

Arabic traces in Alexander Humboldt's *Kosmos* and Central Asian geographies

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Alexander Humboldt ranks among the scholars of Weimar Classicism who not only appreciated Arabic contributions to the universal heritage of sciences but revived a long lost cosmological and universal understanding of sciences, tracing back to flourishing periods of the Abbasids from early 9th century onwards. A universalistic approach to historical layers of sciences follows long-term developments, retracing historical layers in sciences' history while overcoming outdated Eurocentric concepts of periodization (middle ages, modernity etc.). The Abbasid Era under Caliph Ma'mūn in the first third of 9th ACE with Baghdad at its center introduced an Early Enlightenment reaching finally Middle Europe. Scientific classifications were approved, interdisciplinary, experimental sciences enhanced and scientific travelling flourished. Alexander Humboldt not only reflected upon Arabic contributions to the universal heritage of sciences but followed up Arabic universalism himself, applying it during his scientific travelling. The Humboldtian approach combined scientific traveling with interdisciplinary observations, determinations (geographic coordinates), and classifications from the very beginnings onwards. When traveling Central Asia in 1829, he especially showed an interest to Arabic contributions in the field of geography and cartography. Humboldt had not only studied Arabic sources on Central Asia but compared historical coordinates with his own measurements. The source studies of Fuat Sezgin (1924–2018) enable nowadays to comprehend the important contributions of Arabic-Islamic geography and cartography, and while contextualizing the rich fund historically, Eurocentric distortions in the history of science, here geography and cartography, losing their relevancy.

Keywords: Alexander Humboldt, Arabic geography, Arabic cartography.

*Dedicated to my teacher, the great orientalist and historian of science
Prof. Dr. Fuat Sezgin (1924–2018) who reintegrated
the invaluable contributions of Arabic sciences
into the universal heritage*

From the Early Arabic Enlightenment to Alexander of Humboldt's Universalism

Universalistic approaches towards the history of sciences, philosophies and ideas enable to understand the embedding of knowledge layers in long-term history and regarding space in universally enmeshed history. In the course of knowledge unfolding, the *long durée* of sciences' history proves continuities and discontinuities.

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Alexander von Humboldt, who disliked being named with nobility, was aware of this problem, especially when it comes to the historical development of Geography, Cartography and corresponding methods. And, he reflected on the history of Geography while referring to sources of Arabic provenance which still were of practical use for him. In the following his name is written Alexander Humboldt. But not only Arabic historical sources were of help for Humboldt, while researching Central Asia in 1829, he revived Arabic universalism while traveling scientifically in Central Asia. The Arabs, Humboldt emphasized, are to be seen as the real founders of physical sciences in the modern sense.¹

In his late work *Kosmos* Humboldt introduced the new approach he followed towards natural sciences which richness 'is not any more the plethora but the interlinking (Verkettung) of the observations. Structures (Gebilde) of plants or animals which appeared for a long time as isolated strung together by newly discovered middle links and intermediate forms. A general interlinkage, not in simple linear direction but in a net-like interwoven web"² [2, p. 523].

The seemingly new Humboldtian approach had its predecessors, and was now gaining ground again.

A cosmologically derived web of life in which micro- and macrocosm is inseparable concatenated, tracing back to mainly Plotinian philosophies (Neoplatonism), was the pillar of early Arabic universalism.

Already Aristoteles doubted the rigid categorization of life, when observing certain phenomena in nature. In his zoology we find gradual transitions. Here, the sponge appears to be endowed with a certain sensibility, and, rooted in the earth, is immobile, but reacts to external forces. Aristoteles called these "transitional beings" zoophytes. But the Aristotelean meta-scientific laddering of the soul (plants, animals, and human beings) hindered him to overcome the vertical understanding of life's unfolding.

