THE UNITY OF SCIENCE IN THE ARABIC TRADITION

LOGIC, EPISTEMOLOGY, AND THE UNITY OF SCIENCE

VOLUME 11

Logic, Epistemology, and the Unity of Science aims to reconsider the question of the unity of science in light of recent developments in logic. At present, no single logical, semantical or methodological framework dominates the philosophy of science. However, the editors of this series believe that formal techniques like, for example, independence friendly logic, dialogical logics, multimodal logics, game theoretic semantics and linear logics, have the potential to cast new light on basic issues in the discussion of the unity of science.

This series provides a venue where philosophers and logicians can apply specific technical insights to fundamental philosophical problems. While the series is open to a wide variety of perspectives, including the study and analysis of argumentation and the critical discussion of the relationship between logic and the philosophy of science, the aim is to provide an integrated picture of the scientific enterprise in all its diversity.

The Unity of Science in the Arabic Tradition

Science, Logic, Epistemology and their Interactions

Edited by

Shahid Rahman
University of Lille 3, France

Tony Street
Cambridge University, UK

Hassan Tahiri
University of Lille 3, France

Springer

Editors
Shahid Rahman
Université Lille III
U.F.R. de Philosophie
Domaine Universitaire
"Pont de Bois"
59653 Villeneuve d'Ascq
France
shahid.rahman@univ-lille3.fr

Tony Street
University of Cambridge
Faculty of Divinity
West Road
Cambridge
United Kingdom CB3 9BS
ads46@cam.ac.uk

Hassan Tahiri
Université Lille III
U.F.R. de Philosophie
Domaine Universitaire
"Pont de Bois"
59653 Villeneuve d'Ascq
France
hassan.tahiri@yahoo.fr

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إذا مات ابن آدم انقطع عمله إلا من ثلاث :صدقة جارية، أو علم ينتفع به أو ولد صالح يدعو له.

حديث شريف

When a man is dead, his actions are brought to an end except in three cases: a permanent charity, beneficial knowledge or a good son that prays for him.

The Prophet

To the memory of my late father Prof. Dr Aziz ur-Rahman who kindled in me a passion for the adventure of science and to my mother, Hilde Rahman, for her brave vision of a world without frontiers.

Shahid Rahman

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Contributors

Ahmad Hasnawi is a Research Fellow at the CNRS (Paris). His research interests are in Avicenna's natural philosophy, the history of Arabic logic and the transmission of Greek philosophy into Arabic. His publications include: "La définition du mouvement dans la *Physique* du *Shifā'* d'Avicenne", *Arabic Sciences and Philosophy* **11** (2001); "Topic and Analysis: The Arabic Tradition" in R. W. Sharples, *Whose Aristotle? Whose Aristotelianism?* Aldershot, 2001; "Alexandre d'Aphrodise vs Jean Philopon. Notes sur quelques traités d'Alexandre "perdus" en grec, conservés en arabe", *Arabic Sciences and Philosophy,* **4** (1994).

Albrecht Heeffer is post-doctoral researcher at the Center for Logic and Philosophy of Science, Ghent University, Belgium. His main topic of research is the history and philosophy of mathematics. More information about his activities, including a database of original sources on early algebra can be found at http://logica.ugent.be/albrecht

Allan Bäck teaches in the Philosophy Department at Kutztown University. He has published widely in the history and philosophy of logic and comparative philosophy. His books include *On Reduplication* and *Aristotle's Theory of Predication* and, forthcoming, *Aristotle's Theory of Abstraction* and a translation of Avicenna's *al-Maqālāt* (his work on Aristotle's *Categories)*. His awards include a Humboldt Forschungspreis (Senior Research Prize) and a Chambliss Research Prize.

Asad Qadri Ahmed is Harper Schmidt Collegiate Assistant Professor at the University of Chicago. His research interests include classical Arabic poetry and poetics, Arabic-Islamic theology and philosophy, and Islamic history.

Cornelia Schöck is a Research Associate at the University of Cambridge, UK. Her research interests are in Muslim theology, Arabic logic, History of Arabic-Muslim thought. She has recently published *Koranexegese, Grammatik und Logik. Zum Verhältnis von arabischer und aristotelischer Urteils-, Konsequenz- und Schlußlehre* (Brill 2006).

Deborah L. Black is Professor of Philosophy and Medieval Studies at the University of Toronto. She is the author of *Logic and Aristotle's* Rhetoric *and* Poetics *in Medieval Arabic Philosophy* (Brill 1990) and of numerous articles on medieval Arabic philosophy, most recently "Knowledge *('ilm)* and Certitude (*yaqīn)* in al-

Fārābī's Epistemology" (*Arabic Sciences and Philosophy*, 2006) and "Soul and Intellect in Arabic Philosophy," in *The Cambridge Companion to Arabic Philosophy* (2005). Her current research focuses on issues in epistemology and cognitive psychology, in particular medieval theories of the imagination and the internal senses. She is currently completing a book on Medieval Latin and Arabic interpretations of Aristotle's *Posterior Analytics* entitled *Finding the Middle Term: Intuitive Knowledge in the Medieval Interpretation of Posterior Analytics 1.34*.

Hans P. van Ditmarsch is currently senior lecture at the Computer Science Department of the University of Otago, New Zealand. His research focuses on the dynamics of knowledge, information-based security protocols, modal logics for belief revision, proof tools for epistemic logics, combinatorics, and computer and information science education. Ditmarsch's contribution follows his recent publication of the author on the same subject—not accidentally—entitled "Prolegomena to Dynamic Logic for Belief Revision", Knowledge, Rationality & Action, *Synthese*, **147**, 229–275 (KRA pages 41–87), 2005. He is co-author of *Dynamic Epistemic Logic*, Springer Synthese Library volume 337, 2007 (forthcoming).

Hassan Tahiri is currently a fellow researcher at the University of Charles de Gaulle Lille 3 (MSH, Nord-Pad-de Calais) and a member of the scientific board of the series Cahiers de Logique et d'Epistémologie (King's College). His contribution to this volume is based on Shahid Rahman's research project "La Science dans ses contextes" (MSH, Nord-Pad-de Calais) and developed in his unpublished thesis in relation to the history of mathematics where the systematic study of mathematical controversies concerning the foundations of mathematics is used to close the gap between the history and philosophy of mathematics.

Jon McGinnis teaches classical and medieval philosophy at the University of Missouri, St. Louis and has published widely on the history of natural philosophy. He together with David C. Reisman has recently completed *Classical Arabic Philosophy*, An Anthology of Sources (Hackett). Currently he is working on an overview of the philosophy of Avicenna (Oxford UP) and a translation of Avicenna's *Physics*. He has received three National Endowment for the Humanities awards and was a member of the Institute for Advanced Study.

Mohammad Ardeshir is Professor of Mathematics in the Mathematics Department at Sharif University of Technology, Tehran, Iran. His research interests include constructive logic and mathematics, and philosophy of mathematics.

Paul Thom is Honorary Visiting Professor at the University of Sydney. His research interests are in the history of logic and the philosophy of the performing arts. His most recent books are *Medieval Modal Systems: Problems and Concepts* (Ashgate 2003) and *Logic and Ontology in the Syllogistic of Robert Kilwardby* (Leiden: Brill 2007). Forthcoming with Pennsylvania State University Press is *The Musician as Interpreter*.

