

Truth," tr. T. L. Davis and Chao Yun-ts'ung, *Proc. Am. Aca. Arts & Sci.*, 1939, Vol. LXXIII; G. Heym, "al-Rāzi and Alchemy," *Ambix*, 1938, Vol. I; H. S. Redgrove, *Alchemy, Ancient and Modern*, 1922; E. Darmstaedter, *Die Alchemie des Geber*, Berlin, 1922; Maung Htin Aung, "Burmese Alchemy Beliefs," *J. Burmese Res. Soc.*, 1955, Vol. XXXVI.

Chapter LXVI

NATURAL HISTORY

A

Inasmuch as the sciences studied in any traditional civilization, that is, one based upon a divine revelation, depend upon the metaphysical and religious bases of that civilization, Muslim sciences have always echoed and reflected the central Islamic doctrine of unity (*tauḥīd*). Just as the Islamic religious and moral sciences have begun from and returned to the idea of divine unity, the natural sciences have tried to discover the interrelation of all created beings. It is a general feature of all medieval cosmological sciences¹ that they seek to express the "unicity of all that exists." Especially in the Muslim natural sciences this goal has been central, and the idea of the unicity of nature and the interrelatedness of all parts of the universe has remained as a complement to and necessary consequence of the oneness of the Creator.

Since the most legitimate and meaningful way of studying a science is with respect to its ultimate aim and from the point of view of those who have cultivated it, we shall best understand the Muslim sciences if we keep in mind that their primary aim, unlike that of the modern natural sciences which are only analytical and quantitative, has been to arrive at the unity lying behind the veil of multiplicity of natural forms by a synthetic and qualitative study of nature.²

This search for unity is clearly manifested in a general science like natural history. As studied by the Muslims, natural history covers a large number of fields and includes not only such subjects as geology, botany, zoology,

¹ By cosmological sciences we mean all sciences dealing with the cosmos, including the natural sciences. The traditional sciences should, properly speaking, be divided into the metaphysical, dealing with God and supracosmic realities, and the cosmological, dealing with beings in the cosmos. See T. Burckhardt, "Nature de la perspective cosmologique," *Etudes Traditionnelles*, Vol. XLIX, 1948, pp. 216-19.

² See Seyyed Hossein Nasr, introduction to the section on "Muslim Sciences" in the *Mentor Foundations of Scientific Thought*, Vol. II, Signet Books, New York, (in press). In his famous *ʿAjāʾib al-Makhlūqāt* (The Wonders of Creation), abu Yahya Zakariya al-Qazwini writes that the presence of divine wisdom in every atom of the universe and in all forms of multiplicity is itself a proof of divine unity, and quotes the famous verse "*wa fi kull-i shai'in lahu āyātun ta'dullu 'ala annahu wāḥidun*" (that His sign exists in all things is a proof of His unity).

and anthropology, but also cosmogony and sacred history.³ Natural history means essentially the history of nature in the vastest sense of the word, and because Muslims have never separated the spiritual and the mundane, they have usually written natural history within the context of sacred history as is seen so clearly in the universal histories like those of Tabari and Mas'ūdi. The many allusions in the Qur'ān to natural phenomena and the fact that the verses of the sacred book as well as the phenomena of nature are called *āyāt* (signs) signify that in the Islamic perspective there is a fundamental affinity between the divine and natural orders and indicate, therefore, the legitimacy of connecting sacred history with natural history.

The question of the "signs" of nature leads to another basic feature of Muslim natural history. Most Muslim scientists have sought to study nature in order to observe "signs" of the Creator in it, to witness directly the "vestiges" of God in His handiwork.⁴ This is a feature which seems most irritating to some modern scientists who aim to discover only the immediate and the material causes of things. But from the point of view of Islam, no science can be considered legitimate which does not ultimately consider things in reference to their divine origin and which does not take into account the transcendent cause of all finite beings. The marvels and wonders of nature and the moral and spiritual lessons drawn from plant and animal life mentioned by the Muslim natural historians, which many modern historians have ridiculed, have been from the point of view of Islam itself the most beneficial and basic elements of natural history because they have led the reader to a recognition of the divine agent present in nature.

