Ancient Cosmologies

Edited by

CARMEN BLACKER AND MICHAEL LOEWE

With contributions by

J. M. PLUMLEY W. G. LAMBERT
RABBI LOUIS JACOBS JOSEPH NEEDHAM
R. F. GOMBRICH EDITH JACHIMOWICZ
H. R. ELLIS DAVIDSON G. E. R. LLOYD
PHILIP GRIERSON

London George Allen & Unwin Ltd
Ruskin House Museum Street

First published in 1975

ISBN 0 04 100038 2

Printed in Great Britain
in 12 point Fournier type
by Cox & Wyman Ltd
London, Fakenham and Reading

Contents

Acknowledgements *page* 7

Introduction by CARMEN BLACKER 13

1 The Cosmology of Ancient Egypt 17

J. M. PLUMLEY
Professor of Egyptology, University of Cambridge

2 The Cosmology of Sumer and Babylon 42

W. G. LAMBERT
Professor of Assyriology, University of Birmingham

3 Jewish Cosmology 66

RABBI LOUIS JACOBS
Lecturer in Talmud, Leo Baeck College, London

4 The Cosmology of Early China 87

JOSEPH NEEDHAM
Master of Gonville and Caius College, University of Cambridge

5 Ancient Indian Cosmology 110

R. F. GOMBRICH
Lecturer in Sanskrit and Pali, University of Oxford

6 Islamic Cosmology 143

EDITH JACHIMOWICZ
University of Vienna

7 Scandinavian Cosmology 172

H. R. ELLIS DAVIDSON
Lecturer at Lucy Cavendish College, University of Cambridge

8 Greek Cosmologies 198

G. E. R. LLOYD
Reader in Ancient Philosophy and Science, University of Cambridge

9 The European Heritage 225

PHILIP GRIERSON
Professor of Numismatics, University of Cambridge

Notes to the plates appear on pages 63–5 and 160–61

6

Islamic Cosmology

EDITH JACHIMOWICZ
University of Vienna

Western scholars have sometimes speculated whether or not Islamic ideas of cosmology have any claim to be treated as an independent branch of learning. It has been asserted, for example, that Islam is entirely indebted to Greece for its scientific knowledge of the cosmos, in so far as Islamic learning on the subject was derived from Greek ideas which found their way to the early Islamic scholastic centres in Damascus and Baghdad. At the same time it has been alleged that orthodox Islam has never hesitated to reject those doctrines that were incompatible with the spirit and law of the Koran, and that in consequence the cosmological ideas derived from Greece were to remain strange.[1] Such arguments appear difficult to refute, but they do not tell the whole story. They largely ignore the contribution which Islamic scholars have made to the ancient Greek scientific heritage and hence to the establishment of the modern view of the universe. They ignore, too, the fact that Greek cosmological conceptions were not so antagonistic to Islam as to make their integration into theological doctrine impossible.

Some pseudo-theological arguments are not strictly relevant to the issue at all. Their aim was to analyse the Koranic cosmos in such a way as to prove that it must have 'borrowed' much of its content from Jewish and Christian scriptural sources. We have here, therefore, an argument based on literary rather than doctrinal considerations. It has to be borne in mind that the

Koran, as the central core of Islamic religion, must be unique; to reject its distinct character would mean to reject the existence of the Islamic religion. Each religion must carry its own particular *Weltbild*, not least Islam. The religious cosmology of Islam is therefore inseparable from the revelation of the Koran and consequently is 'Islamic'.

With these short introductory remarks let us look now at the particular circumstances under which cosmological doctrine in Islam developed. It was determined on the one hand by the state of knowledge of the physical universe among the medieval Muslims. This was based mainly on Aristotelian and Ptolemaic theories filtered through Neoplatonism and Hermetism, and often enriched with Iranian gnostic elements. On the other hand, Koranic revelation and prophetic tradition presented distinct views about the cosmos and, even more important, provided the metaphysical basis for the integration into Islam of Greek doctrine about nature. Thus, by means of a synthesis of these two components, Greek heritage and Islamic revelation, Islamic cosmology was formed and elaborated into a system in its own right.

Perhaps because the quantitative outlook of modern scientific thought has tended to stress the physical component of cosmology more than the metaphysical, the Islamic contribution to cosmological science has been undervalued. So in order to study the proper status of Islamic cosmology it is advisable to reverse the usual order, that is to say, to consider first the Koran and the prophetic traditions (*ḥadīth*). This procedure is in fact more correct in both the logical and the historical sense, for it was not before the second century of Islam (eighth–ninth century AD) that the Muslims began to be acquainted with ancient Greek scientific and philosophical thought.[2] Let us therefore investigate the contribution of the Koran to cosmological thought, taking care to distinguish the metaphysical principles set in the Sacred Book from actual cosmographical facts.

The foremost principle has been given its most elaborate

and at the same time simplest expression in the first part of the *shahāda*, the Muslim proclamation of faith, *Lā ilāha illā Allāh*, 'there is no god but God'. Here we have in the Arabic language a clear expression of the absolute uniqueness of God, *aḥadiya*. This one God has created the heavens and the earth 'and all that is between them', a standing expression for the whole universe. Strict monotheism thus leads to another principle which was to become even more important in the development of cosmological doctrine in Islam: the principle of the essential unity, *waḥda*, of all existing beings through their common origin in a single source which is at the same time a common entelechy. We shall consider the full implications of this principle at a later stage, when we come to the metaphysics of Islamic cosmology.

A further important metaphysical principle laid down in the Koran is the special position it accords to man in the cosmos. Through his knowledge of all the Divine names, or aspects, regarded as the key to the knowledge of Nature, man has gained superiority over all other terrestrial beings and even in a certain sense over the angels. The second chapter (*sūra*) of the Koran contains the famous encounter between God and the angels concerning Adam, the first man:

'And when thy Lord said to the angels, "I am setting in the earth a viceroy". They said, "What, wilt Thou set therein one who will do corruption there, and shed blood, while we proclaim Thy praise and call Thee Holy?" He said, "Assuredly I know that which you know not." And He taught Adam the names, all of them; then He presented them unto the angels and said, "Now tell Me the names of these, if you speak truly". They said, "Glory be to Thee! We know not save what Thou hast taught us. Surely Thou art the All-knowing, the All-wise." He said, "Adam, tell them their names". And when he had told them their names He said, "Did I not tell you I know the unseen things of the heavens and earth? And I know what things you reveal, and what you were hiding." And when we said to the angels, "Bow yourselves to Adam"; so they bowed

themselves, save Iblis; he refused, and waxed proud, and so he became one of the unbelievers'.[3]

The theories about the relation between the universe or macrocosm on the one hand and man or the microcosm on the other, as expounded by such eminent Islamic thinkers as the Ikhwān al-Ṣafā, Ibn Sīnā (Avicenna), 'Umar Khayyām, al-Ghazālī, and Ibn al-'Arabī,[4] to name but a few, can, it is true, be traced to Neo-Platonic sources.[5] The doctrines in their final form, however, supported as they were by passages from the Koran and the Ḥadīth, are certainly distinctively Islamic, since such an anthropocentric perspective is a characteristic feature of Islamic metaphysics.