Roshdi Rashed is currently the Emeritus Director of Research (exceptional class) at the CNRS (Paris), an Honorary Professor at the University of Tokyo and Emeritus Professor at the University of Mansoura. Among his wide ranging publications on philosophy and the history of science: *Encyclopedia of the History of Arabic Science*, 3 vol. (editor and coauthor, Routledge 1996); *Les Mathématiques infinitésimales du IXe au XIe siècle*, 5 vol. (al-Furqān Islamic Heritage Foundation, 1993–2006) and *Geometry and Dioptrics in Classical Islam,* (al-Furqān, 2005). Forthcoming: *Lire Les Arithmétiques de Diophante,* in collaboration with Ch. Houzel (Les Belles Lettres).

Shahid Rahman is a Professor of Logic and Epistemology at the University of Charles de Gaule Lille 3. Rahman directs too the following series in collaboration with Dov Gabbay (King's College) http://www.collegepublications.co.uk/ His main work is on non classical logic within the dialogical and GTS approaches. For papers and books in preparation see http://stl.recherche.univ-lille3.fr/sitespersonnels/rahman/accueilrahman.html

Tony Street is the Hartwell Assistant Director of Research in Islamic Studies at the Faculty of Divinity at the University of Cambridge. His research concentrates on Arabic logic, especially post-Avicennan logic. He is currently working on late thirteenth-century treatises on dialectic.

Transcription System of the Arabic Alphabet

All Arabic names in this volume are given in full transliteration by using the following transliteration system (e.g. الغزالي is written al-Ghazālī and not algazel or algazali), except for Ibn Sīnā and Ibn Rushd where the familiar Latinised names Avicenna and Averroes are also used. The same goes for all Arabic terms; thus we write Qur'ān rather than Koran. The definite article is always written al-.

ء	ʾ	ط	ṭ
ب	b	ظ	ẓ
ت	t	ع	ʿ
ث	th	غ	gh
ج	j	ف	f
ح	ḥ	ق	q
خ	kh	ك (ک)	k
د	d	ل	l
ذ	dh	م	m
ر	r	ن	n
ز	z	ه (ہ)	h
س	s	و	w
ش	sh	ي	y
ص	ṣ		
ض	ḍ		

Long (respectively short) vowels

ا (ى)	ā (a)
و	ū (u)
ي	ī (i)

Introduction: The Major Breakthrough in Scientific Pratice

فإذا جُمِعَ يَسيرُ ما نال كل واحدٍ من النّائلينَ الحقَّ منهم، اجْتُمِعَ من ذلك قدْرٌ جَليلٌ.

When, though, the little which each one of them who has acquired the truth is collected, something of great worth is assembled from this.

و ينبغي لنا ألا نستحيي من استحسان الحقِّ، واقتناء الحقِّ، من أين أتى. وإن أتى من الأجناس القاصية عنّا، والأمم المباينة.

We ought not to be ashamed of appreciating the truth and of acquiring it wherever it comes from, even if it comes from races distant and nations different from us.

(Al-Kindī في الفلسفة الأولى (*On First Philosophy*, 1974, pp. 57–58)).

الرِّجالُ أربعة: رَجُلٌ يَدْري و يَدْري أنه يَدْري فسلوه،
و رَجُلٌ يَدْري و لا يَدْري أنه يَدْري فذاكَ ناس فذكّروه،
و رَجُلٌ لا يَدْري و يَدْري أنه لا يَدْري فذلِكَ مُسْتَرْشِدٌ فعلموه،
و رَجُلٌ لا يَدْري ولا يَدْري أنه لا يَدْري فذلِكَ جاهِلٌ فارفضوه.

There are four kinds of men: men who know and know that they know; ask them.
Men who know and do not know that they know, they are forgetful; remind them.
Men who do not know and know that they do not know, they search for guidance; teach them.
And men who do not know and do not know that they do not know, they are ignorant; shun them.

(Al-Khalīl ibn Aḥmad al-Farāhīdī, in Ibn Qutaybah *'Uyūn al-akhbār*, 1986, II, p. 142)

Knowledge was a major issue in science and philosophy in the twentieth century. Its first irruption was in the heated controversy concerning the foundations of mathematics. To justify his rejection of the use of the actual infinite in mathematical reasoning, Brouwer made the construction of mathematical objects dependent on the knowing subject. This approach was rejected by the mainstream of analytical philosophers who feared a fall into pyschologism. Several years later, the question of the progress of scientific knowledge was put forward in the thirties by the post-positivist philosophers to fill the vacuum in the philosophy of science following

S. Rahman et al. (eds.), *The Unity of Science in the Arabic Tradition*,

the demise of the logical positivism programme. The answers given to these questions have deepened the already existing gap between philosophy and the history and practice of science. While the positivists argued for a spontaneous, steady and continuous growth of scientific knowledge the post-positivists make a strong case for a fundamental discontinuity in the development of science which can only be explained by extrascientific factors. The political, social and cultural environment, the argument goes on, determine both the questions and the terms in which they should be answered. Accordingly, the sociological and historical interpretation involves in fact two kinds of discontinuity which are closely related: the discontinuity of science as such and the discontinuity of the more inclusive political and social context of its development. More precisely it explains the discontinuity of the former by the discontinuity of the latter subordinating in effect the history of science to the wider political and social history. The underlying idea is that each historical and social context generates scientific and philosophical questions of its own. From this point of view the question surrounding the nature of knowledge and its development are entirely new topics typical of the twentieth-century social context reflecting both the level and the scale of the development of science. To the surprise of modern historians of science and philosophy, the same kind of questions, which would allegedly be new topics specific to the twentieth century concerning the nature of knowledge and its progress, were already raised more than eleven centuries earlier in the context of the Arabic tradition which, as we discuss further on, developed a trans-cultural and trans-national concept of the unity of science (see the contributions of Deborah Black, Hans van Ditmarsch and Jon McGinnis which tackle the issue of the nature of knowledge). The neglect of the Arabic tradition in philosophy of science is a major a gap not only in the development of science but a fundamental flaw in the writing of its history and the history of philosophy caused by the total reduction of epistemology to political and social history of science. How has this period of the history of science and philosophy come to be ignored? In what circumstances were the questions akin to the nature of knowledge raised in the first place? What is the relation between on the one hand the questions of knowledge and its growth and on the other hand the unity of science in the Arabic tradition? The answers to some of these questions are the aim of the present volume, the first of the series Logic, Epistemology and the Unity of Science to be devoted to a so-called non-western tradition. Let us first highlight in a kind of overview some landmarks concerning the *timing* of the emergence of the Arabic tradition and its significance for the history of science.

1 What Happened in the Ninth Century?

Since the beginning of the history of science in the mid-eighteenth century and its firm establishment as an independent discipline in the nineteenth century, the history of science has been largely written by western historians. The views of most historians of the nineteenth century have succeeded in shaping the standard view, still prevailing today, concerning the Arabic tradition. In this respect, the received view's approach was motivated by two main concerns: (i) to recover the lost Greek heritage extant only in the Arabic version, and in the meantime to find out to what extent Arab scientists and philosophers are proved to be capable of