The Islamic perspective is in a way very practical. The sciences which this perspective has nourished and matured are all in a sense useful, that is, they correspond to a basic need of man as envisaged in Islam. They may, like agriculture, medicine, and the sciences of history and society, be useful in the limited sense and fulfil man's physical and social needs. Or, like logic and theology, they may be useful in preventing people from being misled by false reasoning. Or, finally, like the esoteric doctrines of Sufism, they may be useful in quenching the thirst for spiritual realization of the few, who seek God here and now. But Islam has never considered simple curiosity or intellectual passion either a virtue or a basic need of man and for this reason has never legitimized a science based only on curiosity.⁵ The desire of natural historians

³ But in this chapter we are concerned only with botany and zoology.

⁴ The medieval Christian scientists had a similar aim in view when they sought to observe the *vestigio dei* in nature.

⁵ Our argument does not seek to make knowledge subservient to action. Knowledge is always superior to action in the Islamic perspective as is indicated by such sayings of the Prophet as "One hour of meditation is better than a thousand works of charity," or "The ink of the scholar is more valuable than the blood of the one who fights the Holy War." What we wish to show is that in Islam a mental activity for its own sake, divorced from the spiritual and religious needs of man on the one hand and from his social needs on the other, has never been encouraged.

to learn moral and spiritual lessons from the phenomena of nature is, therefore, legitimate from the point of view of Islam because it is spiritually meaningful and fulfils a need, whereas finding the weight of a certain leaf of a tree to be so many grams is from this point of view a secondary and unimportant inquiry unless it leads to higher knowledge. The modern criticism of Muslim natural historians on this point is, therefore, unjust and based on a misapprehension of their point of view.

There is yet another aspect of Muslim natural history which is difficult to understand from the modern point of view. It is the description of strange animals and plants and magical properties of nature which the medieval authors seem to have recorded so credulously. One finds similar accounts in ancient books like Pliny's *Historia Naturalia*. The creatures described in these texts, which appear strange today, are of several types. One type is of strange animals, especially sea animals, which could certainly have existed but later became very rare or extinct and the description of which, therefore, seems fantastic now for they can no longer be observed. Another type is of animals and plants like the dragon, unicorn, and mandarine, which originally had symbolic meaning only, but the symbolism of which in certain cases was so forgotten that they came to be erroneously described as living creatures.⁶

As to the apparent frequency of "strange" phenomena within nature and the innocence with which medieval authors recorded them, it must be noted that the minds of those people were not as "hardened" as those of the moderns, and that nature in turn then was not taken to be so "dense" and "coagulated" and far separated from its psychic aspect as now.⁷ Therefore, while reading ancient and medieval texts it should be kept in mind that just as the people of those ages, like the people of certain parts of Asia, Africa, and America today, regarded nature from a point of view different from that of modern science, nature also revealed an aspect of itself to them different from that which it reveals to those moderns whose mental constitution is no longer capable of receiving nature's more subtle elements. There is, of course, much misinformation due to narrative and exaggerated style characteristic of the poetic mind of many Muslims. But on the whole most of the contents of Muslim natural history can be understood in terms either of direct observation of physical realities or of symbolism, i. e., the description of the subtle aspects of nature the reality of which is not in any way affected because the modern

⁶ Many medieval authors, especially certain alchemists, were quite aware of animal and plant symbolism and were conscious of what they were writing.

⁷ It is difficult for many to conceive of the possibility that nature and its laws may not have always been the same, but there is no logical or scientific reason to prove that they have been uniform. In fact, this uniformity is one of the assumptions upon which the historical aspects of modern science are based. On the other hand, sacred texts and metaphysical doctrines point to the "cyclic" change both in nature and in man's psychic and mental structure. R. Guenon, *The Reign of Quantity and the Signs of the Times*, Luzac & Co., London, 1953, and F. Schuon, *Les Stations de la Sagesse*, La Barque du Soleil, Paris, 1958, pp. 119ff.

quantitative sciences refuse to consider it from their own peculiar point of view.

