Universität Berlin, wrote in 2003, “Arabic is a language that was developed as a medium for philosophical thought [...] The development of Arabic into an autonomous philosophical language is in part due to a large-scale translation effort that lasted from the eighth to the tenth century. Particularly Christian scholars were involved in this, who translated the principal philosophical works of Classical Antiquity and Hellenism into Arabic. The Christian translators were already familiar with Aristotelianism, which had been predominant in the Syrian cultural region before the advent of Islam, and they probably also influenced the direction that Arabic philosophy took by contributing to its Aristotelian character.”¹² Tamer

¹⁰ Charles H. Lohr, *Christianus arabicus, cuius nomen Raimundus Lullus*. *Randa* 19 (1986): 7–34.

¹¹ Mohammed Abattouy, *The History of Arabic Sciences: A Selected Bibliography* (Berlin, 1996), p. 1.

¹² Georges Tamer, *Durchlässige Grenzen. Wider die Vereinfacher: Arabische Philosophie und Islam*. *Frankfurter Allgemeine Zeitung* no. 48, 26.2.2003, p. N 3.

also points out that the boundaries between philosophy and religion in the Arabic Middle Ages were by and large porous. Themes in metaphysics were subjects that interested philosophers and theologians, and logic, which Averroës defined as a neutral tool of argument, was of great importance for Islamic religious thought.

Among the contacts between the Christian and the Muslim world three historical events are of particular importance: the period of the Arab conquest of Spain 711–1492 (the last Moorish stronghold near Granada fell on 2 January 1492); the fall of Constantinople, capital of the Christian Byzantine Empire to the Ottomans in 1453; and the period of Arab rule in Sicily.

Sicily, the island off the southernmost tip of the Italian peninsula, which over the course of its history was conquered by many foreign powers, did not attempt to obliterate the traces of Arab occupation. The explanation offered for this is that Arab rule was relatively short and they were driven out with relatively little bloodshed. Further, the conquering Norman kings admired Arab culture. Alongside Latin, Greek, and Hebrew, Arabic was one of the four official languages of the Kingdom of Sicily. From 831 to 1072 Palermo was Arab. The city became a centre of Arabic art and science, and even under King Frederick II. Palermo was more *oriented* towards the East than the West. The city's twelfth century castle, the Zisa, with its architecture that incorporates subtle plays of light and fountains, today houses the Museo d'Arte Islamica; recently renovated, it shines out over the city in filigree splendour. In 1224 Frederick II. founded the first European university with royal privileges in the city that was regarded as the northernmost outpost of Africa and Arabia: Naples. One of *Federico II.*'s most celebrated students was Thomas Aquinas. Naples will continue to engage our attention, for we held our 5th Variantology Workshop there in the Biblioteca Nazionale.

The great service rendered by the history of Arabic-Islamic science and scholarship was already acknowledged in the nineteenth century by Johann Gottfried Herder, Johann Wolfgang von Goethe, Kurt Sprengel, and Alexander von Humboldt, for example. The orientalist Ulrich Jasper Seetzen from Jever in Friesland set out in 1802 on a journey that was planned as a three to four-year private research trip to Istanbul, Aleppo, Damascus, Nablus, Jerusalem, Cairo, Suez, Mecca, and Medina to collect interesting things such as minerals, music instruments, plants, jewellery, and also manuscripts for the library in Gotha. He never returned. He sent crates of samples to Gotha until 1811, when he died under unknown circumstances in Jemen.¹³

As a “temporary Arab”, who gave up his German name and later called himself Musza, Seetzen was one of those who paved the way for the modern

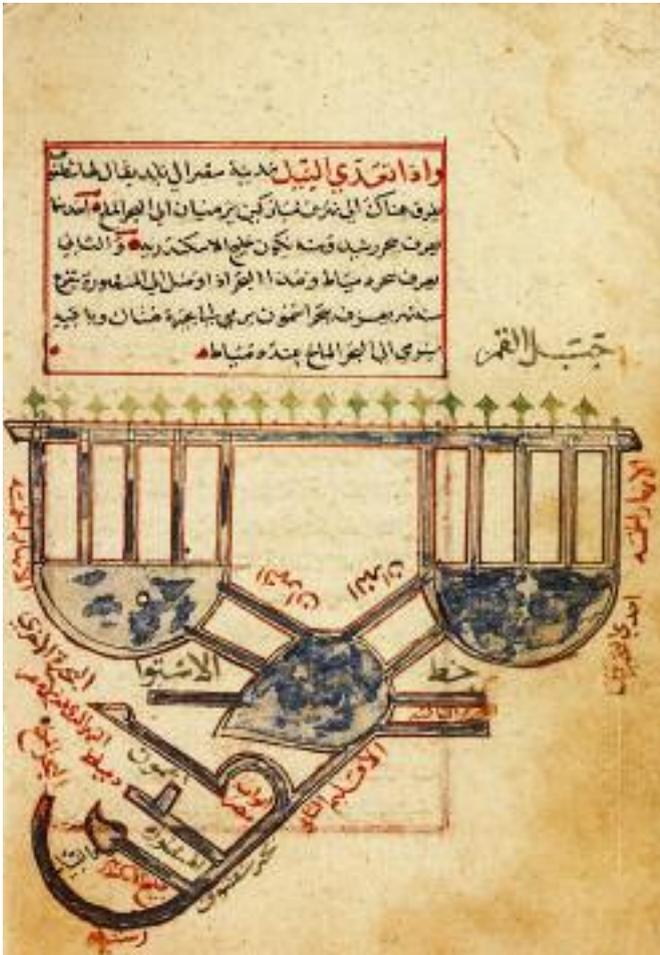


Fig. 4: Map of the Nile. MS orient. A 1638, Bl. 77b. 20.5 × 14.5 cm, map 11.5 × 13 cm. Mubammad Ibn Abi s-surur: ar-Rawda az-zahiya fi wulat Misr wa-I-Qahira al-mu'izziya. From the catalogue Orientalische Buchkunst in Gotha, p. 169.