correctly understanding sophisticated Greek thought; (ii) to assess the contribution of the Arabic tradition to the development of so-called western science. The focus on the relation between the Greek and the Arabic traditions reflects the major concern of this approach which consists in examining what has commonly been called the reception of the Greek scientific and philosophical works in the Arab world. While it is true that the Arabic tradition was developed against the background of Greek scientific and philosophical writings—a phenomenon which is similar in this regard to the fact that Greek philosophy had emerged against the background of the achievements of the Babylonian and Egyptian civilisations—the standard approach seems to have gone too far in its assessment of the so-called reception-role of the Arabic tradition. Indeed, according to the received view the Arabic tradition seems to be deprived of any interest of its own. In fact, the impression given is that Greek philosophical doctrines have succeeded not only in overthrowing the Babylonian and Egyptian beliefs, but that they continued to dominate throughout the classical Islamic era. It is thus not surprising that the received view came to the conclusion that the importance and the relevance of the Arabic tradition to the history of science lies only in its intermediary role consisting in handing over almost intact the Greek works to the medieval Europeans. It looks as if Greek scientific and philosophical books were brought to the Arabic libraries to save them from an imminent major disaster that could strike the Greek heritage. We have here some kind of paradox: many historians make this kind of definitive judgments, by considering only a few materials from a tradition which reigned alone over the scientific and philosophical scene for up to seven centuries. This paradox is symptomatic of the underlying epistemological approach to the history of science which is by its very nature an open system. The assumption is that the study of the Arabic tradition was sufficiently exhausted to the extent that no new findings could have any significant impact on our present state of knowledge concerning the development of knowledge. This view, which prevails for years, has recently been challenged by a careful study of some important Arabic scientific works. From the mid-twentieth century onwards some historians have set themselves the task of translating important Arabic writings aimed at filling the gap in our understanding of the development of the Arabic tradition. It is in this context that Sabra has challenged the use of what seems to be a neutral term to describe the transmission of Greek scientific and philosophical works. He argues that “Reception” might “connote a passive receiving of something being pressed upon the receiver, and this might reinforce the image of Islamic civilisation as a receptacle or repository of Greek learning” (Sabra 1987, p. 225). He stresses that Greek science and philosophy was not thrust upon but rather “invited [as a] guest” by the Arabic Islamic society (ibid., p. 236). Sabra proposes instead “appropriation” to describe the “enormously creative act … the cultural explosion of which the translation of ancient science and philosophy was a major feature” (ibid., pp. 226–228). His argument seems to have had little effect on the received view concerning the Graeco-Arabic transmission. But some historians such as Willy Hartner and Gotthard Strohmaier have tried to refine their analysis of the periodisation of the development of Arabic science by admitting the existence of a second period during which the Islamic society was more productive and creative than receptive and

imitative. The restriction of the application of the Reception concept to the early period of the translation movement can be seen as an important concession to the opponents of the Reception doctrine. But Dimitri Gutas, who devotes a whole book to precisely this question, rejects out of hand this compromise which consists in applying the Reception interpretation to the early period

> One such prevalent misconception [about the development of Arabic science] is that the translation movement went through two major stages, a 'receptive' one, roughly through the time of al Ma'mūn, and a creative one subsequently. Study of the translation complexes, as the example of the Kindī circle complex of the translations shows, invalidates by itself even the very posing of the question in such a way (Gutas 1998, pp. 149–150).

Besides its passive connotation underlined by Sabra, the misconception induced by "Reception" is that the transmission can be understood as the result of direct cultural exchanges between on the one hand the Greeks, as producers and exporters (Strohmaier actually speaks of providers) of scientific and philosophical theories, and on the other hand the Arabs as users and consumers. Unlike the transmission of science and philosophy to medieval Europe, the Graeco-Arabic transmission has taken place in an entirely different climate as Gutas rightly points out (ibid., p. 4). In other words the large number of translations from Greek and Arabic into Latin starting from the twelfth century reflect the powerful and profound impact that the flourishing and advanced Arabic-Islamic civilisation had on the medieval European psyche, where there is no equivalent driving force in the case of the Graeco-Arabic transmission since the social and cultural environment in which Greek science and philosophy were developed was extinguished for so many centuries. Does it mean that no driving force can be found behind the translation movement? Is there only one or more than one driving force? And in the latter case, do they have equal influence on the development of Arabic science or do some of them play a much more prominent role than others? We shall see in a moment how Gutas deals with these various questions.

While agreeing wholly with Sabra on the creative nature of the translation movement, he expresses his reservation to the use of "appropriation" to describe the process of the transmission since he finds it a "surreptitiously servile term" (ibid., p. 187). No specific term has been proposed by Gutas since he prefers simply to call it a "creation of early ʿAbbasīd society and its incipient Arabic scientific and philosophical tradition" (ibid.). It looks as if the language has run short of words since, among the many memorable moments of the history of science, this is the only particular historical moment for which no specific word could be found to mark the unprecedented large-scale scientific activity triggered by what some historians call a political revolution. It thus seems that the description of the Arabic translation movement is no less problematic than the question of the assessment of the Arabic tradition itself (see Tahiri's introduction to his chapter). What happened in the ninth century is not the recovery of Greek science but the implementation of a new idea of science, where science and the scientist are conceived as institutions and instruments of research and development.[1] Moreover, as we shall see in paragraph two and three of our introduction, this new concept of science was first carried out by means of the creation in Bagdad of an institution, namely the House of Wisdom (*bayt al-ḥikma*) and the production of an Arabic

scientific literature with a technical vocabulary in a kind of what Gutas calls *a high koiné language* fit for inter and trans-disciplinary work in a way which might be considered to be an analogue to what has been described as the role of *lingua franca* given to formal language by the French Encyclopedists (see Rahman/Symons 2004, pp. 3–16). Both projects, the House of Wisdom and the production of an Arabic *koiné* language, provided the instruments with the help of which the notion of the unity of science was implemented within the Arabic tradition.

2 Science Awakening and *bayt al-ḥikma* (the House of Wisdom)

There have been many conquests in history but few had such a direct and decisive impact on the history of science and philosophy as the Arabic conquests. One of its main features is that the expansion of the Arabic-Islamic civilisation and the development of science go hand in hand. The Arabs did not wait for science and philosophy to come to them. We have to bear in mind that the Arabic peninsula did not come under the rule of Alexander the Great. They had instead to go after knowledge. The task was challenging since they had to start from scratch. Gutas describes in the following passage how the scale of this ambitious intellectual project required the unprecedented mobilisation of a huge amount of resources and energy of an entire nation for more than two centuries.

> The Graeco-Arabic translation movement lasted, first of all, well over two centuries; it was no ephemeral phenomenon. Second, it was supported by the entire elite of ʿAbbasid society: caliphs and princes, civil servants and military leaders, merchants and bankers, and scholars and scientists; it was not the pet project of any particular group in the furtherance of their restricted agenda. Third, it was subsidized by an enormous outlay of funds, both public and private; it was no eccentric whim of a Maecenas or the fashionable affectation of a few wealthy patrons seeking to invest in a philanthropic or self-aggrandizing cause. Finally, it was eventually conducted with rigorous scholarly methodology and strict philological exactitude — by the famous Ḥunain ibn Isḥaq and his associates — on the basis of a sustained program that spanned generations and which reflects, in the final analysis, a social attitude and the public culture of early ʿAbbasid society; it was not the result of the haphazard and random research interests of a few eccentric individuals who, in any age or time, might indulge in arcane philological and textual pursuits that in historical terms are proven irrelevant. (ibid., p. 2)

This is modern science in the making. Modernity should be understood here not in the narrow sense which is traditionally associated with the advent of the new physics conceived as a finished product, but in the act of creating, through the close co-operation of political power and the Arabic-Islamic society, a new and long-lasting dynamic structure. It turns out that the unstoppable growth of the new entity, which proved to outlive by far both the political entity which gave it birth in the first place and the social context of its formation, is designed to transform the life of the Arabic-Islamic society and with it the societies of the rest of the world. For the first time in history science becomes a profession. This is unlike in the Greek tradition, where it was practised by a happy few who have the luxury thanks to their wealth to enjoy what they regarded as the supreme life by merely

contemplating nature. Science becomes in the Arabic-Islamic tradition a third institution with growing influence along side the two most powerful extant institutions: the legal and the political powers. The result of this unprecedented collective hard and enduring work: by the end of the tenth century almost all non-literary and non-historical Greek books that were available had been translated into Arabic. Greek science and philosophy has been transformed once and for all by "the magic translator's pen", as it is nicely put by Gutas.