To return to the Koran and its cosmological elements: the picture of the universe and its creation emerges from several scattered verses, but these rather obscure remarks together do not produce a very concise description of the cosmos. In fact, their ambiguity and occasional inconsistency gave rise to many different, even contradictory, interpretations, particularly with reference to the act of creation. Certainly, it was God who created the earth and the heavens; but whether this was a *creatio ex nihilo* or out of a primary matter, or how this primary matter came into being and what its nature was, were subject to numerous theological as well as philological disputes, in particular between the *Mutakallimūna* or apologetic theologians, and the *Falāsifa*, or peripatetic philosophers. We cannot dilate here on these problems since it would lead to a discussion of God's nature, the nature of beings, and the problem of time and causality.[6]

From the Koranic text it appears there that God created everything,[7] that in fact 'He is the first and the last';[8] that God's throne was above the water,[9] that heaven and earth were originally one solid mass, that God separated this mass, and that He created the heavens and the earth in six days[10] whereby the heavens were created out of smoke;[11] that He placed the mountains on the earth, and that He fixed the sun, the moon and the stars in the heavens, and created day and night;[12] that He created all living beings from water.[13] On the

seventh day He seated Himself on His throne in order to rule over what He had created: 'He it is Who holds the heavens so that they do not fall on the earth',[14] and 'He it is who preserves heaven and earth from destruction'.[15] 'He directs the affair, He distinguishes the signs'.[16]

It is not difficult to imagine the vast possibilities which these verses offered to those thinkers who were seeking justification on Koranic grounds for their dialectical arguments. Thus it happened that the same verses were used by such orthodox theologians as al-Ash'arī or al-Ghazālī to support their attacks upon the Mu'tazilites, the followers of Greek philosophy, as well as by the Mu'tazilites themselves and by the later mystics who were sometimes viewed with suspicion in orthodox circles. The importance of the Koranic text, not only with regard to all aspects of religious life, law and ethics, but also as a book of symbols, a cosmic cypher containing all the fundamental principles of existence, was realised and expounded by many Muslim authors. As a matter of fact, many of the esoteric practices of the Ṣūfīs and Dervishes employed cosmological symbols ultimately derived from The Book. It may be significant to observe that the Koran itself thus represents a perfect example for the second important principle mentioned above, that is unity, in a sense of the oneness comprising multiplicity.

Now as to the structure of the Universe, other passages in the Koran tell us of seven heavens and seven earths,[17] the latter being interpreted by Muslim cosmographers as the seven traditional climatic zones. In Muslim eschatology, however, these seven earths were identified with the seven strata into which the body of the world is horizontally divided and which are described as the seven mansions of Hell.[18] Above the heavens are situated the pedestal (*kursiyy*) and the throne (*'arsh*) of God.[19] At the demarcation between the seven astronomical spheres, which are those of the planets, and the superior spheres, at the gateway of the heavenly Paradise[20] grows a large tree known as the Lotus-tree of the Boundary.[21] Four rivers spring from its roots; two of them water Paradise, the other two are the earthly Euphrates and Nile.

These heavenly spheres and landscapes are populated by hosts of angels, the highest amongst them being the Cherubim. Islamic angelology, firmly rooted in the Koran, was later to develop under Iranian influence into an important branch of esoteric disciplines, with a strong impact on cosmological doctrine.[22] But already early Islamic tradition and legend based on episodes in the Koran are rich in descriptions of the world of angels. Collection and compilation of these texts was started at a very early stage, within a century of Muḥammad's death in 642 AD. They reflect the exuberantly colourful imagination of the pious Muslim. A brief discussion of one example which is the most significant as regards its cosmological contents will illustrate this.

Mention is made in the Koran of the Prophet Muḥammad's night journey (*isrā'*) from Mecca to Jerusalem and his subsequent ascent (*mi'rādj*) under the guidance of the archangel Gabriel through the heavens to the Throne of God, where the mysteries of Divinity were revealed to him. This story is only briefly referred to in the Koran in a single verse.[23] But pious Islamic imagination has elaborated this verse into long narratives containing a wealth of popular beliefs about cosmology and geography. In later centuries, particularly in Persian and Turkish literature, narratives and poetic cycles on the *mi'rādj* became a kind of literary genre, the *mi'rādjnāma*. In this process the heavenly regions of the Islamic cosmos were furnished with new details, partly of Manichaean and Central Asiatic origin, of which one of the finest examples is undoubtedly the *Mi'rādjnāma* of the illustrious Persian poet Abd al-Raḥmān Djāmī which is contained in the first book of his work *Silsilat al-Dhahab*.

The original story of the *mi'rādj* has come down to us in three main versions, two early and one later, probably of Persian origin. A full critical discussion of them has been given by Miguel Asìn Palacios.[24] What interests us here are the descriptions of the various stages of this journey through the cosmos. Here astronomy and popular Muslim eschatology are firmly linked together.

Ten is the usual figure given for the stages of the ascent. The first seven stages correspond to the seven astronomical heavens. At the gate of each the travellers, Muḥammad and the archangel Gabriel, are met by a guardian angel who welcomes them after having learned who they are. In each heaven Muḥammad is greeted by one or two prophets dwelling in that particular sphere. The most frequent order in which they appear is Adam, Jesus and John, Joseph, Idrīs (Enoch), Aaron, Moses, and Abraham. The prophet Abraham is seen leaning against the wall of the temple of the celestial Jerusalem, a replica of the earthly city. Then begins the ascent through the last three heavens. The first is represented by the gigantic 'Lotus-tree of the Boundary', with leaves as large as the ears of an elephant and fruits like jars, the second by the 'Inhabited Place', a Koranic expression for the temple of the celestial Jerusalem,[25] and the third and last by the Throne of God.

There are, however, certain variations in the descriptions of the different stages. In one version, the vision of a gigantic cock is introduced into the first heaven, an element of distinctly Persian origin. The wings of this cock stretch across the horizon and its crest touches the throne of God. The third heaven, with a fiery angel as doorkeeper, sometimes contains a vision of Hell.[26] There are seven levels in Hell, with fiery landscapes, cities and seas. The tortures inflicted in each of them are described with the exaggerated enthusiasm of popular religious imagination.