B

Types of writings which contain material on natural history, particularly on plants and animals that form the centre of our interest in this chapter, are quite diverse. Muslim authors have rarely had a taste for over-specialization so that one finds a discussion of the plant and the animal kingdoms not only in scientific texts but also in literary, historical, philosophical, and theological works. More specially, the sources for natural history include the writings of historians, geographers and travellers, physicians, alchemists, philosophers, encyclopedists, cosmographers, moralists, theologians, and Sufis, and, of course, authors writing specifically on the subject of natural history.

The *Tārīkh al-Rusul w-al-Mulūk*, the universal history of Ṭabari, the *Kitāb al-Buldān*, the book of countries of Ya'qūbi, the *Kitāb al-Bad' w-al-Tārīkh* of Maqdisi, the *Murūj al-Dhahab* and *Kitāb al-Tanbih w-al-Ishrāf* of Mas'ūdi, the *Tārīkh-i Jahān-gusha* of Juwaini, and the geography of abu 'Abd Allah ibn al-Idrisi, all dealing with history and geography, contain valuable sections on natural history. Moreover, they provide, on the one hand, the perspective of time in the light of which Muslims have viewed the life of all creatures, a time stretching between the creation and the final annihilation of the universe on the Last Day, and, on the other, they mention the geographical setting, the seven climates, and other terrestrial conditions which form the matrix of natural history.⁸ They demonstrate, further, how closely the study of plants and animals is bound up with that of the other parts of the universe, both terrestrial and celestial,⁹ and how the history of nature is intrinsically related with the history of man as well as with sacred history.

Another source for the knowledge of natural history comes from the many books of travel which survive from that period of Islamic history when the Muslim world was still more or less united and travelling from one place to another was easy. The accounts of the travels of abu al-Ḥasan al-Maghribi, ibn Jubair,

⁸ For general information regarding these and other authors whose names are to follow, see G. Sarton, *Introduction to the History of Science*, Vols. I to III, Williams and Wilkins Co., Baltimore, 1927-48; A. Mieli, *La science arabe et son rôle dans l'évolution scientifique mondiale*, E. J. Brill, Leiden, 1939; B. Carra de Vaux, *Les penseurs de l'Islam*, Librairie Paul Geuthner, Paris, 1921-27, Vols. II and IV. Among the texts mentioned above, the *Murūj al-Dhahab* (Prairies of Gold) translated into English by Sprenger, W. H. Allen Co., London, 1841, especially offers useful material on the historical and geographical framework of natural history.

⁹ Muslim natural historians not only divided the earth into several climates, each with its own flora and fauna in conformity with its particular terrestrial condition, but further assigned each climate to a particular planet which acted as the archetype and "guardian angel" for that particular climate. For an example of this astrological theory, see the *Rasā'il* of the Ikhwān al-Ṣafa, Cairo, 1928, I, pp. 116ff. and P. Duhem, *Le système de monde*, Vol. II, A. Hermann et fils, Paris, 1914, pp. 267ff.

Bīrūnī, Nāṣir *Khusrau*, and ibn Baṭṭūṭah, to mention a few names, provide a wealth of information on plants and animals which these men observed themselves or the accounts of which they heard from others. The interpretation which they gave to their observations varied greatly, depending on their knowledge and experience as travellers. One often finds simple description as in the case of Maghribī, or detailed physical observation and inference based upon it as in the case of Bīrūnī, or philosophical and metaphysical reflection upon natural forms as is found in the writings of Nāṣir *Khusrau*.