It should be noted however that the translation movement is not confined to Greek writings—though the latter form the bulk of the works translated—it is a more global and international phenomenon since it concerns all the books fit to be translated. There are Arabic versions of books written in other languages such as the Persian, the Sanskrit and possibly the Chinese language.[2] The successful achievement of this monumental enterprise, which could have at any moment been interrupted or aborted altogether for a variety of reasons, is nothing short of miracle, the assessment of which has not yet begun, since it opens a new era in the history of human thought. The idea of knowledge has been completely reinvented through the systematic survey of all existing scientific writings. By the turn of the eleventh century, the translation of Greek works has significantly died down reflecting the advanced level reached by Arabic science. As Gutas puts it bluntly "the waning of the Graeco-Arabic translation movement can only be seen due to the fact that it had nothing to offer… not in the sense that there were no more secular Greek books to be translated, but in the sense that it had no more books to offer that were relevant to the concerns and demands of the sponsors, scholars and scientists alike" (ibid., p. 152), in other words "the translated works lost their relevance and became part of the history of science" (ibid., p. 153). Consequently there was a shift in demand for more up-to-date research. Gutas further explains the major impact of the rapid spread of the Arabic scientific institution model far beyond the spatiotemporal context that gave it rise in the first place

> Once the Arabic culture forged by early ʿAbbasid society historically established the universality of Greek scientific and philosophical thought, it provided the model for and facilitated the later application of this concept in Greek Byzantium and the Latin West: in Byzantium, both in Lemerle's 'first Byzantine humanism' of the ninth century and in the later renaissance of the Palaeologoi; and in the west, both in what Haskins has called the renaissance of the twelfth century and in the Renaissance proper (ibid., p. 192).

Contrary to the prevailing view according to which there is only one renaissance in history, Gutas seems to be saying that the Arabic tradition gives rise to a series of renaissances which reaches its climax in the advent of the famous southwestern European Renaissance. The Renaissance proper as Gutas would like to call it now—which is recognised by the sociological doctrine as the starting point of the scientific revolution—appears to be then not the first of its kind as is generally believed but the outcome of previous renaissances which originate in the foundation in Bagdad of the *bayt al-ḥikma* or the House of Wisdom, the famous scientific institution that gives rise to the development of Arabic science by hosting the first movement of what can be called the translation project (see below).

But what about the crucial period during which the Graeco-Arabic transmission took place? Can the ninth century be called a renaissance? Gutas appears to be somewhat hesitant. On the one hand he is inclined to describe it as the "real renaissance in the original sense of the revival of Greek learning" (ibid., p. 154). But on the other hand this "real renaissance" seems to be quite different from the traditional European Renaissance. He rightly points out that the "philological aspect of classical studies, which also has its modern origin in the European Renaissance, was wholly absent in the Arabic counterpart" (ibid., p. 155), for the obvious reason that the translation activity was very selective since it was restricted only to scientific and philosophical writings, thus excluding the humanities (such as literary and historical works). As a result of this methodologically worked-out plan, the translation activity virtually ceased, as already mentioned, once its goal was achieved. Because of the advanced level reached by Arabic science in the eleventh century and reflected in the comprehensive philosophical and scientific work of Ibn Sīnā, there was no need to pursue Greek studies, for the "hurricane of Avicenna's philosophy quickly swept such tendencies away" (ibid., p 155, see Ardeshir, Bäck and Thom's chapters devoted to his encyclopedic thought). The second major difference is that the translation movement, as Gutas' fascinating account demonstrates, is much more than the mere revival of Greek learning. First of all, if by revival Gutas means translation then we need to bear in mind that it is not only Greek learning which was revived through the translator's creative imagination but also the learning of other civilisations such as the Persian, Indian and even the Chinese. Second, the real intention of the translation project is not to revive the culture of previous civilisations, a task best left to the indigenous people, but the construction of knowledge according to a long-term research programme.

Gutas describes the historical background of the foundation of the *bayt al-ḥikma* and its later development as follows

> It was a library, most likely established as a "bureau" under al-Manṣūr, part of the ʿAbbāsid administration modelled on that of the Sasanians. Its primary function was to house both the activity and the results of translations from Persian to Arabic of Sasanian history and culture. As such there were hired translators capable to perform this function as well as book binders for the preservation of books. This was its function in Sasanian times, and it retained it throughout the time of Hārūn ar-Rashīd, i.e. the time of the Barmakids [the secretaries of the early caliphs]. Under al-Ma'mūn it appears to have gained an additional function related to astronomical and mathematical activities; at least this is what the names[3] associated with the name *bayt al-ḥikma* during that period would imply. We have, however, no specific information about what those activities actually were; one would guess research and study only, since none of the people mentioned was himself actually a translator (ibid., p. 58).

In this passage, Gutas wants to make the point, strongly emphasised afterwards, that Graeco-Arabic translation, the subject of his book, is not conducted in the *bayt al-ḥikma*.[4] As a result, the whole translation movement during the early ʿAbbāsid era was conducted in two stages. (1) The first wave of translations of Persian heritage undertaken in the *bayt al-ḥikma* (conducted under the ruling of al-Manṣūr (754–775)); (2) the Graeco-Arabic translation represents the second wave of translations (from the time of al-Mahdī (775–785) onwards). One of the main

reasons given by Gutas for denying any role of the *bayt al-ḥikma* in Graeco-Arabic translation is that there is no mention of Greek works being stored on its shelves. To back his argument, he quotes Ḥunayn ibn Isḥāq (d. ca. 873) who seems to have been complaining about the "efforts he expended in search of Greek manuscripts and again he never mentions that he looked for them right under his nose in the *bayt al-ḥikma* in Bagdad" (p. 59). This might be the case. But Ḥunayn's complaint might also indicate that Greek works were circulating in society. One does not expect important manuscripts, which existed in a very limited number of copies, to be stored in an official library. The absence of books from the shelves reflects their relevance to the concerns of society. This may explain why texts of humanities such as Persian, Ethiopian or Ḥimyarite manuscripts could be found in the *bayt al-ḥikma* but not Greek ones due to their scientific nature. By denying the *bayt al-ḥikma* any role in the Graeco-Arabic translation, Gutas seems to create a gap between the two translation movements, a gap that he seems to narrow by appealing to the translation culture: "What the *bayt al-ḥikma* did do for the Graeco-Arabic translation movement, however, is to foster a climate in which it could be both demanded and then conducted successfully" (p. 59). According to Gutas, two common points can be found between the two translation movements: (1) the obvious point is that they are both part of the translation culture widely prevailing in the region. Gutas reminds us of the existence of "pre-Islamic translations into Pahlavi [the Persian language] of Greek scientific and possibly philosophical works" (p. 25). This explains the fact that the earliest translation of Greek works into Arabic are made not directly from the Greek, as it is generally believed, but through Pahlavi. (2) The heavy involvement of the state apparatus though for entirely different political motivations. Actually, the contrast that Gutas is struggling to make is that the Persian-Arabic translations were temporary and narrower in scope than the Graeco-Arabic translations. The first was confined to the political sphere while the second was a social phenomenon. Neither the structure of the *bayt al-ḥikma*, as was inherited from the Sasanians, nor state resources could cope with the scale of the second wave of translations. This explains the role of the private sector which seems to be absent or at least very limited in the first wave of the translations. The private sector stepped in to satisfy the growing demand for knowledge expressed by the wider society.