For Arabic universalism and transdisciplinarity the 10th century Ikhwān aṣ-Ṣafā', a collective of scientists and philosophers who wrote a voluminous encyclopedia for teaching and didactical purposes, came, when observing life, to far-reaching conclusions, thereby following the flow of life cosmologically:

"... the first and lowest rank of plants is of what is close to dust, and it is moss [or 'mold' or 'lichen': *khaḍrā' al-dīman*], which is nothing other than dust which becomes felted on the ground, rocks and stones. Then it is exposed to the moisture of the rains and the dew of the night, and, in the early morning, it becomes green, as if it were the germination of seed or grasses. And if it is exposed to the heat of the midday sun, it reverts. Then the very next day it becomes like it was from the night-time dews and fresh air. And neither truffles and nor moss [*khaḍrā' al-dīman*] will sprout in adjacent locations except in the days of spring, because of the proximity of what is between the two of them, for the

¹ „Die Araber sind, wir wiederholen es, als die eigentlichen Gründer der physischen Wissenschaften zu betrachten, in der Bedeutung des Worts, welche wir ihm jetzt zu geben gewohnt sind“ [1, p. 248]. URL: http://www.deutschestextarchiv.de/book/view/humboldt_kosmos02_1847/?hl=Alhazen&p=253 (accessed: 26.06.2018).

² Translated from German by the author. See also the digital reproduction and transliteration: "Pflanzen- und Thier-Gebilde, die lange isolirt erschienen, reihen sich durch neu entdeckte Mittelglieder oder durch Übergangsformen an einander. Eine allgemeine Verkettung, nicht in einfacher linearer Richtung, sondern in netzartig verschlungenem Gewebe, ...". URL: http://www.deutschestextarchiv.de/book/view/humboldt_kosmos01_1845?p=52 (accessed: 24.06.2018).

mineral element of this [one] [*hādhā*] is plant-like, and that [one] [*dhālika*], also a plant, is mineral-like” [Transl. from German by the author, 3, p. 101–102].

Ikhwān aṣ-Ṣafā’ were in line with the metaphysic frame of Aristotelean categorization when it comes to classifying “the plant” along the vertical laddering of the soul. But they were observing and documenting masterfully. This scientific tradition was enhanced by Abū r-Raiḥān Muḥammad Ibn Aḥmad Bīrūnī (973–1048). The Arabic writing Bīrūnī from Kath in nowadays Uzbekistan was an outstanding, an intensively experimenting, observing, multi- and inter-disciplinary researching scientist at the beginning of the second Millennium. He was probably one of the most noteworthy universalistic scientists. It was al-Bīrūnī, who allocated e. g. the coral, because of its respond to touch, already to the „kingdom of animals“. And, he was a pioneer of scientific traveling, recorded in his around 1030 AD written book on India. In *Taḥqīq mā li-l-hind... or Kitāb al-Hind*, where Bīrūnī paid great tribute to Indian scientific and philosophical developments, comparing these with Hellenic and Arabic-Islamic ones, he not only designed a religious-cultural panorama of India, but also determined coordinates of the river Ganges — a study which combined ethnology, religious studies with natural sciences, and astronomy. The works of Bīrūnī were (to our current state of knowledge) not translated into scholastic Latin. In Europe and long after Bīrūnī the coral was still believed to be a mineral. The coral was finally categorized as an animal following the studies of Peyssonnel in the Caribbean at the end of the first half of the 18th century [4, p. 127].

Scientific findings once obtained did not necessarily find its way to scholastic Europe. Or, they had been lost, as several examples in the history of Cartography show — a question to which we shall return.

These examples may suffice to give an insight into methods of observation, systematization and theories of natural sciences in early Arabic enlightenment.³ Although Humboldt was influenced by the Aristotelean-Linnean concept of life’s development from lower to higher levels, on a meta-scientific level he followed closely the micro-macro-cosmological interplay in the web of life.

The essentials of the universalistic early Arabic enlightenment were: rational reasoning and deduction, practical research and experimental verification, inter- and transdisciplinary, ethical foundation and cosmological embedding of science. And not least, scientific traveling reached a climax with Bīrūnī. Alexander Humboldt, who picked up this heritage, should be analyzed in the long-term and universal historical context of sciences’ unfolding.

