

Al Kindi and the universalisation of Knowledge through mathematics[†]

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Resumen

La tradición árabe-islámica está fundada en la siguiente nueva actitud epistémica que reinventa el conocimiento: aprender de las aportaciones de las civilizaciones anteriores a través del estudio sistemático de todos los trabajos científicos existentes; contribuir al desarrollo del conocimiento mediante la vinculación, a través de la utilidad, a la práctica y la necesidad práctica de la sociedad; esto facilita su aprendizaje para las generaciones más jóvenes y su transmisión a las futuras civilizaciones puesto que es concebido no como un producto final, sino como un proceso continuo. El desarrollo mundial de los conocimientos reinventados ha llevado a su universalización y la rápida expansión de las matemáticas y dado lugar en particular a la completa deshele-nización de la concepción griega de la ciencia y la filosofía.

Palabras clave: algebra, arábico, argumentación, deshelenización, interacción, universalización del conocimiento, usefulness.

Abstract

The Arabic-Islamic tradition is founded on the following new epistemic attitude that reinvents knowledge: to learn from the contributions of previous civilisations through the systematic survey of all extant scientific works; to contribute to the further development of knowledge by linking it, through usefulness, to practice and the practical need of society; to facilitate its learning for younger generations and its transmission to future civilizations since it is conceived not as a finished product but as an ongoing process. The worldwide development of the reinvented knowledge has led to its universalisation and the rapid expansion of mathematics has particularly and led to the complete de-hellinisation of the Greek conception of science and philosophy.

Keywords: Algebra, Arabic, argumentation, de-hellinisation, interaction, universalisation of knowledge, usefulness.

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Few philosophers that have been studied as much as Ibn Sīnā have been as much misunderstood. His extraordinary ability to reflect upon and write in a variety of styles about seemingly every topic in every domain has steered his thought from philosophy and theology to mysticism and esoterism. Instead of helping us to learn and understand better Ibn Sīnā than he has been previously been understood, the recent surge of Avicennan studies only adds more confusion to the already complex social context which he was living in. Further evidence of his creativity is that he knew how to make his own life more legendary by writing an autobiography but which only deals with the first part of his life and entrusting to one of his disciples the task of finishing the rest of his biography. His life turns out to be so fascinating that it gave rise to two popular novels which appeared around the same time (cf. Gordon, 1986; Sinoué, 1989). It is not surprising that many scholars have been struggling for years to separate fact from fiction. Ibn Sīnā's philosophical thought is as open to speculation as is his autobiography, with many scholars regarding him as Aristotelian, others as Neo-Platonist, a third group consider his philosophy as a mixture of Aristotelianism and Neo-Platonism, and a fourth group portray it as an extension of late Alexandrian Aristotelianism.¹ By bringing him back to an ancient tradition, however, they fail to recognize the epistemic obstacles inherited by his own tradition, the new questions generated by his own scientific context and to appreciate the new means he invented to deal with them.

The case of Ibn Sīnā is by no means an exception; it is in fact part of a general misconception of the history of Arabic-Islamic philosophy. This deep entrenched tendency that systematically links Arabic-Islamic philosophers backwards to the Greek tradition, despite its interest in describing the background against which their work arose, overshadows the underlying process at work and the real scope of their undeniable achievements and innovations. The various Greek affiliations to which they are linked amounts in fact to the Hellenisation of their thoughts as if the Arabic-Islamic civilization is part of the Greek world view, while what was happening was

¹ In his pioneering paper "Philosophy of mathematics" (cf. Rahman et al. 2008), Roshdi Rashed makes crystal-clear in many passages that his mathematical investigations do not support the received view:

To understand the distance put by Ibn Sīnā between himself and traditional, Hellenistic and Greek classifications as well as between himself and his own theoretical classification, it is worth introducing here one of his predecessors, al-Fārābī. (167)

In the presence of this new discipline which has to be taken into account, the new classification of the sciences which aimed at both universality and exhaustiveness has to justify in one way or another the abandonment of certain Aristotelian theses. Names such as "science of ingenious devices", "derivative parts" are coined so that a non-Aristotelian zone can be arranged within a received Aristotelian style of classification. The philosophical impact caused by such a revision is on a larger scale and—especially—more profound than mere taxonomic modification. (168)