There is in fact a third point, not a political but a scientific one, which can indeed intimately link the Graeco-Arabic translations to the Persian-Arabic translations and ultimately to the activities of the *bayt al-ḥikma*. Despite the little historical information available about the *bayt al-ḥikma*, it is known for sure that a number of astronomers and algebraists such as al-Khwārizmī (d. 850) were employed full time in the *bayt al-ḥikma*, in the service of the caliph al-Ma'mūn (813–833). This evidence indicates that the activities undertaken in the *bayt al-ḥikma* were not confined throughout its existence to its original task, that is, translating the Persian heritage. The nature of such activities seems to have broadened to include research and study which prompt Gutas' suggestion made in the aforementioned passage: "Under al-Ma'mūn it [*bayt al-ḥikma*] appears to have gained an additional function related to astronomical and mathematical activities." Informed speculation gains some assurance when we know that *Algebra*

was not a work translated from the Persian but the result of al-Khwārizmī's studies and reflections on the Babylonian and Indian scientific practices (see Heeffer's chapter). In chapter V (i.e. two chapters later) devoted to Applied and Theoretical Knowledge of his book, Gutas describes the circumstances (and the motivation) of the composition of *Algebra*, which gives us a more specific idea of the nature of research pursued by scientists in the *bayt al-ḥikma*

> During early ʿAbbāsid times, however, Islamic law was also developing rapidly and algebra became an essential tool for working out all the intricate details of inheritance laws. Both of these applications are mentioned by Muḥammad ibn Mūsā al-Khwārizmī himself in the introduction to his *Algebra*. Al-Ma'mūn, he says: 'encouraged me to compose a compendious work on algebra, confining it to the fine and important parts of its calculations, such as people constantly require in cases of inheritance, legacies, partition, lawsuits, and trade, and in all their dealings with one another where surveying, the digging of canals, geometrical computation, and other objects of various sorts and kinds are concerned (ibid., p. 113).

The significance of the *bayt al-ḥikma* lies not only in the continuity of scientific research, since it paves the way for more translations from both the farther eastern tradition (mainly Indian sources) and the western tradition (Greek sources), but also in setting the pattern of how future scientific activities should be conducted. By contributing to the emergence of a new scientific tradition, the translations and scientific activities taken place in the *bayt al-ḥikma* explain Gutas' insight according to which "translations are seen from the very beginning as part of research processes"[5] whose aim is the construction of knowledge based on the constant interaction between theory and practice as was implemented by the early scientists working in the *bayt al-ḥikma*.

The details of such a programme were clearly spelled out by the first Philosopher of the Arabs, al-Kindī (ca. d. 870)[6], so-called because his name was traditionally linked to the introduction of philosophy to the Islamic world. The programme's first step should be seeking to acquire knowledge, as he insists in his introduction to *On First Philosophy*.

> The knowledge of the true nature of things includes knowledge of Divinity, knowledge of Unity and knowledge of virtue and a complete knowledge of everything useful, and the way to it; and the distance from anything harmful, with precautions against it. […] Devotion to this precious possession is, therefore, required for possessors of the truth, and we must exert ourselves to the utmost in its pursuit (al-Kindī 1974, p. 59).

The process of translations is a means of getting rid of those linguistic elements that might jeopardize the universality of scientific writing, it tends to act as some sort of a filter through which only scientific thoughts are allowed to pass. The result of this process of acquisition is that knowledge becomes accessible to everybody. Because Arabic was the only global language in all walks of life, even in science and philosophy, knowledge is promoted to an international level. As a result, it is no longer linked to a specific culture but becomes the property of all humanity.

The second step of the construction of knowledge is to work towards its unification in the sense of putting together its various pieces which were collected from previous civilisations.

> It has been clear to us and to the distinguished philosophers before us who are not our colinguists, that no man by diligence of his quest has attained the truth, i.e., that which the truth deserves, nor have the philosophers as a whole comprehended it. Rather, each of them has not attained any truth or has attained something small in relation to what the truth deserves. When, though, the little which each one of them who has acquired the truth is *collected* جُمِعَ, *something of great worth is assembled from this* اجتُمِعَ من ذلكَ شيء له قدرٌ جليلٌ. […] Indeed this has been assembled only in preceding past ages, age after age, until this our time, accompanied by intensive researches, necessary perseverance and love of toil in that (our emphasis, al-Kindī 1974, p. 57).

The second step announces the next one, which consists in building upon the achievements of previous civilisations. Al-Kindī goes on to tell us more precisely how the body of knowledge can be increased.

> In the time of one man — even if his life span is extended, his research intensive, his speculation subtle and he is fond of perseverance — it is not possible to assemble as much as has been assembled, by similar efforts, — of intense research, subtle speculation and fondness of perseverance — over a period of time many times as long. […] It is well for us — being zealous for the perfection of our species, since the truth is to be found in this — to adhere in this book of ours to our practice in all composition of presenting the ancients' complete statement on this subject according to *the more direct way and facile manner* على أقصد سبله و أسهلها سلوكاً to be followed for those who take it; and completing that which they did not say completely, و تَتْميم ما لم يقولوا فيه قولا تاما by following the custom of the language and contemporary usage, and insofar as is possible for us. (This) in spite of the disadvantage affecting us in this of being restrained from going into an extended discussion necessary to solve difficult, ambiguous problems (our emphasis, ibid., pp. 57–58).

The third step amounts then to seeking the progress of knowledge and to facilitating its learning for younger generations and its transmission to future civilisations since it is conceived not as a finished product but as an ongoing process. As a result knowledge needs to be continually and constantly worked out and perfected by correcting and improving the inevitable shortcomings inherent to the achievements of previous civilisations for which they should not of course be blamed.

> *Our most necessary duty is not to blame* و من أوجب الحقّ ألا نذمَّ anyone who is even one of the causes of even small and meagre benefits to us; how then shall we treat those who are responsible for many causes, of large, real and serious benefits to us? Though *deficient in some of the truth* و إن قصَّروا عن بعض الحقّ, they have been our kindred and associates in that they benefited us by the fruits of their thoughts which have become our *ways and instruments* سُبُلا و آلاتٍ leading us to much knowledge of that the real nature of which they fell short of obtaining (our emphasis, ibid., p. 57, Ivry's translation is slightly modified).

According to the Arabic conception of knowledge, there is no such thing as perfect knowledge. This idea is so deeply entrenched in the Arabic-Islamic culture that it is expressed in a variety of ways by many proverbs, one of them is the following: "a man remains knowing as long as he searches for knowledge and continues to study. When he thinks he knows, he has become ignorant لا يَزَالُ المَرْءُ عالِماً ما طلبَ العِلمَ فإذا ظنَّ أنْ قد عَلِمَ فقد جَهلَ."

Gutas is well aware of the fact that "renaissance" is not the appropriate word to describe the translation movement; the passage mentioned above is the only place where he brings it up, in the context of responding to other scholars. Throughout his whole book, he prefers rather to focus on the man whose vision and sagacity led to the foundation of the first scientific institution in history.

> The crux of the matters seems to lie in al-Manṣūr's creation, after the ʿAbbasid revolution, of a new social configuration in Bagdad through the genial idea of creating a new city. This meant, in essence, granting himself the licence to start everything anew by freeing him from constraints carried over from the previous *status quo* (Gutas 1998, p. 189).

The series of renaissances including the Renaissance proper appears to be then the result of the original creation of the famous House of Wisdom from which all sprang.

> In this context, al Manṣūr's adoption of a Sasanian imperial ideology becomes possible and meaningful, as does the establishment of the attendant translation movement. The process once set in motion, proceeded for over two centuries on its own (ibid., p. 191).