13 See the essay by Hans Stein, Ulrich Jasper Seetzen und Gotha. 1. Zur Geschichte und Erschließung der orientalischen Handschriften in Gotha, in: *Orientalische Buchkunst in Gotha*. Exhibition for the 350th anniversary of the Forschungs- und Landesbibliothek Gotha, ed. Hans Stein (Gotha: Forschungs- und Landesbibliothek, 1997), pp. 17–40; and Jutta Schienerl, *Der Weg in den Orient. Der Forscher Ulrich Jasper Seetzen: Von Jever in den Jemen (1802–1811)*, ed. Mamoun Fansa (Oldenburg, 2000).

discipline of Oriental Studies, like Eilhard Wiedemann, who engaged with virtually all areas of Arabic-Islamic science. In his lifetime Wiedemann did not publish one book on his findings; instead, he published a multitude of papers which were documented posthumously in three large volumes edited by Fuat Sezgin's Institut für Geschichte der Arabisch-Islamischen Wissenschaften in Frankfurt. The actual founder of modern Islamic Studies, Ignaz Goldziher, is little known by comparison. Born in Hungary, Goldziher published a large proportion of his work in German. Among the most important orientalists in the nineteenth and twentieth centuries were Silvestre de Sacy and Ernest Renan.

Compared to these great scholars, we can only stammer about the deep time of the relations between the arts, sciences, and technologies in the Arabic-Islamic world, and laboriously learn their language. But we have begun to take up the challenge: with this new knowledge, to conceive of the history of the means of communication and the arts in a different way. The development of automata, optics and its instruments, music, combinations of technologies, and other theories and practices that are labelled “modern”, must be reconsidered from this perspective.

The concluding section of al-Jazarī's famous book about the theory and practice of the engineer's art from 1206 is devoted to a rather unprepossessing mechanical box; here al-Jazarī engages with the question of how one can construct a container, made, for example, to hold valuable objects, where one must know a complex code in order to open it. Al-Jazarī proposes a combination of four locks; their mechanisms only engage to open the box if the three key levels of letters and numbers, which each of the four locks possesses, are set correctly. If the combination is not known, then a person must have cryptological abilities in order to be successful.

First and foremost we should like to thank our authors, the University of Arts Berlin, which enables us to conduct our research, and the many irreplaceable people who worked to realise this volume—translating, editing, commenting. Our special thanks go to Fuat Sezgin; his unstinting and generous aid supported our project in a great variety of ways. Claus-Peter Haase, director of the Museum of Islamic Art in Berlin for many years, lent us his expert support right up to the time the book went to press. Abdelhamid I. Sabra, the great translator and commentator of Ibn al-Haytham's work on optics helped us by providing important information. Franz Fischer stepped in when, towards the end, difficult translations from the Latin were urgently needed. Besides the Institut für Geschichte der Arabisch-Islamischen Wissenschaften in Frankfurt, the Institut du monde arab (IMA) in Paris, the Süleyman Library in Istanbul, the



Fig. 5: A lock for locking a chest by means of a combination of letters and numbers. From al-Jazari, *Compendium on the Theory and Practice of the Mechanical Arts*. Reproduction by the Institute for the History of Arabic-Islamic Science Frankfurt am Main, 2002.

Staatsbibliothek Berlin, and Forschungs- und Landesbibliothek Gotha graciously allowed us to reproduce material from their collections.

Amnon Shiloah was the last speaker at this Variantology Workshop in Berlin. The subject of his presentation was the divine or devilish qualities that are ascribed to music. Not least due to the choice of its words, Shiloah reminded us of a wise saying by the musician and composer Frank Zappa, which leaves no doubt as to the special nature of music: “Information is not knowledge. Knowledge is not wisdom. Wisdom is not truth. Truth is not beauty. Beauty is



Frontispiece for *al-Jazarī's Compendium on the Theory and Practice of the Mechanical Arts* (Reproduction Frankfurt 2002)

not love. Love is not music. Music is THE BEST.”¹⁴ The deep truth of these words vibrate in harmony with a well-known saying by the Prophet Mohammed—“The ink of a scholar weighs more than the blood of a martyr.”

14 Cf. the lyrics of the song *Packard Goose* on the Frank Zappa album *Joe's Garage: Act III* (1979). In his biography, Francis Vincent Zappa, Jr., born 21 December 1940 as the son of Sicilian-Greek emigrés in Baltimore, Maryland, refers to his background: “My ancestry is Sicilian, Greek, Arab, and French. My mother’s mother was French and Sicilian, and her dad was Italian (from Naples). The Greek-Arab side is from my Dad. He was born in a Sicilian village called Partinico.” See also Carl-Ludwig Reichert, *Frank Zappa* (Munich, 2000), p. 9.