It is sufficient to recall that, being neither Platonic nor Aristotelian, this new [formal] ontology arose, in part at least, due to the new results in mathematical sciences. (169)

This distinguished historian of mathematics has set himself the task of demonstrating that what the received view finds it not so obvious: the various Greek affiliations have little intrinsic meaning in a scientific context based on a new concept of knowledge. For a general assessment about the present state of Arabic philosophical research, see his introduction to his paper.

something far more important for the history and development of thought, namely, the universalization of science and philosophy or more generally the trans-cultural trans-national character of knowledge. This aspect of the worldwide historical development of science and philosophy is outshined by their current periodization² which gives the misleading impression that the so-called “globalization” of knowledge is a new western phenomenon. This is particularly relevant for the study of the Arabic tradition for it is during the Arabic period when the first globalization of knowledge was achieved. The wide circulation of scientific and philosophical books from Samarkand in the East to Toledo in the West has generated at least three more new traditions that did not exist before: the Persian, the Jewish and the rising powerful Christian tradition.³ Many historians and scholars underestimate the unprecedented globalization of knowledge that enables its non-stop development since the ninth century by confining the historical role of the Arabic tradition to a mere preserver and mediator of the Greek heritage. By taking for granted the evolution of science and philosophy from one culture to another, important epistemic questions about the significance and the timing of their emergence in a new culture are overlooked: why did it occur in the ninth century but did not happen before? Had the Greeks ever imagined for example that the philosophy they cultivated since the 6th century B.C. could be practiced one day in a language other than their own? More generally, how could science and philosophy be further developed if they remained encoded in a language which was no longer in use?

Epicurus (341-270 BC) is reported to have said that “only Greeks philosophize”⁴, by this he probably means that philosophy is so specific to the Greek cul-

² Despite its refutation since the second half of the last century following the discovery of the works of the Marāgha astronomers, it is unfortunate that the dogmatic periodization imposed by modern historians of science has yet to be updated and revised by the scientific community (cf. Tahiri).

³ In the fourth chapter entitled “Le tribut des arabes avant le XIII^e siècle” of his third volume *Le Système du monde*, the great French historian Duhem points out that there is evidence which suggests that early translations were carried out before the millennium:

Les premières infiltrations de la Science arabe en la Science latine sont, sans doute, très anciennes; il est fort probable qu'avant l'An Mil, les écoles de France possédaient déjà des livres traduits de ceux qu'avaient composés les sarrasins, et que certains de ces livres concernaient l'Astronomie pratique, celle qu'occupent la confection des tables et l'usage des instruments. (1913: III, 164)

He then reminds us of the turning point in western history brought about by the translation of Arab works

Les livres traduits de l'Arabe vont se répandre, de plus en plus nombreux, dans les écoles latines; la science enseignée dans ces écoles n'en sera pas seulement accrue; elle sera, en même temps, orientée suivant une direction toute *différente* de celle qu'elle avait suivie jusqu'alors (163-164; my emphasis)

⁴ This quotation can be found in van den Bergh's second volume of the translation Abū-Walīd ibn Rushd (1126-1198) of Averroes' *Tahāfut al-Tahāfut (The Incoherence of the Incoherence)*, he cites two authorities as reference: Clement of Alexandria, *The Stromata*, I. 15 and Diogenes. Laertes X. 117. He immediately quotes Ibn Maimūn or Maimonides (1135-1204) to express what he has in mind: “one must know that everything the Moslems, *Mu'tazilites* as well as *Ash'arites*, have professed concerning these subjects, has been borrowed from the Greeks and Syrians who applied themselves to the criticism of the philosophers” (Maimonides, *Guide for the Perplexed*, I. 71). The two quotations are put as epigraph to the first page of his substantial second volume (Rushd, 1954: II, 219) devoted entirely to notes and extensive commentaries in addition to a long introduction to his translation of the work of the philosopher of Cordoba. The

ture and the philosophical corpus accumulated over centuries is so enormous that its transmission to a different language is simply an impossible mission. He would be astonished by the worldwide practice of philosophy today and yet few scholars and historians know and recognize that this is the outcome of its transformation that goes back to the ninth century. How could have such a transformation been brought about? And why did it take such long time to materialize? If history is any indication, there was little awareness of the need for change during the immense life span of the Greek period. But what kind of change? And by what means could have it been brought about? Science and philosophy have been developed in the context of Greek culture to such extent that any further progress required their de-hellenisation; and by de-hellenisation we mean the substitution of Greek metaphysical and cultural conceptions that hampered the further progress towards a concept of knowledge that could cross frontiers and interact with different conceptual frames and traditions.