Besides these land travellers, there were several ocean travellers like Sulaimān the Merchant, who in the third/ninth century journeyed by sea to the coast of China and described many of the wonders of the Indian Ocean and the Chinese coast, and Shihāb al-Dīn ibn Mājid, Sulaimān ibn Mahri, and Piri Ra'is, who in the ninth/fifteenth and tenth/sixteenth centuries travelled extensively through the Mediterranean Sea and Indian Ocean and gave a detailed description of these areas. The accounts of sea animals found in books of natural history and the fables of the sea encountered so often in *Arabian Nights*, *Sindbad Nāmeh*, and other collections of stories, both Arabic and Persian, were originally taken from the accounts of the sea travels of merchants, adventurers, and occasionally military men who roamed the then known extremities of the world.

Another source of natural history, considered from quite another aspect of our subject, is medicine. Muslim medicine, the heir both to the Greek and to the Indian science of medicine, has always had a general theory of living beings; nearly all medical treatises have included in their introduction a general treatment of the constitution (*mizāj*) of animals, which provides a major source of information for the internal structure of animals and the functioning of their organs.¹⁰ Moreover, since much of the treatment of diseases in Muslim medicine is based on plants, medical books have usually contained sections on pharmacology treating of the medical properties of plants. In fact, one may say that, apart from the metaphysical and philosophical study of plants and animals, most of Muslim research in botany and zoology has been in the service of pharmacology, agriculture, medicine, and animal husbandry. The important medical treatises like 'Alī al-Ṭabarī's *Firdaus al-Hikmah* (The Paradise of Wisdom), Muḥammad Zakariyā Rāzī's *al-Hāwī* (Continens), and ibn Sīnā's *Qānūn* (Canon) contain important chapters on zoology and botany.

Alchemy, a subject closely allied to medicine and botany in ancient times and later identified more with the study of the mineral kingdom, has also much to contribute to natural history. In Chinese alchemy we find a close link between the elixir and the plant life; certain modern scholars have even

¹⁰ Regarding the internal constitution of animals, perhaps no book is so masterly and complete as ibn Sīnā's *Qānūn*. See the introduction to ibn Sīnā, *A Treatise on the Canon of Medicine, Incorporating a Translation of the First Book*, by O. C. Gruner, Luzac & Co., London, 1930; also ibn Sīnā, *Poème de la médecine-Urghūza fi'l-ṭibb*, Société d'édition "les Belles Lettres," Paris, 1956.

suggested that the Arabic word *kīmiya* itself, from which the English word alchemy is derived, comes from the Chinese *Chin-Ia*, meaning the gold-making juice of a plant.¹¹ Whatever the validity of this theory may be, there is no doubt that plant and animal symbolism has a major role to play in alchemy as the writings of so many alchemists like Jābir ibn Ḥayyān or in the Western world Flamel and Basil Valentine demonstrate. In Muslim alchemy certain authors like Jābir have written specific treatises on plants and animals dealing with their hidden and "occult" qualities.¹² Authors writing on the esoteric sciences (*al-'ulūm al-gharibah*), like Jābir, Shams al-Dīn al-Būnī, and Jildaki have all written treatises dealing with the psychic and symbolic aspects of both plants and animals and their influence on man's physical, psychic, and spiritual life.

The philosophers have also treated plants and animals in their general consideration of the world of "generation and corruption," to use the terminology of Aristotle. It must be kept in mind that medieval philosophy is based upon the idea of hierarchy and the chain of Being which begins from the One and through the angelic and intellectual orders descends to material manifestations, to rise once again through the mineral, plant, and animal kingdoms to the origin of all things. The philosophers, especially the systematic Peripatetics (Mashā'iyūn), therefore, have always entered into a discussion of plants and animals from the point of view of their place in the great chain of Being. We find examples of this type of discussion not only in the Peripatetics like Fārābī, ibn Sīnā, and ibn Rushd but also in the philosophers of the Illuminationist (*ishrāqī*) school like Suhrawardī Maqtūl and Mulla Ṣadra, and in Sunni and Shi'ah theologians like al-Ghazālī and Khwājah Naṣir al-Dīn al-Ṭūsī. The most detailed and profound scientific account of plants and animals in these philosophical treatises appears in ibn Sīnā's *Shifā'* (*Sufficientia*), the greatest encyclopedia of philosophy and sciences ever written by one man. Here, ibn Sīnā deals not only with the place of plants and animals in the cosmic hierarchy but also with their morphology, genesis, and growth. Sections seven and eight of the *Shifā'* on natural philosophy (*Ṭabī'iyāt*) are among the most important pages of medieval natural history.