These two crucial passages have far-reaching implications for the periodisation of science. According to Gutas' analysis, it is the ninth century and not the Renaissance which should be the starting point not only of a series of renaissances but also of the scientific revolution. But he stops short of drawing such a conclusion for obvious epistemological reasons since he warns that his "book is not about Arabic science and philosophy" (ibid., p. 192). Precisely the gap left by Gutas' approach between political and social history and the history of science has been bridged by Tahiri's chapter, which provides badly needed epistemological backing for Gutas' underlying thesis, since it reaches basically the same conclusion by analysing the history of astronomy. Further analysis of Arabic scientific and philosophical writings will provide further evidence for making the ninth century a landmark in the history of science and philosophy and will indicate how it should be viewed and remembered in the history of science.

3 The Arabic Language and the Unity of Science

Historians of science and philosophy are usually selective in their choice of the kind of questions they seek to answer. One of the remarkable historical facts seldom noticed is that science and philosophy have been developing without interruption since the ninth century as the great French historian Pierre Duhem shows in his monumental *Le Système du Monde*. How can we explain, in the case of astronomy for example, the fact that this scientific discipline has made no progress whatsoever since the second century (and a fortiori for much older scientific disciplines like mathematics)? A particularly tempting answer follows a recent trend in the history of science: the lack of progress is due to extrascientific factors. According to the sociological interpretation of the history of science which is now fashionable in the humanities, major gaps in the development of science cannot be explained intrinsically but only by appealing to the political, social and cultural

context in which science and philosophy are developed. After all, according to this view, science is a social and cultural phenomenon since it is the product of human beings, and its development is determined by the social environment in which scientists live and work. That is why the Dark Ages, the period during which science made no progress in Europe, has been blamed entirely on Roman-Christian societies for a failure to generate the kind of change needed for the development of science. Thus it seems that medieval Europe had to wait for the emergence of the Arabic-Islamic culture to emerge into the light at the end of a long tunnel. This is at least the conclusion drawn by Gutas' analysis.

> Byzantine society, although Greek-speaking and the direct inheritor of Greek culture, never reached the level of scientific advancement of the early ʿAbbasids and had itself later to translate *from Arabic* ideas that ultimately go back to classical Greece. In such an analysis, the contribution of individuals is also to be put in perspective. Sergius of Reshʿaynā and Boethius, at the two antipodes of Greek cultural spread in the early sixth century, conceived of projects to translate and comment upon philosophy and the sciences as presented in the philosophy of Aristotle – and hence all knowledge, as understood in the Alexandrian scholarship of their age. The conception is to their credit as individuals; that they failed indicated the adverse circumstances of their environment (ibid., pp. 188-189, also p. 22).

Our analysis will show, however, that Gutas' conclusion is only half the story. The other half is yet to be told. By focusing only on extrascientific factors, there is a risk of neglecting those epistemological and methodological considerations which might have influenced the lack of progress of science. Indeed, Gutas' work *Greek Thought Arabic Culture*, where he describes the political and social factors that occasioned the translation movement, can be seen as further support for the sociological interpretation of the history of science. Gutas justifies his approach by the fact that the translation movement as a social phenomenon has been very little investigated while "its significance for Greek and Arabic philology and the history of philosophy and science… have been overwhelmingly studied to this day" (ibid., p. 2). He may have a point here, but this might lead one to overlook the fact that some crucial epistemological points with regard to the significance of the Arabic tradition has been missed out by most historians. Actually, while describing the political and social context of what he calls the ʿAbbasīd revolution, Gutas' work draws attention to one of the important central epistemological points in the development of Arabic science: namely the fundamental role played by the Arabic language in the development of science and philosophy.

> The particular linguistic achievement of the Graeco-Arabic translation movement was that it produced an Arabic scientific literature with a technical vocabulary for its concepts, as well as a high *koiné* language that was a fit vehicle for the intellectual achievements of scholarship in Islamic societies in the past and the common heritage of the Arab world today. […I]ts significance lies in that it demonstrated for the first time in history that scientific and philosophical thought are international, not bound to a specific language or culture (ibid., p. 192).

This aspect of the contribution of the Arabic tradition to the history of science and philosophy has been ignored or widely underestimated. How could the progress of a major scientific discipline, like mathematics for example, be achieved

had not its various parts, scattered for so many centuries from the East to the West, been brought together by a unifying language? How could the awakening of science even be imagined if it was still encoded in a language no longer in use? For science to develop the way it did, it needed the emergence of a nation that should have such an admiration for its language[7] and a passion for knowledge[8] that sets itself the historical mission of collecting, processing and translating all scientific data produced by previous civilisations and making the resulting systematic work available worldwide easily accessible through the unprecedented circulation of books. Historically the Arabic language shows 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 language and science to another. As mentioned above, the production of an Arabic *koiné* language provided one of the bases of the notion of the unity of science within the Arabic tradition. This might also help to understand why in the Arabic tradition the study of grammar and logic (see the chapter of Cornelia Schöck), including poetics and rhetoric, was conceived as a kind of integrating factor for all other fields of knowledge and science. Moreover, in the Arabic tradition grammar, poetics and rhetoric were seen as closely linked with what we would now call a normative epistemic logic conceived as an extended organon for the search and transmission of knowledge. Logic and grammar were at the centre of the creation of a scientific Arabic *koiné* language with precise epistemic and epistemological aims.

Rashed, one of the first distinguished historians to question the current periodisation of science, suggests in his investigation into the development of mathematics between the ninth and the seventeenth centuries, that what he calls the notion of *differential* is much more adequate in historical scientific studies than the dominant continuity/discontinuity approach, currently widely used in the history of science. Rashed argues that the notion of differential when applied to the history of mathematics can be used as an instrument in assessing effectively the actual increase of mathematical truths by comparing the state of each mathematical branch (its results, methods and ways of reasoning) at two important times of its evolution (Rashed 1987, p. 360). Indeed this approach not only helps us adequately to determine the *timing* of the emergence of a new scientific discipline but also to illuminate *how* science is viewed and understood by indicating the underlying motivation of the context of its development. This is the method that underlies the analysis of our introduction. More precisely, we think that Rashed's notion of differential can be fruitfully applied to study the uninterrupted development of science and philosophy since the ninth century in the Arabic tradition by comparing it with the approach of the ancient Greeks. Certainly this would involve us in the development of a long and difficult thesis but let us simply highlight some brief remarks which we think will be sufficient to suggest the main lines of an analysis which pursues such a comparison.

4 Some Remarks in Relation to the Heritage of the Greek Approach to Scientific Inquiry

In his *Posterior Analytics* Aristotle imposes strict conditions on the definition of *episteme*. Knowledge is produced by a demonstration which, he asserts, "must proceed from premises which are true, primary, immediate, better known than, prior to, and causative of the conclusion" (71b20). It is clear for the Stagirite that the mere use of syllogism cannot produce knowledge since he insists on the fact that "syllogism will be possible without these conditions, but not demonstration; for the result *will not be knowledge*" (our emphasis). This makes it harder for disciplines other than mathematics ultimately to reach the episteme status since they cannot fulfil the tough Aristotelian criteria. (It is worth noting that the axiomatics of Euclid could not be captured by syllogism.) It seems thus that Aristotle actually calls knowledge is that knowledge displayed in what we now call formal sciences—some interpreters would include here metaphysics. Since by definition this kind of knowledge is of things that cannot be otherwise than they are, i.e. necessary knowledge, Aristotle introduces a sharp distinction between mathematics and empirical sciences. But when it comes to physics, for example, Aristotle's task is to give a discursive and systematic explanation of all kinds of change. The problem of physics is according to him to find the "principles of perceptible bodies" (*On Coming-to-be and Passing-away*, 327b7). The main conceptual apparatus that he invents for this purpose is the famous four-causes doctrine.