The significance of the Arabic-Islamic tradition lies in reinventing knowledge that set off the unstoppable de-hellenisation of the Greek heritage. The starting point for this new tradition that inaugurates the de-hellenisation era is its specific approach to knowledge which marks a major shift in the direction in which the scientific inquiry was practiced. For according to the Arabic-Islamic understanding, knowledge is and must be useful (عفانل املعل); its usefulness lies in its ability to be at the service of society by yielding some practical benefits which in turn contribute to its further theoretical development.⁵ By identifying itself with this conception of knowledge, Arabic-Islamic civilization has conceived a distinctive and global project,⁶ for its intellectuals, whether they are jurists or *mutakallimūn* (theologian-philosophers), poets or litterateurs, grammarians or linguists, scientists or artists, philosophers or

two volumes are presented as proof of his claim and the definitive word on the topic. Misguided by such kind of prejudices still widely prevailing, our modern scholar fails to grasp the meta-dialogical issue that motivates Ibn Rushd's reaction which is the transformation of philosophy by our author. This is just another reminder that the philological approach used by scholars who work on the complex domain that lies between the Greek and Arab lands is by no means sufficient to fill the gaps in our understanding of the history of philosophy, and could even be misleading.

⁵ In the introduction of his foundational work that appeared about 820, al-Khwārizmī (last decades of the 8th century-mid 9th century) explains that usefulness is what his Algebra is all about and mentions, after acknowledging his debt to the caliph for having encouraged him to compose his calculation of algebra and *al-muqābala*, some of the domains where his new science can significantly contribute to their development.

I wanted it to include what is subtle in the calculation and what is the most noble in it, what people necessarily need in their inheritances, legacies, partitions, law-suits, and trade, and in all their dealings with one another where surveying, the digging of canals, geometrical computation are concerned, and other affairs relevant to calculation and to its sorts. (Rashed, 2007: 94).

Like mathematics, astronomy, both theoretical and practical, was also developed in the same spirit (cf. King, 1993). But the practical benefit goes beyond the material aspect of theoretical research. The usefulness of a scientific theory should obviously be understood in a wider sense that includes its capacity to interact with other scientific theories and contribute to their development, like for example the possible application of its concepts and forms of reasoning to another theoretical, empirical or social discipline.

⁶ Cf. Rosenthal (1970), for how Islamic civilization makes knowledge the basis of its foundation and development.

mystics, who have all co-operated in its construction and globalization. The de-hellinisation of science and philosophy was systematic, wide ranging, took different forms and affected the Greek corpus in various ways. But it was not straightforward not without difficulties and not free from controversies. Works such as al-Kindī's *Philosophy Can Only Be Acquired Through the Mathematical Discipline*, al-Rāzī's *Doubts About Galen*, al-Fārābī's *Enumeration of the Sciences*, Ibn Sīnā's *Logic of the Orientals*, Ibn al-Haytham's *Doubts About Ptolemy*, al-Ghazālī's *The Incoherence of the Philosophers*, Ibn Bājjā's doubts about the Aristotelian metaphysical conception of motion,⁷ Ibn Taymiyya's *Against the Greek Logicians* are just some of the most striking examples that illustrate the enormous efforts spent to overcome the epistemic barriers erected by the Greek conception of science and philosophy.