The science historian George Sarton (1884–1956) emphasized the introduction of the experimental spirit into the history of science by Arabic-Islamic approaches. “The main, as well as the least obvious, achievement of the middle ages was the creation of the experimental spirit and this was mainly due to the Muslims down to the 12th century” [5, p. 99]. Additionally, the mathematization of the Kosmos became a corner stone in striving for precise knowledge. While Pythagoras (d. after 510 BC) deduced the mathematization of e. g. music cosmologically (spherical harmony), Euclides (d. 285 BC) applied mathemati-

³ We cannot measure the state of knowledge of Bīrūnī with nowadays standards which gives evidence that e. g. corals live mainly in symbiotic communities as individual polyps together with seaweeds. Some of them are catching small fishes and plankton. In case they are overshadowed, they turn to the sun-light for photosynthesis. Life is more communicative and cooperative as assumed in these times.

cal laws in geometry. Euclidian Geometry became after its translation to Arabic important for the optics of Ibn al-Haitam (lat. al-Hazen, d. after 1040 AD) who combined research on the essence and movement of light with studies on the anatomy of the eyes and the nature of seeing. In order to stress the quality leap which the Arabic unfolding of systematic experimentation Humboldt underscored: "How far is al-Hazen from Ptolemy!" [1, p. 249].

Under guidance and supervision of Fuat Sezgin several experimental arrangements with different mirrors — concave, convex and other forms, demonstrating that the angle of incidence of a ray of light is equal to the angle of its reflection — were reconstructed for the *Institute for the History of Arabic-Islamic sciences* at Frankfurt's J. W. Goethe University, being nowadays shown alongside with around seven hundred scientific, medicinal, technical instruments, models etc. in *Istanbul's Museum for the History of science and Technology in Islam*.⁴

What we might call nowadays experimental sciences was a breakthrough a Millennium ago. Alexander Humboldt had this flourishing period in mind, when writing that Arabs not only contributed to preserve scientific cultures, but developed them further and opened new ways to natural sciences. Already Humboldt saw in experimentation the main contribution by Arabic scientists, a decisive progress in the history of science. With regard to the development of Medicine and pharmacy Humboldt highlighted the scientific integration of medicinal botanic and chemistry into pharmacy (*Arzneimittellehre*) [1, p. 251]. Also in this context it is obvious that the further development of mathematization is of great importance, especially when it comes to the necessary precision of weighing pharmaceutical substances.

At this point we cannot touch upon the History of Medicine, Pharmacy and sciences in general. Here it is sufficient to underline that mathematically based and observationally deduced science became within a short period, in the course of the Arabic translation movement, applied research (e. g. astronomical methods, pharmaceutical chemistry), in natural sciences experimentally verified (e. g. in Optics) and clearly systematized (in Medicine e. g. with Ibn Sina's *Qānūn fī al-Ṭibb / Qanon of Medicine*). This will become apparent when addressing the history of mathematically and astronomically based Geography and Cartography. In Central Asia Alexander Humboldt consulted and compared century's old astronomically determined coordinates of Arabic origin with his own measurements.

We first have to raise the question of the historical-philosophical background for the striving for knowledge from the beginning of the 9th century. Why Baghdad became a flourishing scientific and cultural metropolis in the 9th century?

Baghdad — a scientific melting pot

The second half of the 8th century AD / 2nd century Hiğri (H.)⁵ introduced an early enlightenment, having Baghdad to its starting point. A plurality of knowledge paths mouthed into the Abbāsīd center along the Euphrates and Tigris Rivers. Already under

⁴ The Museum for the History of science and Technology in Islam was founded in May 2008. Together with the Dr. Ursula and Prof. Dr. Fuat Sezgin library and the Prof. Dr. Sezgin Institute, the trifold institution opens its doors to historians of science from all over the world. For a virtual tour throughout the museum see: <http://en.ibtav.org/virtualtour>.

⁵ I will use the German transliteration (DMG) for Arabic terms, names etc. Hiğri for the Islamic Calendar will be abbreviated as H.

the reign of Caliph al-Manṣūr (714–775) e. g. Indian Planispheric Trigonometry together with astronomical tables were translated from Sanskrit into Arabic (e. g. *Zij al-Sindhind*), also Persian and Nestorian treatises and late antique philosophies, Medicine, and sciences, mainly written in Hellenic were assimilated. An intensive translation of all accessible knowledge sources into Arabic began. In the following two centuries some scientific works, e. g. Indian astronomical tables, were translated two or more times into Arabic. Sarton wrote in this context: “Almost every bit of knowledge had to be translated either from Greek, or from Sanskrit, or from Pahlawī before it could be assimilated. And not only that, but these interpretations necessitated the creation of a philosophic and scientific terminology which did not exist. When one takes into consideration, instead of being surprised at the relative smallness of the first harvest, one cannot help admiring the immensity of the effort” [5, p. 523].