We similarly find descriptions of the heavenly Paradise inserted after the stage of the 'Lotus-tree of the Boundary'. Here also are seven subdivisions, with mountains and valleys and seas: the seas of light, darkness, fire, water, pearls, and snow. Unlike those versions that do not contain a full description of Paradise and that describe the theological heavens i.e. the last three, as being completely devoid of angels or human beings, these accounts of Paradise are regularly interrupted with chapters on the angelic populations dwelling in them, praising their indescribable beauties and splendours in words which stretch the expressive power of Oriental

languages to the limit. In later versions we find celestial animals also introduced into the legend, such as the heavenly serpent that curls around the throne of God. Another later introduction is that of the heavenly beast, *Burāḳ*, which carries the prophet Muḥammad on his ascent. This feature must have been particularly popular, as we find it depicted on most of the miniature paintings of the ascent.[27]

Looking back on the structure of the legend, with its seven astronomical heavens, its seven levels of Hell, its seven mansions of the celestial Paradise, and its three stages of the theological heaven, we will recognise their correspondence with certain verses in the Koran, for example: 'Seven are the astronomical heavens and seven the earths, as are seven the seas, the gates of hell and the mansions of Paradise',[28] and other verses referring to the Lotus-tree, the Pedestal and the Throne.[29]

We can foresee the lines on which a legend so rich in vision was certain to develop. This was a shift to a purely allegorical meaning, the ascent being applied to other realities, spiritual or physical, and the images being taken to be mere symbols for intellectual experiences. The natural universe was now conceived as a simulacrum, a reflection of the hierarchy of being emanating from and reverting to its First Principle. Amongst the many authors of such spiritual *mi'rādjnāmas* we may find famous names like Ibn Sīnā, Suhrawardī of Aleppo, Ibn al-'Arabī, and al-Ma 'arrī.[30] We will return to this point later in connection with the cosmic function of man.

We have so far investigated the cosmological principles in the Koran, the few but significant details referring to the cosmogony and the structure of the universe, with examples of their use in Muslim eschatology. It remains for us now to show how the cosmos, as viewed by Islamic astronomical science, itself based on the Greek heritage, was able to preserve its identity as Islamic and Koranic.

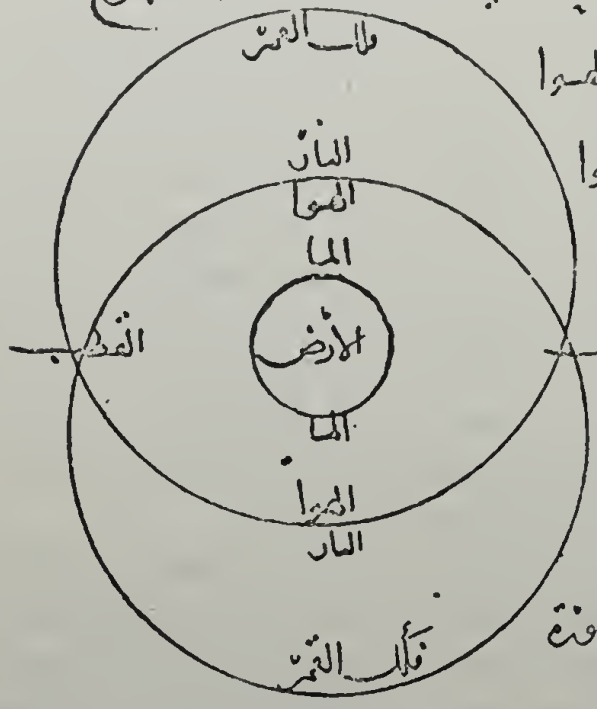
This cosmos was conceived as a spherical entity, comparable in structure to an onion, with the earth at the centre. The part nearest to the centre is the sublunary region, which consists of

the surface of the earth and the zone above it up to the lower boundary of the sphere of the moon. This region is referred to as the world of generation and corruption, the house of the 'Three Kingdoms' (*malakūt*)of natural objects, minerals, plants and animals. These are composed, in varying degrees of perfection, of the four elements, fire, air, water and earth,[31] and contain two of the four fundamental qualities, heat, cold, dryness and moisture. The four elements were often termed 'mothers' (*ummahāt*) by Muslim cosmologists. Those scholars who were following the Aristotelian Peripatetic doctrines, al-Kindī, al-Bīrūnī and Ibn Rushd (Averroes), for example, held that only the sublunary region was composed of the four elements; the celestial spheres and bodies were of a different substance, known as ether (*athīr*), and not subject to generation and corruption. Al-Bīrūnī furthermore maintained that the substance of the spheres was crystalline.[32] Despite the difference in substance assumed by the Peripatetics, both the heavenly spheres and the sublunary region were believed to possess the four fundamental qualities.