Three new fundamental disciplines which were developed in the context of Arabic-Islamic culture have created the new social and scientific milieu needed for initiating the irreversible de-hellinisation movement. Islamic jurisprudence is the first scientific discipline to be set up by the jurists themselves. The formal codification of principles and rules, that structured the Arabic-Islamic society, was not achieved however without disagreement. The jurists agreed on the principles and the rules of inference to generate more laws but acknowledged the differences of their approaches to the interpretation of derivative laws and their applications. They then worked out a dynamic instrument that helped them move forward by developing rules and procedures to increase the rationality and efficiency of empirical debates; this gives rise to a new discipline called the *ādāb al-jadal* or the Rules of Argumentation.⁸

⁷ This is how Ibn Rushd describes Ibn Bājjā's (1095-1138) double attack on Aristotle's conception of motion in the famous passage historically known as Comment 71:

Ibn Bājjā raises doubts in this passage in two places. One occurs when he says that the ratio of motion to motion is not as the ratio of the density of one medium to the density of another. The second, however, is that these motions are resisted by the medium and are not natural. Yet nobody before him had arrived at these questions, and thus he was more profound than any others." And in the copy [of Ibn Bājjā's work] from which we have written, we found a certain page all by itself, and this was written on it. (Grant 1974: 262)

He then explains that the philosopher of Zaragoza's profound argument lies in his conception of speed as mathematical magnitude. Failure to recognise the far-reaching philosophical implication of Ibn Bājjā's groundbreaking mathematical approach to motion that paves the way for the mathematisation of falling bodies has led the traditionalist philosopher to accuse his compatriot of conceptual confusion:

The problem at hand is really sophistical, though difficult, for it is all based upon a confusion of categories. And this is so because, as he assimilates motion to a line, he contends that what occurs apropos a line, occurs apropos motion... The cause of this error lies in the judgment that slowness and speed are motions added to, and subtracted from, a motion in the same manner as a line is added to or subtracted from, a line. (Grant, 1974: 259 - 260)

⁸ *Al-jadal* is the *maṣdar* of the relational verb *jādāl yujādilu* which means to argue with someone over something hence to counterargue i.e. to come up with an argument that challenges someone's claim. *Al-jadal* of the jurists, whose conceptual foundation is based on epistemic grounds, should not though be confused with Aristotle's dialectic also rendered as *jadal* by the translators of the Greek works (Miller, 1985: II, 52). Like *al-qiyās*, i.e. legal analogical reasoning, the jurists conceive their *jadal* as a logic of discovery by which they aim to increase the body of legal knowledge i.e. "to know what is previously unknown" (al-Juwainī, 1979: 46). Despite the existence of a vast Arabic literature on *jadal*, scholars have shown little interest in the topic, which is unfortunate given its historical and epistemic

Islamic jurisprudence was an important source of inspiration for the constitution of future scientific disciplines like Arabic grammar and Algebra, and its new way of arguing has redefined the nature of scientific inquiry since it was so widely adopted that it became a universal method of investigation. It was particularly used by the founder of modern optics and astronomy Ibn al-Haytham (d. 940) in his foundational astronomical work *al-Shukūk* or *Doubts About Ptolemy* to successfully bring change from within the well-established Ptolemaic tradition that was stagnating for centuries.⁹

The study of the Arabic language is the second discipline that played a major role in the universalisation of knowledge. Linguistic studies were developed during the eight-century to such extent that they have made possible the translation of all known scientific works produced by previous civilizations, and one of the main motivations for the codification of Arabic grammar was to ensure the stability and expansion of the Arabic language because of its widespread use by non-native Arab speakers. The process of translations is one of the important means that contributed to getting rid of those metaphysical and cultural concepts that might threaten the universality of knowledge; the Arabic language has in fact acted as some sort of filter through which only scientific thoughts are allowed to pass. The outcome of this process of acquisition is that all knowledge becomes accessible to everyone. The vast production of Arabic scientific literature with technical and rich vocabulary makes Arabic a world language, it was no longer seen as a language of some specific people but belongs to everyone. Because Arabic was the only global language in all walks of life, including science and philosophy, knowledge was promoted to an inter-cultural and inter-national levels, it was no longer linked to a specific culture but became the property of all humanity. Historically, the Arabic language showed for the first time the possibility of the construction of a unified corpus of knowledge able to work as a trans-cultural vehicle for the transmission of scientific and philosophical thoughts from one culture to another.