These enormous efforts would not have bearded fruit, if not techniques had been developed to spread the knowledge on innovative knowledge carriers. The proto-industry of paper making — a technique which reached Baghdad via Samarkand from China — revolutionized in the 750ies the dissemination of knowledge in the vast territories of the Abbāsīd Caliphate and beyond. Mills, among them water-driven hammer mills, stamped rags. An indication that also China contributed to the progress of sciences and Technologies in these times. The techniques, recycling old clothes, were sustainable and still in use in Europe far into the 20th century (rag collectors). The knowledge transfer from China along the Silk Road into Arabic-Islamic lands and beyond is yet not researched extensively. It is sufficient at this point to emphasize that the paper based book revolutionized information technologies.

The more rational orientation of the theological Islamic school of the Mu‘tazila, which became a state doctrine under the Caliph al-Ma‘mun (reigned 813–833), might have contributed to the flourishing of sciences and Philosophy while striving for worldly knowledge which had been promoted by the Abbāsīd State. And not least, a culture of tolerance and living together which dominated the various communities contributed decisively to a constructive atmosphere which stimulated scientific cooperative research. Baghdad was the point of departure for a long wave of a knowledge oriented culture and transcultural and religious cooperation. The wave reached Al-Andalus on the Iberian Peninsula and also Sicily in Southern Italy in the 9th century. Here, we also find scientific cooperation beyond narrow drawn religious borders—a tradition which was later adopted by the European conquerors, e. g. under the reign of Alfons the Wise (Alfonso X the Wise of Castille, reigned 1252–1284) who was inspired by multi-religious scholarly institutions, teaching Jews, Christians and Muslims at the mean time [6, p. 126]. This holds true also for the scientific development under the reign of Frederic II., the emperor who reigned in Germany from the Arabic-shaped Sicily.

Discontinuities

Following scholastic discussions in the mid of the 13th century, it was disputed for centuries whether, and if so, to which extend, Arabic philosophies and sciences contributed to European knowledge paths. It was also an issue whether Arabic knowledge should have its place in the young scholarly development, after central Europe slowly begun to restore knowledge and science. During so called European “dark ages”, a long

period of decline (5th–10th century), the connection to Helleno–Roman knowledge heritage was more or less lost completely. On the Iberian Peninsula, the Arabic Al-Andalus (711–1492) and in Arabic-Norman Sicily (9th–13th century) the situation was different. From the southern periphery of Europe the center of science, Philosophy and Medicine — here multi-cultural and -religious teams translated from Arabic into Latin and into the young vernacular languages (e.g. Italian), and from here sciences, Philosophy and Medicine traveled further towards central Europe. The cathedral school of Chartres became an early center of scholarship in the 11th century. In 1200 the foundation of Paris University was laid — a process in which the assimilation of Arabic Philosophy played an important role.

Following the discussions at Paris University — the Sorbonne had been founded in 1257 during the upcoming dispute on the status of Arabic Epistemology — Scholars like Albert the Great (Albertus Magnus, 1200–1280) and his student Saint Thomas Aquinas (1225–1274) had called in Arabic sources, among them Ibn Sinā (Avicenna) and Ibn Rušd (Averroes, 1126–1198). Both Arabic philosophers were now denounced as a kind of radicals who were not seen as in accordance and harmony with cleric teachings. For the German Mystic *Meister Eckart* (1260–1328), Ibn Sinā (Avicenna) was the main source.