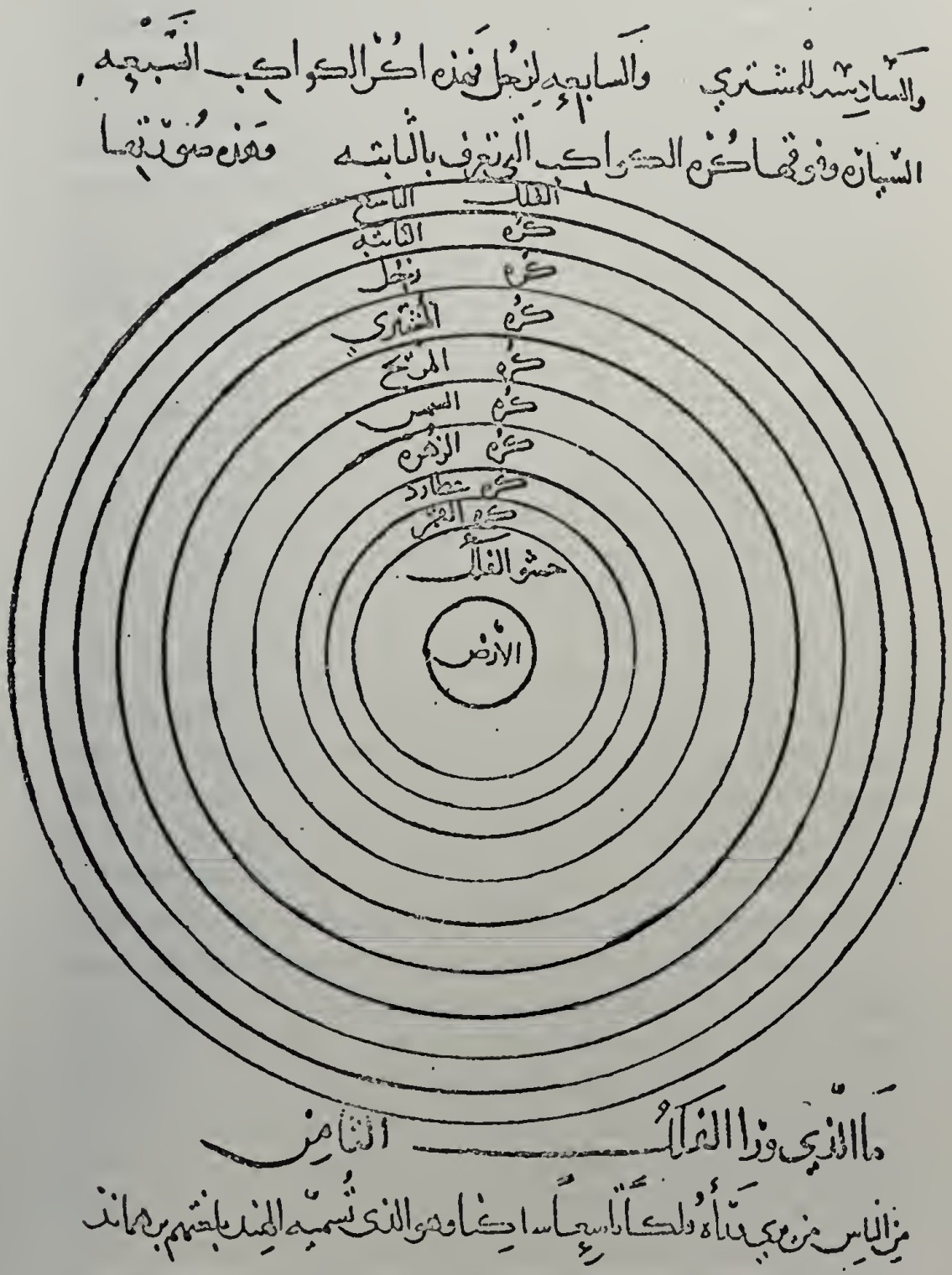
Other scholars, more inclined towards Hermetic tradition, believed the heavenly spheres to be composed of the same four elements as the sublunary region. Suhrawardī of Aleppo, for example, went so far as to abandon the Aristotelian distinction between the sublunary world and the celestial regions, proposing instead a new boundary at the sphere of the fixed stars, at the point where the region of pure light is divided from the world where light is mixed with darkness, or matter, in varying degrees.[33]

Whatever the connections were, their impact on the development of Islamic scientific astrology was enormous. The relation between microcosm and macrocosm was one of the subjects dealt with by Islamic philosophers and scientists, and astrology was only one aspect of it.

The sphere nearest to the earth is that of the moon. Because of its special position, the lunar sphere was seen as a kind of intermediary between the sublunary region and the celestial spheres, exerting an important influence on the world of



10. The natural location of the four elements in the sublunary region. In the centre lies the globe of the element earth, because heavy masses gravitate towards the centre. On the surface of the earth lies water, less heavy than earth. Surrounding the globe and extending to the sphere of the moon is the element air, which, by its friction with the movement of the lunar sphere produces fire. This is less concentrated round the poles owing to the slower movement there. (Reproduced from *The Book of Instruction in the Elements of the Art of Astrology*, by al-Bīrūnī, British Museum, Ms. Or. 8349.)



11. The structure of the Universe. Basically this follows Ptolemy, with the addition of the ninth sphere (from British Museum Ms. Or. 8349.)

elements and natural phenomena. We may quote al-Ḳazwīnī's *Cosmography* here. This treatise contains a detailed description of the various phenomena which were believed to be influenced by the moon. Apart from features based on scientific observation descriptions like this were usually rich in reference to popular beliefs as well.[34] Furthermore, the twenty-eight mansions of the moon were taken as the basis for various systems of numerical symbols, the aim of which was to show that the lunar sphere synthesised the qualities of all the other celestial spheres and transferred their influences to the sublunary world of elements.[35]

Above the sphere of the moon (*falak al-ḳamar*) are the spheres of Mercury (*falak al-ʿaṭārid*) and Venus (*falak al-ẓuhra*). The sphere of the Sun (*falak al-shams*) holds the central position amongst the seven planetary spheres. For this reason the Sun is sometimes referred to as Centre of the Universe. This does not, however, imply heliocentricity in any astronomical sense. Rather, the Sun's natural function as a source of light gave rise to solar symbolism employed at a spiritual level. Here the Sun represents the Active Intellect (*al-aḳl al-fa "āl*), illuminating the forms which exist in the imagination.[36] The last three planetary spheres are those of Mars (*al-Mirrīkh*), Jupiter (*al-Mushtarī*) and Saturn (*al-Zuhāl*). Then comes the eighth sphere, the sphere of the Fixed Stars (*falak al-burūdj*), which is divided into the twelve mansions of the Zodiacal signs. So far the structure of the universe conforms to the Aristotelian and Ptolemaic pattern, but a ninth sphere was added by the Muslim astronomer Thābiṭ ibn Ḳurra, a Sabaean by origin, who considered this sphere necessary in order to explain what he believed to be the trepidation of the equinoxes.[37] The majority of Muslim astronomers after him, with a few exceptions like al-Bīrūnī, and Ibn Rushd, who was an ardent defender of the theories of Aristotle, adopted this notion of a ninth sphere. It was usually referred to as the Sphere of Spheres (*falak al-aflāk*), or Englobing Sphere (*al-falak al-muḥīṭ*), and was believed to be starless.

The mutual influences of the heavenly spheres was the

subject of various studies undertaken by Muslim astronomers, physicists and mathematicians. Whatever their observations, it must be repeated that the ultimate purpose of these treatises was to study these phenomena in terms of their relation to their primary source. A quotation from the *Taṣawwurāt* of the great Persian astronomer Naṣīr al-Dīn Ṭūsī reveals this attitude in discussing

> 'the force of the creative act which, through the process of creation, reached the Throne of God, from the Throne reached the Pedestal, and, from the Pedestal again, descended to the sphere of Saturn and became attached to it. Again, it descended further, from one sphere to the other, until it reached the sphere of the Moon. Then the exhalations and rays of the stars, by the force of that energy and through the mediation of the sphere of the Moon, fell upon the elements. This was certainly the cause which stirred the elements (that they would begin to mix with each other).'[38]