Writings similar to the *Shifā'* in the universality of their subject-matter, but not so strictly systematized, are a number of encyclopedias which have been popular from the very early centuries of Islam. We find an early example of these in the *Book of Treasures* of Job of Edessa written at the end of the second Islamic century.¹³ More important works are the *Rasā'il* of the Ikhwān

¹¹ See S. Mahdihassan, "Chemistry, a Product of Chinese Culture," *Pakistan Journal of Science*, 1957, Vol. IX, No. 1; also his "Alchemy, in Its Proper Setting, with Jinn, Sufi and Ṣuffā, as Loan-words from the Chinese," *Iqbal*, 1959, Vol. VII, No. 3.

¹² See P. Kraus, *Jābir Ibn Ḥayyān*, 2 Vols., Imprimerie de l'Institut Français d'Archéologie Orientale, Cairo, 1942-43.

¹³ A. Mingana, *Encyclopaedia of Philosophical Sciences as Taught in Baghdad in c. 817 A. D. or Book of Treasures of Job of Edessa*, Cambridge, 1935.

al-Ṣafa containing a wealth of information on plants and also on animals drawn from Indian, Persian, and Greek sources and integrated into a vast metaphysical and philosophical panorama.¹⁴ Also of great importance for natural history is the encyclopedia of Mustaufi Qazwini entitled *Nuḥḥat al-Qulūb* (Delights of the Heart), written in Persian in the eighth/fourteenth century, which includes sections on plants and animals.¹⁵ Other works of this kind include the *Kitāb al-Awā'il* (Book of Primordial Knowledge) and *al-Nuqāyat al-Usud al-Muhimmah li 'Ulūm Jammah* (the encyclopedia of sciences) of 'Abd al-Rahmān al-Suyūṭi, the ninth/fifteenth-century historian, and the *Kashf al-Zunūn* (The Clearing of Doubts) of Ḥāji Khalifah dealing mostly with scholars of all types including scientists of the medieval period. All these encyclopedias contain some sections on plants and animals while some like the *Nuḥḥat al-Qulūb* and the *Rasā'il* have large chapters devoted specifically to natural history.

Works on cosmography are in a way similar to encyclopedias, but usually they do not cover as many subjects. Moreover, they are concerned more directly with the creation of the world and its subsequent development as well as with the wonders of nature. This *genre* of writing became popular especially during the later centuries, the most famous examples being the '*Ajā'ib al-Makhlūqāt* (The Wonders of Creation) of abu Yahya Zakariya al-Qazwini and the *Nuḥbat al-Dahr* (Choice of the Times) of Shams al-Din al-Dimashqi, both written in the seventh/thirteenth century. These works represent a combination of natural history and mythology and provide an excellent example of the attitude of the Muslim mind, which takes nature to be as displaying at every turn the power and wisdom of the Creator.

To mention all the sources for natural history, one should include the moral, theological, and Sufistic texts in which the life and qualities of plants and animals are studied with the aim of learning a moral and spiritual lesson from them. Such use of natural history, particularly of the life of animals, is very frequent in Oriental literature as for example in the *Kalilah wa Dimnah*,¹⁶ the *Shāh Nāmeḥ* of Firdausi, the *Thousand and One Nights*, and the *Gulistān* of Sa'di. Likewise, in certain theological texts animals are discussed in the light of their moral virtues. The famous *Kitāb al-Ḥayawān* (Book of Animals) of al-Jāhiz is above all a theological and moral discussion about animals.¹⁷ In Sufi

¹⁴ An interesting section of the *Rasā'il* dealing with the discussion between man and animals has been translated into English as *Dispute between Man and the Animals*, by J. Platts, W. H. Allen Co., London, 1869.