It was the specific understanding of *unitas intellectus*, a uniformed essence of the intellect of all human beings — a cornerstone of the teachings of Averroes — against which Aquinas made a strong effort of refutation [8, p. 234]. In December 1270 the dispute escalated and several, mainly epistemic statements, which had been foremost supported by Avicenna und Averroes, were banned by Bishop Tempier. Besides the understanding of the eternity of the world and among many other paragraphs, the concept of the oneness of all-human intellect and the assumption that human beings know were prohibited⁶ [9, p. 130]. While Averroist philosophies still played an important role in Bologna and Padua in the 16th century, an anti-Arabic tendency, among them the botanist, medic and philologist Leonard Fuchs (1501–1566) tried to ban Arabic sources from Tübingen University in southern Germany.

The anti-Arabic and superficially philological arguing approach — in the 19th century then called „renaissance“, becoming a Eurocentric model for the periodization of history — aimed to regain Greek written sources in Medicine, Philosophy and sciences. At the same time the rich heritage of practical oriented Arabic sciences was marginalized. Since the Paris debates under Saint Thomas Aquinas and Bishop Tempier, the ruling clergy did all in their power to struggle against the enormous influence of Arabic enlightenment, which, when it comes to questions of knowledge (epistemology), responsibility and equality, conceded autonomy to human beingness.

Despite the persecutions of Arabic-Islamic Schools, reaching a new peak after the conquering of the last Arabic-Nasrid city of Granada in Al-Andalus in 1492, we find a substantial impact of Arabic enlightenment on various thinkers and scientists the following three hundred years in Europe, be it René Descartes (1596–1650) or Gottfried Wilhelm Leibniz (1646–1716). Here the discussion of continuity and discontinuity in science's history cannot be deepened, but at that point it has to be emphasized that the

⁶ 1. Quod intellectus omnium hominum est unus et idem numero. (That the intellect of all-human is one and same number, translated by the author). 2. Quod ista est falsa vel impropria: Homo intelligit. Translated by the author.

clerical anti-scientific and anti-epistemic worldview, accompanied by the inquisition, had constituted a serious setback for the development of sciences and philosophies for centuries in Europe. A culture of fear brought scientific curiosity to a standstill.

The lost thread was picked up again by Alexander Humboldt who ranks among the scholars of Weimar's Classicism (Weimarer Klassik) — beside Johan Gottfried Herder (1744–1803), Johan Wolfgang Goethe (1749–1832) and others who not only valued Arabic science, Philosophy and Medicine but also explicitly referred to Arabic sources. In his late work *Kosmos* Humboldt outlined the historical development of Arabic sciences. Here he underscored that the Arabs were those who developed experimental sciences, a level which in Antiquity nearly had yet not been reached [1, p. 249]⁷. In the following we shall focus on the historical development of Geography and Cartography, as understood by Humboldt.

Humboldt and the History of Geography and Cartography

As also the historiography of sciences' history shows it's layers, here the history of Geography and Cartography shall be outlined comparatively, and, while basing on the early research of Humboldt, newest studies of Fuat Sezgin will be consulted. Due to limited sources a few Arabic manuscripts were translated from Arabic into European languages at Humboldt's time. Humboldt who had not known Arabic, did rarely access earlier Latin translations. The state of knowledge on Arabic contributions to the universal heritage of sciences was limited accordingly.

Standing in a line with George Sarton (1884–1956) when it comes to general history of science or Joseph Needham (1900–1995) in the context of regional contributions, here Chinese, Fuat Sezgin (1924–2018) ranks among the great historians of science. With regards to the history of Arabic-Islamic sciences his 17 encompassing volumes *Arabic Scientific Writings (Geschichte des arabischen Schrifttums, GAS)*, covering all disciplines from anthropogeography to zoology, is a standard work in the wide fields of History of science and Technology, and for Arabic and Islamic studies an irreplaceable work.

The large collection of reconstructed instruments, devices, and models — based on the research of hundreds of mainly Arabic, but also Persian and Ottoman manuscripts, bibliographed and analyzed in libraries all over the world, be it in Cairo, Madrid, Tehran, Paris or Berlin — is accompanied by a Museum Catalogue of five volumes (German, Turkish, French, English) and up to nearly 1400 volumes of facsimiled manuscripts and secondary sources. The *Journal for the History of Arabic-Islamic sciences* collected in twenty-one volumes scholarly contributions. In short, the heritage Fuat Sezgin left for further