In Greek cosmology the movements of the planets and the spheres were usually thought to be circular.[39] Naturally, the results achieved through individual observation often contradicted this theory, and explanations had to be found in order to 'save the phenomena'. Thus, in his *Syntaxis* which was to become famous in the Latin Middle Ages under its Arabic name, *Almagest* (*Kitāb al-Madjisṭī*), Ptolemy introduced the notion of the epicycles and eccentrics of the planets. This was to account for the irregularities of the routes of the planets within their spheres. Arab scientists eagerly adopted this theory, and proceeded to develop and elaborate it. Al-Farghanī, al-Baṭṭanī, and Abdurraḥmān al-Ṣūfī, to name only a few, made valiant efforts to correct the theories in the Almagest regarding spherical motions and the distances and measurements of the planets. Ibn al-Ḥaitham composed his famous treatise 'On the Structure of the Universe' (*Fī hay'at al-'Ālam*), which was strongly influenced by the pseudo-Ptolemaic treatise *Hypotheseis*.[40] He studied the motions of each planet, with its eccentrics and epicycles, but with the Aristotelian assumption of

homocentric orbs. As a physicist he concerned himself at length with the question of the substances of the spheres. The theory of solid spheres, known to the Greeks before Ptolemy, was adopted by Ibn al-Ḥaitham mainly as a result of his belief in the physical impossibility of a vacuum. On the other hand, scholars like al-Farghánī and al-Battānī, who were astronomers and mathematicians rather than physicists, regarded the spheres as merely mathematical entities.

Generally speaking, the aims and criticisms of Muslim astronomers were mainly directed towards the improvement and further elaboration of the Ptolemaic system. In fact, however, these endeavours led to the final destruction of the system and, in conjunction with the general dissatisfaction felt about it, paved the way for the Copernican revolution.

The most rigorous criticism of Ptolemy was brought by the Islamic Peripatetics, who sought to revive the Aristotelian theory of homocentric spheres which Ptolemy had superseded. In Spain, the Islamic West in particular, a scholastic tradition of criticism of the Almagest arose, starting with Ibn Badjdja (Avempace).[41] Under his influence, the astronomer Djābir ibn Aflākh composed the famous treatise on 'The Rectification of the Almagest' (*Iṣlāḥ al-Madjisṭī*). A little later the philosopher Ibn Ṭufayl (Abubacer) encouraged his disciple al-Biṭrūdjī (Alpetragius) in his criticism, which was then expounded in the polemical 'Treatise on Astronomy' (*Kitāb al-Hay'a*). This revived the theory of homocentric spheres and at the same time introduced a theory of the spiral motion of the spheres and of the trepidation of the equinoxes. This, already anticipated by Thābiṭ iḅn Ḳurra three centuries before, was essentially wrong. Nevertheless, al-Biṭrūdjī's merit must not be undervalued since it was his ideas which had brought a heavy attack against the Ptolemaic system. In the Latin Middle Ages al-Biṭrūdjī's doctrines were praised as a new astronomy and thus were without doubt indirectly responsible for later developments.

We may add that although the cosmic system as conceived

by Islamic scientists was based on the assumption of the circular motion of the spheres, the possibility of a motion other than circular was considered. Al-Bīrūnī, in his correspondence with Ibn Sīnā, discussed on one occasion the Aristotelian thesis that an elliptical or lentil-shaped revolution needs a vacuum in order to make its movement possible while a circular revolution requires no such vacuum. As far as the physical aspect of this thesis was concerned, al-Bīrūnī did not object. However, from a strictly logical point of view an elliptical or lentil-shaped revolution appeared to al-Bīrūnī perfectly possible without need of a vacuum.[42] He continued: 'I am not saying that I believe the shape of the great heavens is not spherical but elliptical or lentil-shaped. I have made numerous studies to reject this view, but I do wonder at the logicians (that they were unaware of the possibility of such a motion)!'[43]

One thing has emerged clearly from the preceding paragraphs: the main anxiety felt by Muslim astronomers about Ptolemaic theories were with regard to the motion of the spheres and the form of the planetary motions within their spheres. Improved methods of scientific observation and new discoveries, together with the high standards of Arabic trigonometry, fostered the objections made against the Almagest. But the real reason for the dilemma, the essentially erroneous conception of the basic structure of the universe itself, was to remain virtually uncorrected by Muslim scientists. Although, as we have seen, many of Ptolemy's theories were at times strongly criticised, some of his doctrines being proved false, others being corrected or improved, and still others being felt intuitively to be wrong without a better solution being proposed, the general pattern of the geocentric universe was more or less accepted by Islamic astronomers.

Various opinions have quite often been formed in retrospect to account for the apparent stagnation in Islamic scientific thought about the cosmos. The cultural decline of the Islamic world during the political disturbances from the thirteenth century onwards, the growing unpopularity of Peripatetic

rational philosophy in conjunction with the increasing inclination towards mysticism, an exuberant religiosity, a swing from exoteric to esoteric speculation, a triumph of *ḥikma* (sapientia) over *'ilm* (scientia) – these were some of the factors which have been held responsible for the failure of the Muslims to change the medieval picture of the universe. Certainly these factors have contributed in one way or another. But the real problem is not simply a historical one, nor is it religious. The doctrines of Islam and the cosmographical features in the Koran would have produced no essential obstacle to the concept of a heliocentric system, as these principles were metaphysical, and the given facts were vague enough to allow for more than one interpretation.

A quotation from al-Bīrūnī, who was probably the most gifted natural scientist of the Islamic Middle Ages, may help to throw some light on this question. When examining an astrolabe constructed by the astronomer Abū Sa 'īd Sidjzī and based on the heliocentric system, al-Bīrūnī remarked on 'the idea entertained by some that the motion we see is due to the earth's movement and not to that of the sky. By my life it is a problem difficult to solve or refute . . . It is the same whether you assume that the earth is in motion or the sky. In neither case does it affect the astronomical sciences. It is for the physicist to see if it is possible to refute it.'[44] This means that al-Bīruni was fully aware of the fact that heliocentricity and its implications were a matter of physics, and that, in order to assess its significance for astronomical theory, the physical possibilities had to be investigated first. After life-long studies, al-Bīrūnī himself came to a negative conclusion as to the possibility of heliocentricity: he was not able to verify its physics. A few other Islamic scholars, notably Ibn Rushd, toyed with the idea as well, but it invariably remained for them merely a hypothesis. It would be rash to conclude from this that Islamic physicists were deficient in ability, and indeed any historical account of the achievements of Muslim scholars in the natural sciences would seem to reduce any such idea to absurdity.

What thus appears to present a discrepancy may perhaps be

clarified by examining the Islamic study of physics in its relation to metaphysics. For Muslim scholars the realm of physical bodies, their qualities and behaviour, has always been secondary to and derivative from the plane of archetypes, or Platonic ideas reflecting the Divine qualities. In other words, physical phenomena were not studied as objects in their own right, but only in their function as corporal, quantitative offshoots of qualitative realities. A glance at any of the Arabic scientific compendia reveals the same pattern. Metaphysics comes first, serving both as point of departure and of return, or, in Arabic terms, *mabdā* and *ma ʿād*. Physical objects are the last link in the ontological chain of being, the plane of greatest variety and multiplicity. Thus the aim of Muslim physicists in studying natural phenomena was to establish the link between them and their archetypes in order to trace them back to their common single source.