¹⁵ See J. Stephenson, "The Zoological Section of the *Nuḥḥat al-Qulūb*," *Isis*, 1928, Vol. XI, pp. 285-316.

¹⁶ This famous book of tales about the animals is the Sanskrit *Panchatantra* translated into Pahlawi and later into Arabic by ibn Muqaffa'. Various versions of it in Arabic and Persian like *Anwār-i Suhaili* of Ḥusain Wā'iḥ Kāshifi have remained very popular throughout the centuries.

¹⁷ This *genre* of writing has continued to recent times. A work called *Insān wa Ḥaiwān* (Men and Animals) by Ḥāji Mulla Ismā'il Sabziwāri written during

writings also, plants and animals are discussed in the light of their cosmic qualities and in relation to the initiate's (*sālik's*) journey through the cosmos. In these works plants and animals appear primarily in the light of their symbolic aspects which represent realities of a universal order. The *Mathnawī* of Maulāna Jalāl al-Din Rūmi is particularly rich in this respect. There is also the *Manṭiq al-Ṭair* (Conference of the Birds) of Farid al-Din 'Aṭṭār in which the whole spiritual quest of the Sufi disciple for the divine presence is presented in the language of thirty birds, each symbolizing a particular spiritual type.

Finally, among writings dealing with natural history, there are works devoted almost exclusively to plants and animals,¹⁸ constituting perhaps the most important sources of our knowledge of natural history. We mention here a few of these texts. These works concern agriculture, pharmacology, and botany, all dealing with plants, and zoology and animal husbandry.

In agriculture, the *Filāḥat al-Nabā'iyyah* (Nabataean Agriculture) of ibn Waḥshiyyah is the most influential of all Muslim works on the subject. Written in the third/ninth century and drawn mostly from Chaldaean and Babylonian sources, the book deals not only with agriculture but also with the esoteric sciences, especially magic and sorcery, and has always been considered to be one of the important books in Arabic on the occult sciences.¹⁹ The agricultural section of the work was systematized and elaborated by ibn 'Awwām in the sixth/twelfth century in his *Kitāb al-Falāḥah* (Book of Agriculture) which is perhaps the most important Muslim work on agriculture. Ibn 'Awwām describes over five hundred plants and fruit trees mostly from the point of view of their agricultural properties. These two works contain the experience of centuries of agriculture by the people of the Middle East and offer a great deal of descriptive material on the life of plants and animals.

In botany itself, early Arabic poetry has much descriptive material to offer. There were also many early works of a systematic nature most of which have now been lost. One of the most important of these early books was the *Kitāb al-Nabāt* (The Book of Plants) of abu Ḥanifah al-Dinawari (the celebrated third/ninth-century historian and scholar) of which only fragments have

the last century, treating of the moral and spiritual qualities of animals, is still widely used by Persian preachers in their sermons.

¹⁸ By "exclusive" we do not mean so strict a limitation of the subject as is found in a modern text-book on botany or zoology. Muslim sciences have been too closely united to permit a complete separation of one subject from another so that in nearly every book dealing with plants and animals there are references to other sciences as well as to philosophy and theology.

¹⁹ Ibn Khaldūn in referring to this book writes that "people learned the sciences of sorcery from the work and developed its manifold branches" (*Muqaddimah*, tr. F. Rosenthal, Pantheon, New York, 1958, Vol. III, p. 156). Many Western historians have refused to believe that ibn Waḥshiyyah could know anything about the Babylonian civilization and therefore consider his claim to be a forgery.

survived.²⁰ Among later writings in which pharmacology and botany proper are combined, the most famous works are the *Kitāb al-Adwiyat al-Mufradah* (The Book of Simple Drugs) of abu Ja'far al-Ghāfiqī,²¹ the writings of the seventh/thirteenth-century Andalusian author, ibn al-Baitār, the best of all Muslim botanists,²² and the *Ḥadiqat al-Azhār fi Sharḥ Maziyat al-'Ushb w-al-'Aqqār* (Garden of Flowers in the Explanation of the Character of Herbs and Drugs) of the tenth/sixteenth-century Moroccan author, Qāsim al-Ghassānī.