⁷ „Nach der bloßen Naturbeschauung, nach dem Beobachten der Erscheinungen, die sich in den irdischen und himmlischen Räumen zufällig dem Auge darbieten, kommt das Erforschen, das Aufsuchen des Vorhandenen, das Messen von Größe und Dauer der Bewegung. Die früheste Epoche einer solchen, doch aber meist auf das Organische beschränkten Naturforschung ist die des Aristoteles gewesen. Es bleibt eine dritte und höhere Stufe übrig in der fortschreitenden Kenntniß physischer Erscheinungen, die Ergründung der Naturkräfte: die des Werdens, bei dem diese Kräfte wirken; die der Stoffe selbst, die entfesselt werden, um neue Verbindungen einzugehen. Das Mittel, welches zu dieser Entfesselung führt, ist das willkürliche Hervorrufen von Erscheinungen, das Experimentieren.

Auf diese letzte, in dem Alterthum fast ganz unbetretene Stufe haben sich vorzugsweise im großen die Araber erhoben“ [1. p.249.]. URL: http://www.deutschestextarchiv.de/book/view/humboldt_kosmos02_1847?p=254 (accessed: 24.06.2018).

studies of Arabic–Islamic contributions to the universal history of science, Medicine, and Technology provides an invaluable treasure, nowadays motivating a new more universal orientated generation of Historians of science.

The five volumes of *Geschichte des Arabischen Schrifttums* (GAS, *History of Arabic Scientific Writings*), focusing on the history of Geography, Cartography and anthropogeography, is a primary source based on the historical reconstruction of Geography, Cartography, and mapmaking. A milestone, especially when aiming necessarily to overcome Eurocentric mystifications of seemingly monocultural self-creations in this field of sciences and its visualization in maps. Alexander Humboldt was yet not affected by the myth of the *Renaissance* which imagined the origin of all European scientific discoveries in Helleno-Roman Antiquities while fading out or, at the best, marginalizing especially Arabic contributions. Without the centuries of Arabic–Latin translation movements, experimental-empirical methods and so-called Exact sciences in general would not have found their way from Arabic shaped southern peripheries (Al-Andalus, Sicily) further into inner Europe. Fuat Sezgin substantially contributed to overthrow Eurocentric walls in the History of science, paving the way for a humanistic approach towards new universal horizons in the history of sciences.

Also the earlier universal approach of Humboldt's understanding of history of science was fully aware of the long-term layers of knowledge development. With regard to geographical knowledge of Central Asia, he outlined old Chinese contributions and Buddhist itineraries which were — among them a kind of proto-mapping of mountain ranges on copper engraved vessels — older than information given by Arabic-Islamic travelers. Interestingly, it seems that the coordinates of *Abulfeda* were already accessible to Humboldt before the translation was published, showing that Humboldt's scientific travel in Central-Asia was well prepared. A study of the correspondence between Humboldt and Reinaud would shed more light on this question.

The major lines of Arabic–Islamic shaped developments in the fields of Geography and Cartography, pointed out by Humboldt, bear witness to the state of knowledge at that time. Even when writing that the Geography of Ptolemy (ca. 100–178 AD) had been translated under the reign of Caliph al-Ma'mūn (reigned 813–833), maybe together with so far not known fragments of Marinus of Tyre (ca. 80–130 BC) [1, p. 258], as Humboldt assumes, he could not been aware of the map descriptions which the historian and traveler al-Mas'ūdī (895–956 AD) handed down to us. Sezgin documenting and analyzing the passages in Mas'ūdī who mentioned a Ma'mūn Map (*aş-Şūra al-Ma'mūniya*) [10, p. 78] — named after the Caliph — came to the conclusion that the detailed description (locations of cities, colours of mountains, rivers etc., geographical figures, e. g. mountain ranges etc.) witnesses the existence of a world map, elaborated by a team of Astronomers, Geographers, and Geodesists under the patronage of Caliph Ma'mūn which was far more enhanced than a not preserved map of Marinos of Tyre or Ptolemy.