The question of heliocentrism or geocentrism thus became a matter of intellectual speculation, but it was never in Islam one of fundamental importance with regard to theories about the universe. Hence we cannot attribute the failure of Muslim physicists to solve the problem of heliocentricity to any lack of intellect or creative imagination. It was a matter of perspective, of what was considered to be important. In any case, although the Muslims certainly made remarkable discoveries in the field of physics, it was in the field of the Quadrivium, the sciences deriving from mathematics, that Islamic scholarship proved itself most brilliant.

We must therefore glance briefly at the Muslim attitude towards mathematics, of which astronomy was a branch and which therefore affected Islamic cosmological doctrines. The science of numbers and geometrical figures was studied by the Muslims in the Pythagorean manner, that is to say in their qualitative and symbolic, as well as their quantitative and numerical, aspects. This means that each number and each geometrical figure was considered in relation to its metaphysical basis. The various series of numbers starting from the source, which is the number one, the variety of geometrical

figures built up from the point, whereby their essential connection with the number one was always maintained, offered a perfect symbolic system for the understanding of the metaphysical principle of unity in multiplicity. This principle was also a cosmic one. A few quotations from some of the most eminent Islamic thinkers will illustrate this. According to the *Ikhwān al-Ṣafā*, the science of numbers is 'the first support of the Soul by the Intellect, and the generous effusion of the Intellect upon the Soul.'[45] 'Umar Khayyām stated that 'the number necessarily embraces everything'.[46] Particularly relevant is al-Fārābī's remark that 'it is characteristic of this science of numbers and magnitudes that its directives are identical with the principles of being.'[47]

This passage is important in so far as the principles of being are the object of the discussion that follows. Cosmology is necessarily closely linked with ontology, and ontology in Islam is concerned with the study of the hierarchy of beings descending or emanating from the one Being. In order to make this chain of beings in its relation to Being intelligible, Islamic scholars established systems of symbols mainly drawn from the science of numbers and from cosmology. Thus seen, the cosmos of corporal forms became the stage, or the surface of a mirror where the permanent archetypes, the ideas behind all natural objects, were present, or reflected, in their variety of forms, spiritual or corporal. These archetypes, however, are ultimately seen as aspects of the one Being. This Being has been referred to by various names, such as God, the First Principle, the First Cause, or the Prime Mover; and, depending on the philosophical system, one of these expressions was used for denoting Being in its most abstract sense.

Earlier in this paper we dealt with the act of creation, with the historical event of the generation of the Universe. From an ontological point of view, this universe was generated through Divine self-manifestation by means of a gradual concretisation and differentiation of Being through several stages, the lowest[48] of which was the realm of natural objects composed of the four elements. This process was frequently referred to by Arab

writers as *tadjallī*, a term usually translated 'emanation'. The basic idea of this was that Being, in its highest and most abstract sense, is completely void of any attributes and qualities; it can only be defined in terms of itself: it *is*. In order to make intelligible the essential relation between this abstract Divine Essence and the multiplicity of beings in their infinite variety of forms – a relation which can be ultimately realised as an essential unity – a system was elaborated of descending stages of existence, or 'presences' (*ḥaḍarāt*) of Being. At each stage Being manifests itself in a certain degree of differentiation; it is 'present', that is to say, in the particular forms which constitute the hierarchy of beings.

Muslim writers usually postulated five, sometimes six, stages of Being. The first and highest is the stage of the Divine Essence or *ḥaḍrat al-dhāt*, Being in its unspecified oneness and absolute transcendence. This stage is therefore also named *Hāhūt*, which means Selfhood. In more esoteric language, we may further come across the name World of the Absolute Mystery, *'ālam al-ghayb al-muṭlaḳ*. From this stage the process of the self-manifestation of the Divine essence starts, first reaching the second stage which is called Presence of Divinity (*ḥaḍrat al-ulūhiyya*), and represents the stage of Divine Names, that is to say the attributes and qualities of Divinity. This stage is sometimes also referred to as *lāhūt*, meaning that at this level of existence the Divine essence manifests itself through its own qualities. All the intelligible beings which constitute the remaining stages of the hierarchy are nothing but derivatives of these archetypal Divine names, in essence undifferentiated from them. This is why the second stage became associated with the Universal Intellect, *al-aḳl al-kulliy*. From this the individual intelligence emanate, thus forming the third stage, that of the *djabarūt*. These intelligences are the direct agents, the executive forces of the Divine command, and this stage is therefore referred to as Presence of the Masterhood, *ḥaḍrat al-rubūbiyya*. The angelic substances are usually identified with the intelligences, which signifies the ontological position of the angels.

The fourth stage is established as an intermediary – or isthmus – (*barzakh*) between the pure intelligences of the angelic world and the realm of material objects. The soul and its faculty of producing images (*mithāl*) through imagination (*khayāl*) constitute this stage of existence. It is characterised by individual forms and figures of subtle, incorruptible matter. Here are reflected, as in a mirror, the realities which belong to the higher planes of existence, appearing in shapes similar to those of the material bodies. Since they do not possess corporality however, they cannot be perceived through the natural senses. They can only be experienced through that particular 'sense' of the soul, the imagination which forms the link between the spiritual and physical worlds. This realisation of the ultimately symbolic nature of natural forms in all their infinite varieties, and the discovery of their inner meaning makes it possible for the human mind to understand realities which are completely beyond physical existence. This plane of existence greatly interested Islamic mystical philosophers, particularly from Suhrawardī onwards.

The fifth and final plane is that of sensible experience, *mushāhada*, comprising the world of composite bodies including mankind, *nāsūt*. The prototype of man, known as the First Man, *al-insān al-awwal*, or Perfect Man, *al-insān al-kāmil*, or simply Adam, used to be given a separate and superior position in the hierarchy of beings. This was the sixth plane, mentioned above, in which all other planes of existence were thought to be contained. This idea of a human ontological prototype can be traced back without difficulty to Neo-Platonic sources, in particular to the Hermetic texts and to the so-called Theology of Aristotle, a summary of Plotinus's Sixth Ennead. In Islam, however, from al-Ghazālī onwards, and later particularly in the Shi'ite gnosis, Perfect Man emerged as a cosmic principle of paramount importance. In his function as a microcosm he was seen as the inner aspect of the whole creation, unity and variety combined in one being, and therefore the most noble and perfect representative of the Highest Being Itself.