In zoology, the *Manāfi' al-Ḥayawān* (The Benefits of Animals), by abu Sa'id Bakhtishū', and the treatises on various wild and domestic animals by Aṣma'i are among the earliest works on animals. To this early period belongs also the *Kitāb al-Ḥayawān* (Book of Animals) of al-Jāhīz, the celebrated Mu'tazilite theologian and philologist. Being one of the most famous works of Arabic literature, this book, written in the third/ninth century, combines the account of the life of animals with tales, anecdotes, theological discussions, and frequent quotations from Arabic poetry. The sources of this book include the Qur'ān, the Ḥadīth, and Arabic poetry, especially pre-Islamic poetry, which last contains many descriptions of animals that al-Jāhīz often quotes to refute Greek authors, personal observations of Aristotle, and information collected from various travellers.

Ḥayāt al-Ḥayawān (Life of Animals) of Kamāl al-Dīn al-Damiri, written five centuries after al-Jāhīz, came to be acknowledged as the most important Muslim work on zoology, especially on animal psychology. It was based to a large extent upon the book of al-Jāhīz as well as on the writings of the intervening encyclopedists and cosmographers already mentioned. Al-Damiri's is the most comprehensive work of its kind in Arabic literature and has, therefore, been taught and studied extensively since the date of its composition.

C

The philosophical point of view in terms of which plants and animals have been studied by the great majority of the above-mentioned authors is nearly the same and is one derived mostly from the Greeks, particularly from Aristotle. According to this view, the universe is divided into two parts: the heavens and the world of change or generation and corruption; the latter occupies the

²⁰ M. Hamidullah, "Dinawari's Encyclopaedia Botanica (*Kitāb al-Nabāt*) in the Light of Fragments in Turkish Libraries," *Mélanges F. Kopriülü*, pp. 195-206. See also B. Lewin, *The Book of Plants of Abu Ḥanīfah al-Dinawari*, A. B. Lundeguiuska Bokhandeln, Upsala, 1953, introduction, in which is discussed the influence of this early work on the later Muslim botanists.

²¹ This sixth/twelfth-century Maghribi botanist has given some of the most detailed descriptions of plants found anywhere in Muslim botanical literature.

²² His two most important books are the *Kitāb al-Jāmi' fi al-Adwiyat al-Mufradah* (The Complete Book of Simple Drugs), dealing with the classification of plants, and *Kitāb al-Mughni fi al-Adwiyat al-Mufradah* (The Sufficient Book of Simple Drugs), dealing with the medical properties of plants.

sublunary region. This region is made of four elements, fire, air, water, and earth,²³ arranged in concentric spheres with fire at the highest and earth at the lowest sphere. These elements combine in various ratios and when a correct proportion is reached, one of the faculties of the world-soul or nature, as some authors have called it, joins them together into a nexus,²⁴ and by this wedding, minerals, plants, and animals come into being, each having been brought about by the coming into play of a new faculty of the world-soul or, as some have called it, a new soul.²⁵ All the kingdoms of nature are, therefore, united in having been made of the same four elements and given life by souls or faculties which belong to the same single power called the world-soul or nature running through all the arteries and veins of the universe.

As minerals, plants, and animals lie in the hierarchical order of Being, they also come into existence by means of causes which are dependent upon other orders of creation, although these causes may appear to be hidden.²⁶ The causes are the four already mentioned by Aristotle, namely, the material, the formal, the efficient, and the final. The material cause for plants consist of the four elements; the formal cause, the set of planetary influences symbolizing various cosmic intelligences and forces which are instrumental in sublunary changes; the efficient cause, nature or the world-soul; and the final cause, which last is their use by animals as food.²⁷ The causes for animals are the same except that their final cause is their use by man.²⁸

²³ These are not elements in the modern sense but rather the principles. They are to the sensible substances of nature what the geometric points and lines are to points and lines actually drawn on a piece of paper.