> Now, the causes being four, it is the business of the physicist to know about them all, and if he refers his problems back to all of them, he will assign the 'why' in the way proper to his science (Physics II 7198a).

According to this view, knowledge in physics seems to be quite different from mathematics since it amounts to seeking out all the four causes of any natural phenomenon. In his physical theory, he endorses Empedocles' fundamental idea that all substances are made of the four simple elements: earth, water, air and fire. Earth has some privilege in his explanation of motion. Though being made of the four elements, it is also the natural place of terrestrial objects. As for the supralunar world, the matter from which it is made, that he calls *aither*, is of a completely different order because of the eternal, circular and regular motion of the heavenly bodies.

Aristotle is indisputably *the* philosopher of antiquity. His conceptual apparatus lays down both what type of questions should be asked and the terms in which they should be answered. This explains why philosophers who followed Aristotle's framework closely contributed little to the development of science. Indeed the great advances in such subjects as mathematics or astronomy are the work of men who were primarily scientists and not philosophers and thus manage to escape his influence. Despite important scientific achievements, however, Aristotle's physical doctrine remains unshaken and the domination of his philosophical system seems to be the last word of the Greek tradition. The Greek heritage was henceforth in the hands of their successors, though it seems that the Greeks did not care so much about their legacy, as is suggested by the eminent classical scholar

G. E. R. Lloyd's perspicuous remark: "although there were many [of the ancients] who recognised that civilisation had developed in the past, there were few who imagined that it would or could progress much further in the future" (Lloyd 1972, p. 394). The lack of the idea of scientific progress in Greek culture, which has an impact on their philosophical and scientific approach, explains at least in part why we have to wait until the ninth century for the emergence of their immediate successors. In his comprehensive study, Lloyd sums up the whole ancient Greek approach to scientific inquiry as follows

> Experimental method was only of very limited usefulness on the fundamental problem of physics, the question of the ultimate constituents of matter. Although quite simple experiments would have yielded useful information about the nature of certain compounds, the principal controversy between atomism and the qualitative theory of Aristotle, for example, was not one that could be settled by an appeal to either observations or experiments, since the controversy turned on the question of the type of account that was to be attempted. […] A more important point is that such experiments as were performed by the Greeks were usually carried out with the set purpose of supporting the writer's own theory. The appeal to experiment was an extension of the more usual notion of appealing to evidence: experimentation was a corroborative, far more than a heuristic, technique. Tests were conducted to confirm the desired result, and it is only in late antiquity that we find examples where attempts were made to vary the conditions of experiments systematically in order to isolate causal relations. […] Nevertheless the impression that much of the history of early Greek science leaves is one of the dominant role of abstract argument (Lloyd 1970, pp. 139–142).

A second limitation is the inferior place given to practice in relation to theory which led most of the philosophers to oppose the two activities dramatically. Theoretical studies which should be pursued for their own sake are highly valued at the expense of practical arts which are viewed with disdain. This is true, as Lloyd explains, even for some scientific disciplines like medicine, which one would expect to be highly regarded because of its noble cause.

> Many of the most famous biologists were doctors, who were motivated in their research partly by the desire to improve the treatment of the sick, and sought to apply their knowledge to this end. Yet not even the most famous and successful doctors in antiquity entirely escaped the disdain usually felt for the craftsman. In the Greek scale of values the theorist was always superior to the technologist (Lloyd 1972, p. 395).

It is clear that empirical sciences, and with them theoretical studies, cannot flourish in a cultural context where the role of practical arts in the prosperity and the well-being of the society is heavily undermined by its top elite. Lloyd has rightly identified the huge gap created by the Greek society between theory and practice as one of the main reasons preventing the development of scientific research.

> The institutions where extensive investigations were carried out were rare throughout antiquity. The ancients lacked the idea that dominates our own society, that scientific research holds the key to material progress. […] The *raison d'être* of the Lyceum and Museum and of the many minor schools modelled on them was not any idea of the *usefulness of scientific research*, but the idea of a 'liberal' higher education (our emphasis, p. 394).

The second main reason is the lack of co-operation and of scientific and philosophical exchanges because of the extrascientific motivations underlying the formation of many schools.

> The development of science and mathematics required other factors as well, particularly the idea of co-operation in research. Here both the Pythagoreans and the medical schools (in their very different ways) had important contributions to make. But in neither case was the chief motive for these associations any idea of the value of scientific research for its own sake. Religious and political ties helped to keep the Pythagoreans groups together, and the medical schools were exclusive associations formed from professional motives, like a medieval guild or a modern trade union. Moreover the doctors, like the Pythagoreans, were on occasion secretive about their discoveries (ibid., p. 394).

More generally, the production of scientific and philosophical works and the spread of ideas were greatly hampered by a deeply entrenched cultural tradition practised by many Greek philosophers who, because of their distrust of the written word, confined what they regarded as their most important doctrines to oral teachings (ibid., p. 383). A diametrically opposed stance is expressed by al-Jāḥiẓ (d. 868), a famously prolific Arabic author[9]

> Our duty is to do for those who will come after us what our predecessors have done for us. For we found more knowledge[10] than they found, just as those who will come after us will find more knowledge than we did. What is the scientist waiting for to display his knowledge in the open, what prevents the servant of the truth from devoting himself without fear to the task that he was assigned, now that the word has become possible, the times are good, the star of caution and of fear is extinguished, a wind favourable to study is blowing, babble and ignorance are no longer current, eloquence and knowledge are circulating freely in the market? For a man does not find a teacher to train him and an expert to educate him at all times (Al-Jāḥiẓ 1969, I pp. 86–87).

On the methodological and epistemological levels, we find the sharp distinction mentioned above between mathematics and empirical sciences (mainly physics). In his *Almagest*, Ptolemy further widens the already existing gap between mathematics and physics by subordinating the latter to the former the implication of this methodological decision and of his overall approach to astronomy will be convincingly refuted by Ibn al-Haytham (d. 1041). The fourth limitation which is proved to have serious repercussions on the development of science is indicated by Ibn al-Haytham. He makes clear that his *al-Shukūk* is motivated first and foremost by epistemological considerations designed to break the deadlock caused by the Greek synthetic approach of exposing scientific theories which represents more an obstacle than an incentive to the progress of science since it closes the door for further theoretical research (for more details see Tahiri's chapter).

What these various shortcomings indicate is that Greek science and philosophy were developed in the context of Greek culture to a point that no further progress could be made unless deep changes in the approach to scientific practice came about. Any translation movement of Greek works would not be able to overcome these obstacles if the translation project was to be reduced just to the task of recovering and preserving the Greek heritage. The success of the translation project is due to the growing awareness that the scientific inquiry concerning nature as it was understood and practised by the Greeks was not able to respond to the new questions

and problems raised at this time. This awareness was actually brought to the forefront by a major shift of focus from the heritage of the Greek idea of logos to the Arabic concept of knowledge.