After this first consideration of the structure of existence,

with its various ontological strata, it remains to study the means by which this system of existences actually worked. This may be described as a continuous process of intellection in conjunction with an interplay of active and passive capacities. It would take a whole book to do justice to all the Muslim writers who have discussed this subject, but I may confine myself here to one scholar of the later Islamic Middle Ages: Naṣīr al-Dīn Tūsī, the philosopher, scientist and founder of the so-called Maragha School,[49] Islamic cosmologist *par excellence*, of particular significance for the final trends in Islamic philosophical and scientific thought. The battle between Peripatetic and non-Peripatetic doctrines, which had raged during the centuries before him, was finally moving towards the victory of the latter, and Naṣīr al-Dīn was one of the foremost figures in this tendency. Al-Fārābī, Ibn Sīnā, 'Umar Khayyām, al-Ghazalī, Ibn al-'Arabī, and many others, all of them dealt with the process of intellection fully in their writings. This was the background against which Naṣīr al-Dīn worked. Consequently, in his treatise *al-Taṣawwurāt* we find this subject expounded with particular clarity.

This is the scheme: God, Who is the source of all existence, became conscious of Himself as a Creator. The Divine will to create necessarily demanded the existence of a created object. This created object had to be a unified entity, as it was created directly, and without intermediary, by the Divine will and according to the principle that one can only produce one. This creation was the First Intellect, *al-aḳl al-awwal*, a unified whole which conceived the ideas of all spiritual and material beings below it. Three modes of cognition were effected by the First Intellect, thus bringing about three other kinds of existence. By reflection on its own cause – that is, the Divine will – the First Intellect brought about the existence of the Second Intellect, which is associated with the sphere of the Fixed Stars. Next, the reflection of the First Intellect on its own substance, as being necessary with regard to God's consciousness as a creator, produced the Universal Soul, which is the soul of that sphere of the Fixed Stars. Thirdly, in reflection

on its own substance as a matter of possible existence, the First Intellect became the cause of the existence of the substance of the Zodiacal sphere itself. The body of this sphere was then created by means of a double cognition of the Universal Soul. Its reflection on the substance of the First Intellect, realising the perfection of this substance, brought into existence the form of the sphere; and, in thinking of its own substance, the Universal Soul realised its imperfection and with this brought the matter of this sphere into being. This process was continued in exactly the same way: the Second Intellect caused the existence of the Third Intellect, the soul and the substance of the Sphere of Saturn (*ẓuhāl*), whereby its body was again generated by the twofold reflection of the soul of this sphere, and so on. Finally, the Ninth Intellect, belonging to the sphere of the moon, produced the Tenth Intellect, which governs the world of the elements and natural objects. The Ninth Intellect is also referred to as 'Active Intellect', *al-al aḳl-fa "āl*, and holds a special position in so far as it is the one that acts directly on the world of elements, bringing them from potentiality to actuality.

The following three features are characteristic of this cosmology of intelligences: 1. To each sphere an intellect is attached which brings into existence the intellect, the soul and the substance of the sphere below it. 2. Each sphere thus contains the principle of the one below it. 3. Intellect and Soul are the moving agents of the spheres.

Let us look more closely at this third feature. Although both intellect and soul are moving forces their functions must not be identified. Naṣīr al-Dīn explained their relation with great clarity:

> 'Each sphere was provided with a soul and an Intellect as the controller of the latter. This was done in order that each sphere should possess an independent and a direct moving agent. This independent moving agent was the Intellect and the direct moving force was the soul. This may be compared, for example, with a magnet, which itself does not move but

which brings iron into motion and attracts it to itself. And the 'direct mover' is like, for example, the wind which whirls round a tree and shakes it.'[50]

For the majority of Muslim authors this intellect-soul relation was that of a pair of opposites, whereby the Intellect became the active principle and the soul the passive. In further analogy the Intellect emerged as the masculine factor and the soul as the feminine. Another system of symbols, the roots of which were to be found in Hermetic texts, was mainly employed by Islamic mystics like Ibn-al-'Arabī. The Intellect became identified with the Divine Breath that stirs the soul to motion, which the soul in turn transmits to its proper sphere.[51]

This dualism was further developed by the theory of alchemy. According to this spiritual alchemy the traditional basic substances, sulphur and mercury, were identified with the active and the passive principle, masculine and feminine, spirit and soul, Divine Act and Universal Nature. The motor which operates this system of cosmic polarities, which all ultimately represent the same cosmic principle at different levels of modality, is their sympathetic attitude towards each other. Sympathy between two contrasting terms leads to synthesis which generates another pair of opposites at a different level. This process is not, however, carried on infinitely, but finds its end and culmination in a being, which holds a markedly distinct position within the whole universe: Man.

The concept of Universal Man as a microcosm is not an invention of the Muslim philosophers. It was the current view amongst the Neo-Platonists and appears also in the *Corpus Hermeticum*.[52] Islamic philosophical and scientific thought, with its clearly anthropocentric orientation, was thus well prepared to assimilate and incorporate such kind of doctrine.

Within the ontological chain of being, man occupies the last stage. It has been said already that the stages of existence were arranged according to increasing degrees of multiplicity. The level of greatest multiplicity is at the same time the lowest, that of man. This accounts for man's unique position. In his

reality all the cosmic principles are combined in a perfect synthesis. Because of this, his knowledge is superior to the knowledge of every other being. This has led to the concept of Perfect Man (*al-insān al-kāmil*). He reflects the totality of the cosmos, and, since the cosmos is a manifestation of God's attributes, Man in his cosmic function is the most perfect representation of the Divine Reality. Man is to God like a mirror in which He can contemplate His own qualities. With Man, the creation is unified and traced back to its common single source, back from multiplicity to the unity of the Divine Being. When man becomes aware of his twofold nature, of that outer aspect which connects him with the world of material bodies, and the inner aspect, the reflection of the Divine Being, this process of gradual realisation constitutes his spiritual *mi 'rādj*.

'Abdul Karīm Djīlī, a well-known disciple of Ibn al-'Arabī, in his treatise on Perfect Man tells us: 'Know that Universal Man bears within himself correspondences with all the realities of existence. He corresponds to the superior realities by his subtle nature, and to the inferior realities by his gross nature.'[53]

This particular cosmic view, which is expounded in a masterly way by important Muslim philosophers, proves the original character of Muslim scientific speculation, and offers a noteworthy model of the universe.

Notes

1. On the transmission of scientific sources from Greek into Arabic, and hence into Latin, see R. Walzer, 'Greek into Arabic, Essays on Islamic Philosophy', *Oriental Studies* I (Oxford, 1962); F. E. Peters, 'Aristotle and the Arabs; The Aristotelian Tradition in Islam,' *Studies in Near Eastern Civilisation* I (New York, 1968); L. Gardet, 'Le Problème de la 'philosophie musulmane'', *Mélanges offerts à Etienne Gilson* (Paris, 1959).