Fuat Sezgin discovered in the early 1980s in Istanbul's *Topkapı Palace* a world map as part of an encyclopedia written by Ibn Faḍlallāh al-Umarī around 1340 AD. The *Ma'mūn World Map* was traced back by Fuat Sezgin to the so far lost *Şūra al-Ma'mūniya*, described by Mas'ūdī. Parts of the world map survived in 10th centuries' copies, e. g. the so far oldest Arabic maps — the Sea of Azov, the Ruby Islands and the Nile — nowadays preserved at Strasbourg University, dating back 428 H / 1037 AD. The Nile Map which is part of al-Hāwarizmi's *Şūra al-Arḍ* depicts at that time known course of the world's longest river.



Fig. 1. Ptolemaic World Map, commissioned under Maximos Planoudes in Constantinople around 1300, Codex Seragliensis GI 57, Topkapı Sarayı Müzesi, Istanbul

As I will show in a soon to be published study «The Nile in Early Arabic–Islamic Maps & Sources» (*Environment & Religion in Ancient & Coptic Egypt: Sensing the Cosmos through the Eyes of the Divine*, Maravelia, A. & Guilhou, N., eds, Oxford Archeopress / Egyptology Series, 2019, in press), Ḥāwarizmī's Map of the Nile entered the seemingly Ptolemaic world maps from the 14th centuries onwards up to Gerhard Mercator's maps and beyond.

Due to the livelong and untiring research efforts of Fuat Sezgin, historians of Geography and Cartography are nowadays able to revise the Eurocentric and mystified history of Cartography, in which Ptolemy plays an important role. Fuat Sezgin has proven that Arabic Geography and Cartography brake down with the old ideas of a land bridge, connecting the Indian Subcontinent with Africa and showing the Indian Ocean as a lake, enclosed with landmass. Cartography was revolutionized by the depiction of the circumnavigation of Africa on Arabic maps, a fact that already Humboldt highlighted.

Moreover, most of the historians of Geography and Cartography are sure that Ptolemy himself did not draw a world map but wrote a description on how to draw world maps, including different methods of projections, and he passed on around 8000 coordinates, forming the first basis for adopting, assimilating and further developing by Arab astronomers. The rapid development of mathematical Geography during the Abbasids, based on the establishment of state observatories, the further development of astronomical instruments (e.g. astrolabes), accordingly more precise astronomical determinations of latitudes and longitudes had been gained and systematized, resulting in an extended map grid of the earth — all this is documented and analyzed by Sezgin with great attention to details. Even if we cannot enter into further details at that point, but in short we could state: when studying the works of Fuat Sezgin it becomes obvious that science and

Technologies, not least Geography and Cartography during and in the footsteps of the Ma'mūn Era reached a new high point.

An aspect of importance for the history of Cartography was emphasized by Humboldt who pointed to the precise determination of one meridional degree during a research excursion in the plain between "Sindschar, Tadmor und Rakka" [1. p. 265]⁸.

Humboldt honoured the precise determination as an expression of scientific Arabic erudition. Sezgin researched in depth the mathematical, astronomical and geodetic methods of the Ma'mūn commission which determined 56 2/3 miles for a meridional circle (today 111,138 km) [10, p. 94].

It is still a puzzle for historians of Cartography why the team under the Byzantine monk Maximos Planoudes (1260–1330), designing at the end of the 13th century the so far oldest, non-mythological and today in the Topkapı Palace preserved map of the world — after years of laborious paper restauration the map is now restored — continued to depict the Indian Ocean as a lake, the Caspian sea as a melon and over-extended the length of the Mediterranean up to 20 degrees?

Centuries ago, from the Ma'mūn Era in the early 9th century onwards, these geographical and cartographical heavy mistakes and distortions had been corrected by Arabic geographers and map-makers. When we take into consideration the much more advanced and precise Arabic maps in the tradition of the 9th centuries' *Ma'mūn Geographers*, the world map of Idrīsī (1100–1166) and the world map in Brunetto Latini's encyclopedia (ca. 1265) which followed closely not only the cartographical figuration (southward orientation, circumnavigation of Africa, course of the Nile etc.), but also mathematical principles of its Arabic models, among them and most obvious the 56 2/3 miles for a meridional circle in the "Latini Map". It seems that these innovations did not reach the Byzantine-Ptolemaic Cartographers at the end of the 13th century while at the same time specific coordinates, e. g. from al-Battānī, were taken over by one Ptolemaic manuscript [10, p. 56].