Islamic jurisprudence and linguistics were instrumental in the reinvention of mathematics.¹⁰ The emergence of arithmetic and algebra marks the triumph of the new epistemic attitude that bounds theory to action, it is the emergence of usefulness. Theory and practice are not opposed to each other as in the Greek tradition, they are

importance and relevance to modern argumentation theory. One of the few such studies is Miller's unpublished dissertation *Islamic Disputation Theory: a Study of the Development of Dialectic in Islam from the Tenth Through Fourteenth Centuries*. It is an excellent survey on how the jurists and the *mutakallimūn* have developed the topic from its early beginning as *ādāb al-jadal*, specific to legal reasoning, to its final transformation as *ilm al-munāzara* by al-Samarqandī (1250-1310), giving rise to the formation of a new logical science that provides the first logical model of argumentation to be used in scientific debates. It is worth mentioning a forthcoming second work on the topic entitled *The Dialectical Forge: Juridical Disputation and the Evolution of Islamic Law* by W. E. Young to appear in LEUS, which is a landmark on the application of *jadal* to juridical reasoning.

⁹ In the first discussion of his *Tahāfut*, al-Ghazālī (1058-1111) explains why refutation according to the *kalām*-type *jadal* matters: "Counterargument necessarily demonstrates the flaw of the proponent's argument, and many aspects of the problem are dissolved in evaluating counterarguments and arguments." (Al-Ghazālī, 2002: 46).

¹⁰ About the role of linguistics and the legal sciences in the emergence of algebra, cf. Rashed, 2007: sections 1.4 and 1.5.

intrinsically and dynamically linked by usefulness which is regarded as evidence for the soundness of the theory: a theory should improve an existing practice and practice should improve the elaboration of the theory; it is considered as the ultimate test for any discourse since any acquired knowledge must yield sooner or later some tangible results.

These three innovative disciplines, which constitute the basic education of Arabic-Islamic intellectuals, have enriched the scientific and philosophical corpus with new concepts and modes of thought that opened up an immense number of new horizons for their development. Of the three it is undoubtedly the reinvention of mathematics which not only carried much farther than any other discipline the de-hellenisation of the Greek heritage but more importantly brought the whole process to completion as it expanded.¹¹ Algebra in particular has created a dynamic that transformed mathematics and with it the rest of scientific disciplines including philosophy. Al-Kindī (801–873), a mathematician, seems to have foreseen the implications of the renewal of mathematical studies on ancient philosophy, his insight led him to require that mathematics should be used as an indispensable instrument of analysis and investigation in philosophical activity:

This is the number of his [Aristotle] books, that we have already mentioned, and which a perfect philosopher needs to know, after mathematics, that is to say, the mathematics I have defined by name. For if somebody is lacking in mathematical knowledge, that is, arithmetic, geometry, astronomy and music, and thereafter uses these books throughout his life, he will not be able to complete his knowledge of them, and all his efforts will allow him only to master the 'ability' to repeat if he can remember by heart. As for their deep knowledge and the way to acquire it, these are absolutely non-existent if he has no knowledge of mathematics. (Rashed 2008: 156-157)

The first Arabic philosopher has in effect established a new philosophical tradition that binds philosophy to mathematics. Rashed further points out that the links between philosophy and mathematics are essential to the reconstitution of al-Kindī's system; his *Philosophy Can Only Be Acquired Through the Mathematical Discipline* is an announcement of a new research program designed to make mathematics a model for philosophical analysis. Al-Fārābī (872–950) belongs to this new tradition founded by al-Kindī, his mathematical and philosophical works, which bring much closer the two disciplines, pave the way for the transformation of philosophy by Ibn Sīnā (980-1037).

Conclusion

One of the main achievements of the Arabic-Islamic civilization is the institution of an unprecedented dynamic research tradition, stretching from Samarkand in the East to Toledo in the West, in which mathematics is the driving force behind its sci-

¹¹ Some of what historians call scientific revolutions, such as the one that took place in the 17th century, can thus be seen as the most important stages in the de-hellenisation process.

entific and social development. Its contribution lies simply in its huge impact on the rest of the world because of the universalization of knowledge and learning in which Arabic was the vehicle language par excellence.

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