5 Knowledge in the Arabic-Islamic Culture

The ʿAbbasīd dynasty[11] (750–1258) certainly gets great credit for putting knowledge at the centre of their political strategy by working out and supporting the first ambitious scientific research project in history which gives rise to the surge of an intensive scientific and cultural activity in Bagdad led by the prestigious institution *bayt al-ḥikma*. By learning from the mistakes of the Umayyads' rule[12] (661–750), the ʿAbbāsids succeeded where their predecessors failed. Short of full legal legitimacy, the ingenuity of the house of al-ʿAbbās lies in capturing the imagination of Arabic-Islamic society by focusing, as we shall see later, on one of the fundamental components of its identity. The ʿAbbāsids' strategy was a resounding success because it was a response to the demands of society since the quest for knowledge had already begun in earnest. This sets a precedent in Arabic-Islamic history since knowledge proves for the first time to be the only credible alternative by means of which a political body can effectively justify its rule. As a result of the vulnerability of the political power due to the conditional support of the legal authority, the distinctive political and social configuration that emerged has the body politic find its rule dependent on its unlimited support for knowledge; it is not knowledge which relies on the goodwill of politicians. This outcome in the balance of power indicates that one of the main features of the political and social ideal favoured by Islamic society is the one where political power should be at the service of knowledge and not the other way round. By putting knowledge at the top of their political agenda, the ʿAbbāsids wanted to show that their accession to power was a force for good; they were to some extent successful, since they succeeded in winning the support of the majority of Islamic society. This explains the remarkable longevity of their rule, which reached its climax with Hārūn al-Rashīd (786–809). His name is legendary associated in the West with the famous *Arabian Nights*; but in Arabic-Islamic conscience, he is remembered as one of the enlightened caliphs (al-Rashīd literally means the well-guided), chairing regular meetings of top intellectuals (jurists and theologians, poets and writers, linguists and grammarians, scientists and philosophers) in discussions of pressing and topical legal, cultural and scientific issues.

But the development of Arabic science was undoubtedly not the work of politicians, it was the result of unprecedented interaction among the intellectual elite whether they were jurists, grammarians, theologians, poets, scientists or philosophers. Its explanation must ultimately be found in the dynamics of Arabic culture and its specific approach to knowledge underlying the whole translation enterprise, summarized by al-Kindī in the following words:

> *We ought not to be ashamed of appreciating the truth and of acquiring it wherever it comes from* و ينبغي لنا ألا نستحيِيَ من استحسان الحقّ، و اقتناء الحقّ، من أين أتى *even if it comes from*

> *races distant and nations different from us. For the seeker of the truth nothing takes precedence over the truth* لا شيء أولى بطالب الحقّ منَ الحقّ and there is no disparagement of the truth, nor belittling either of him who speaks it or of him who conveys it. The status of no one is diminished by the truth; rather does the truth ennoble all (our emphasis, al-Kindī 1974, p. 58).

Al-Kindī's passage contains three crucial points which show the intertwining ethical and epistemological dimensions of the translation movement, namely:

(i) The unity of science must be conceived in trans-national and trans-cultural terms.
(ii) Since each society can have some form of truth, the second step in acquiring knowledge, which is the harder task, is in recognising and appreciating it. The question here is how? The answer relates to the confluence of grammar, logic and Law in the translation project—this point is not explicit in this paragraph but it links the first and the third point and has been developed by al-Kindī before (recall the passages quoted in section 2 above).
(iii) The supremacy of the truth (not authority), the search for which is the driving force behind the progress of knowledge, is the ultimate goal of scientific inquiry.

In relation to the first point, it is important to see that the search for the unity of science involves a determined ethical perspective: the humility to learn from others, and an ability to acknowledge one's own ignorance; and a social dimension: the need to seek the interaction with other people. The idea of a search for knowledge and its ethical and social implications is deeply entrenched in the Arabic-Islamic culture which goes back to the teaching of Islam i.e. to the seventh century.[13] Indeed the Arabic people of the seventh century *knew that they knew* little about the external world, a fact eloquently expressed by the Qur'ān (Sūrat 17, verse 85) "و ما أوتيتم من العلم إلا قليلا (you are given only a little knowledge)." Hence they are not only willing but—what is more interesting—ready to learn from the contributions of previous civilisations. The Arabic-Islamic society thus claims no privilege over other societies since the latter can have something that the former does not have: some form of truth, knowledge, wisdom. The Arabic intellectuals of the ninth century such as al-Kindī and Ibn Qutaybah were just following the same Islamic teaching that was followed by their predecessors, which makes seeking knowledge a duty for every believer. Ibn Qutaybah (d. 889) explains the rationale behind the search for knowledge

> Knowledge is the stray camel of the believer العلم ضالة المؤمن; it benefits him regardless from where he takes it: it shall not disparage truth should you hear it from polytheists, nor advice should it be derived from those who harbour hatred; shabby clothes do no injustice to a beautiful woman, nor shells to their pearls, nor its origin from dust to pure gold. Whoever disregards taking the good from its place misses an opportunity, and opportunities are transient as the clouds. … Ibn ʿAbbās [the Prophet's uncle] said: "Take wisdom from whoever you hear it, for the fool may utter a wise saying and a bull's eye may be hit by one untrained to shoot (Ibn Qutaybah 1986, p. 48).

Since Arabic-Islamic society cannot have the whole truth, it is urged by Islamic teaching to learn from a wide range of different societies to seek as far as China.[14]

If knowledge fails to come to the Arabic peninsula, its inhabitants have instead the duty to go after it; this is after all one of the main *raisons d'être* of the existence of the human being according to the Islamic doctrine. This is what led Sabra to speak of the translated Greek works in terms of an "invited guest" which is warmly welcomed by traditional Arabic culture. Respecting the culture of one's neighbours, no matter how different from Arabic culture, and getting acquainted with the culture of distant peoples appears to be the first step in acquiring knowledge. Acknowledging one's own ignorance amounts in fact to acknowledging the contributions of these people to the formation of the unity of science. Al-Kindī expresses here his deep sense of gratitude to all ancient civilisations on behalf of Arabic-Islamic civilisation:

> *It is proper that our gratitude should be great* فينبغي أن يعظم شكرنا to those who have contributed even a little of the truth, let alone to those who have contributed much truth, since they have shared with us the fruits of their thoughts and facilitated for us the true yet hidden inquiries, in that they benefited us by those premises which facilitate our approaches to the truth. If they had not lived, these true principles with which we have been educated towards the conclusions of our hidden inquiries would have not been assembled for us لم يُجْتَمَعْ لنا, even with intense research throughout our time (our emphasis, al-Kindī 1974, p. 57).

In relation to point (ii) and (iii), it is important to see that the way to acquire knowledge implemented by the translation project is connected with a specific feature of the Arabic notion of knowledge that stems actually from the development of Arabic society before the translation era, namely the role of Law and Grammar. Both disciplines were considered very early to be scientific disciplines. They were and continued to be the most important scientific disciplines for Arabic culture because of the vital role they play in organising social and cultural life. Moreover, as already mentioned in section 2 above, grammar and logic (including poetics and rhetoric) were conceived as instruments of the scientific programme implicit in the notion of knowledge underlying the translation project. The link of knowledge with Law had the function of putting the scientific programme of knowledge acquisition into practice. The link between knowledge and logic had the function of designing a grammar of a superior order able to render a language with the help of which different kinds of knowledge could be expressed and studied. Actually one might argue that this notion of knowledge stems from the use of the word *'ilm*. Indeed the Arabic word علم or *'ilm* can mean both science and knowledge and, remarkably, is used by the Arabic tradition in a wide sense similar to our usage today and quite different from the Greek meaning of *logos* (if the latter is understood as a theoretical notion of knowledge separated from the notion of practice). It is Franz Rosenthal (1970) who connected the notion of knowledge in classical Islam, designed to introduce a major transformation in scientific and social practice, with Islam. In his study, Rosenthal described first the central position occupied by knowledge in the life of the Islamic society such that he identified knowledge as the distinctive character of the Islamic civilisation:

> *'Ilm* is one of those concepts that have dominated Islam and given Muslim civilization its distinctive shape and complexion. In fact, there is no other concept that has been operative as a determinant of Muslim civilization in all its aspects to the same extent as *'ilm*. This