Fuat Sezgin has proven in his studies that in order to draw geographical figures nearer to reality, e. g. the shapes of seas, lakes, coastal lines etc., a closed enmeshed grati-



Fig. 2. Map of the Nile, Kitāb Šūra al-Arḍ (428 H / 1037 AD), Strasbourg Bibliothèque Nationale et Universitaire, MS 4247

⁸ „Eine Gradmessung, welche der Chalif Al-Mamun in der großen Ebene von Sindschar zwischen Tadmor und Rakka durch Beobachter ausführen ließ, deren Namen uns Ebn-Junis erhalten hat, ist minder wichtig durch ihr Resultat als durch das Zeugniß geworden, das sie uns von der wissenschaftlichen Bildung des arabischen Menschenstammes gewährt“. URL: http://www.deutschestextarchiv.de/book/view/humboldt_kosmos02_1847/?hl=Alhazen;p=265 (accessed: 28.06.2018).

cule of precise coordinates is necessary. From the 9th century onwards until the 13th century hundreds of coordinate tables were developed by Arabic-writing astronomers, which developed more realistic shapes of geographical figures. Among them were the coordinate tables of Abū-l Fidā' (1273–1331) which were consulted by Humboldt, after being translated from Arabic by the French Orientalist Reinaud.

When traveling Central Asia Alexander Humboldt, he was studying geographies and cartographies of the Eurasian Regions, especially the Caspian Sea and the Aral Sea. With regards to the center of the Aral See Humboldt stated a deviation of only 1° latitude, comparing his own measurements with the table of Abū-l Fidā'.

In the wider historical context of the history of Geography and Cartography Humboldt wrote:

As the only Asiatic national literature it is the Arabic national literature which includes ideas which were the fruit of direct encounter and connections. ... When the famous geographers El-Istachry, Edrisi and Ibn el-Wardi already followed the Ptolemaic system of the total separation of the Caspian Sea already at the beginning of the 10th century, they were far from being just copyists. Instead of extending the basin in East-West direction, Edrisi extended it, as Herodotos, in the direction of a meridian [11, p. 319].

We also owe Humboldt the “finding” that Arab cartographers mapped the circumnavigation of Africa long before Vasco da Gamma, the first European who reached India. Already in 1492 Christopher Columbus believed to sail in Indian waters. In his latest studies Fuat Sezgin collected evidence in all sources accessible to him, showing understandable that there were most probably Arabic seafarers who reached America long before the Spanish colonialists at the end of the 15th century. Fuat Sezgin corrected not only the Eurocentric imagination of sciences' historical development but also reinstated the history of so-called European discoveries, paving the way for a universal understanding of sciences in which Arabic contributions had a decisive role.

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Арабские следы в «Космосе» Александра Гумбольдта и центральноазиатской географической науке

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Александр Гумбольдт входит в число ученых веймарской классики, которые не только оценили арабский вклад в мировое научное наследие, но и возродили давно утраченное космологическое понимание наук, проследив за ним с периода Аббасидов начала IX в. и далее. Эпоха Аббасидов в годы правления халифа Мамуна в первой трети IX в. с Багдадом в центре показала, как раннее Просвещение наконец достигло Средней Европы. Были одобрены научные классификации, расширены междисциплинарные, экспериментальные науки, совершались научные экспедиции. Александр Гумбольдт показал не только арабский вклад в универсальное наследие наук, но и сам арабский универсализм, применив его в ходе своего путешествия. Гумбольдтовский подход объединяет практику исследовательских поездок с междисциплинарными наблюдениями, определениями (географическими координатами) и классификациями с самого начала и далее. Путешествуя по Средней Азии в 1829 г., он проявил особый интерес к арабскому вкладу в область географии и картографии. Гумбольдт не только изучал арабские источники в Центральной Азии, но и сравнивал их с собственными измерениями. Исследования Фуата Сезгина (1924–2018) позволяют в наши дни осмыслить важный вклад арабо-исламской географии и картографии, проложив путь к преодолению европоцентрических искажений в истории науки.

Ключевые слова: Александр Гумбольдт, арабская география, арабская картография.

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