2. See W. Montgomery Watt, *Islamic Philosophy and Theology*,

Edinburgh 1962, pp. 37–48; M. Meyerhof, 'Von Alexandrien nach Bagdad', *Sitzungsberichte der Preuss. Akad. der Wissenschaften*, Phil.-hist. Klasse (Berlin, 1930), 389–429.

3. Koran 2, 29–33, in Arberry's translation.

4. Ikhwān al-Ṣafā, *Rasā' il*, Beirut 1957, II, 23–6, 456–73. Ibn Sīnā, *Risāla fi 'l-'ishk*, tr. E. L. Fackenheim, *Medieval Studies*, Toronto, VII (1945), 208–28.

'Umar Khayyām, *Raudhat al-ḳulūb*, tr. A. Christensen ('Un traité de métaphysique de 'Omar Hayyam), Le Monde Oriental, Uppsala, I (1906), 5–13.

Ibn al– 'Arabī, *Futūḥāt al-Makkīya* (Cairo, 1976), II, 373 ff; III, 356 ff.

5. For example, the so-called 'Theology of Aristotle'.

6. C.f. al–Ash 'arī, *Makālāt al-Islāmiyīn wa Ikhtilāf al-Musallīn* H. Ritter (ed) (Istanbul, 1929), I.

7. Koran:2, 17; 6, 102; 12, 26; 16, 38 and others.

8. Koran: 57, 3.

9. Koran: 11, 7.

10. Koran: 21, 30; 50, 34.

11. Koran: 41, 9–12.

12. Koran: 25, 61–2; 50, 5–6; 40, 26; 17, 12.

13. Koran: 21, 30.

14. Koran: 22, 64.

15. Koran: 35, 65.

16. Koran: 13, 2.

17. Koran: 65, 12; 78, 12.

18. See al–Thaālabī, *Ḳiṣāṣ* 4.

19. Koran: 2, 55.

20. As distinguished from the earthly Paradise, the Garden of Eden.

21. Koran: 53, 14.

22. See H. Corbin: 'Épiphanie divine et naissance spirituelle dans la Gnose ismaèlienne', *Eranos Jahrbuch*, XXIII (1954), pp. 141–250; H. Corbin: 'Les motifs zoroastriens dans la philosophie de Sohrawardī Shaykh-ol-Ishraq', *Publications de la Société d'Iranologie*, No. 3, Teheran; S. H. Nasr, *Three Muslim Sages: Avicenna, Suhrawardi, Ibn Arabi* (Cambridge, Mass.), 1964, 70–4.

23. Koran: 17, 1.

24. Miguel Asín Palacios, *La Escatalogia Musulmana en la Divina Comedia* (Madrid, 1919).

25. Koran: 52, 4.

26. Again, this hell has to be distinguished from the earthly hell mentioned above.

27. See Plate 25. There are also very fine examples in the Bibliothèque Nationale in Paris.

28. Koran: 65, 12.

29. v. *supra*, 8.

30. For Ibn Sīnā cf. H. Corbin, *Avicenna and the Visionary Recitals*, Eng. trans. W. Trask (New York, 1960), 171 ff.

Suhrawardī wrote a *Risāla fi 'l-mi 'rādj*. See further H. Corbin and P. Kraus, 'Le bruissement de l'aile de Gabriel' (trans.), *Journal Asiatique*, Vol. 52 (1935), 1–82.

Ibn al-'Arabī, At Futūhāt al-Makkīya, II, 356–75; III, 447–65.

al-Ma 'arrī, *Risālat al-Ghufrān* (Cairo, 1950).

31. The order in which they appear corresponds to their natural positions, fire being located at the highest part of the sublunary sphere, underneath which comes air, then water, and finally earth, with the highest degree of compactness.

32. Al-Birūnī, *Chronology of Ancient Nations*, trans. E. C. Sachau (London, 1879), 248.

33. See S. H. Nasr, *Science and Civilisation in Islam* (Chicago 1964), 346.

34. For al-Ḳazwīnī, see H. Ethé, *Zakharia ben Muhamman El-Kaẓwinis Kosmographie* (Leipzig, 1868).

35. Ikhwān al-Ṣafā, *Rasā' il*, II, p. 39, and *Risālat al-Djāmi 'a*, Damascus (1949), I, p. 28; T. Burckhardt, 'Clé spirituelle de l'astrologie musulmane d'après Mohyiddin ibn Arabi,' *Etudes Traditionelles* (Paris, 1950).

36. The theory of illumination was developed, particularly by Suhrawardī, into a philosophical doctrine which became of paramount importance in the Islamic East in the later thirteenth and fourteenth centuries, and was known as *al-ḥikmat al-mashriḳīya*.

37. See A. Mieli, *La science arabe* (Leiden, 1938), 87 ff; S. H. Nasr, *Science and Civilisation*, 170.

38. Al-Taṣawwurāt, trans. W. Ivanov. *The Ismaili Society Series A*, No. 4 (Bombay, 1950), 15.

39. See Chapter 8.

40. See K. Kohl, 'Über den Aufbau der Welt nach Ibn al-Haitham,' *Sitzungsberichte der Physikalisch-medizinischen Sozietaet in Erlangen*, Vol. 54 (1923), 140–79; A. Mieli, *op. cit.*, 87–8.

41. See G. Sarton, *Introduction to the History of Science*, Baltimore 1929, II, 16.

42. The vacuum was employed by Islamic physicists in a purely hypothetical sense, since they did not believe in its physical possibility.

43. Al-Bīrūnī, *Isti'āb*, trans. S. H. Barani, 'Al-Biruni's Scientific Achievements,' *Indo-Iranica*, V, No. 4, 1952, 276.

44. Al-Bīrūnī: *Isti'āb*, 277.

45. *Risālat al-Djāmi 'a*, I, 28.

46. *Raudhat al-Ḳulūb*, 12.

47. Al-Fārābī, *Philosophy of Plato and Aristotle*, trans. M. Mahdi (New York, 1962), 19.

48. Not in terms of evaluation but of local position.

49. Died 672 AH/1274 AD.

50. Al-Taṣawwurāt, 13.

51. For example in Ibn al-'Arabī's treatise, *Nushat al-Ḥakk*; Ms. Istanbul, Shehit Ali Pasha, No. 2813, fol. 4a.

52. A. M. J. Festugière, *La Révélation d'Hermés Trismégiste* (Paris, 1949–54), II, 'Le dieu cosmique'.

53. Translation from Nicholson, *Studies in Islamic Mysticism*, 105.