²⁴ The union of the soul, which in Muslim cosmology lies above the cosmic spheres, with a certain combination of the elements in the sublunary region is also considered to be *ad extra* and not as in a compound. As the combination of elements attains more harmony and greater equilibrium, it becomes purer so that the combination naturally attracts the soul to itself. In the minerals the elements are not as perfectly balanced as in animals so that they attract a lower soul unto themselves.

²⁵ Although minerals have been considered by many Muslim authors to be transmutable into one another, plants and animals have been considered to be unchangeable. Each plant, according to the *Ikhwān al-Ṣafā*, for example, has a chyme (*kaimūs*) formed from a particular combination of elements which always reproduces the same plant as each animal has a sperm which propagates the same species.

²⁶ "Although plants are obvious and visible creations, the causes of their existence are hidden and veiled from the perception of man. It is what the philosophers call 'natural forces,' what the *Shari'ah* calls 'the angels and troops of Allah appointed for the nurturing of plants, the generation of animals and the composition of minerals,' and what we call 'partial spirits.'" *Ikhwān al-Ṣafā, Rasā'il*, II, p. 130; also R. Levy, *The Social Structure of Islam*, Cambridge, 1957, p. 490.

²⁷ We are following here the teaching of the *Ikhwān*, but these views are shared by most Muslim authors writing on this subject.

²⁸ The *Ikhwān* have a most interesting section in their *Rasā'il* in which the animals dispute with man over his right to use them for his own ends. They refute all of man's claims of superiority by demonstrating their own spiritual and bodily

The plants have the powers of the mineral soul (*rūḥ 'aqdiyyah*) as well as those of the vegetative soul (*al-naḥs al-nabāṭiyyah*) which is possessed of the three faculties of feeding (*ghadhā'iyyah*), growth (*nāmīyyah*), and reproduction (*muwallidah*).²⁹ The animals in turn possess all the faculties of the mineral and vegetative souls as well as the powers of motion (*muḥarrikah*) and comprehension (*mudrikah*). The animal faculties may be summarized as follows:³⁰

Animal soul	{	power of motion (<i>muḥarrikah</i>)	{	power of lust (<i>shahwatīyyah</i>)
		power of comprehension (<i>mudrikah</i>)		power of anger (<i>ghadhābiyyah</i>)
	{	power of desire (<i>shauqīyyah</i>)		
		power of motion of body (<i>ʿāqilah</i>)		

Subscribing to the view that all things are alive and that plants and animals have souls of their own, Muslim natural historians have tried to understand the behaviour of these creatures in terms of the faculties stated above and, thus, averted many of the difficulties of the post-Cartesian view which regards plants and animals as "machines."

The classification of plants and animals is closely allied with the study of their faculties and is based in certain cases upon the hierarchy of the powers of the soul mentioned above. Muslim authors have followed several principles of classification, some drawn from Aristotle, especially in the case of animals, and some devised by them independently.³¹

qualities and virtues. It is only by realizing that there are among men a few sages and saints who in their spiritual realization fulfil the purpose of the whole of creation, that animals finally agree to submit to man. See the *Dispute between Man and the Animals*.

²⁹ The most thorough discussion of the vegetative and animal souls appears in the sixth part of the *Ṭabī'iyāt* of the *Shifā'* of ibn Sina where he deals in detail with all the faculties of plants and animals and their functions. Cf. J. Bakoš, *La psychologie d'Avicenne*, Editions de l'Académie Tchécoslovaque des Sciences, Prague, 1956. Ibn Sina and also most other authors writing on the faculties of the vegetative and animal souls derived many of their ideas from the *De Anima* of Aristotle. The *Ikhwān*, however, enumerate the faculties somewhat differently: as attraction, fixation, digestion, repulsion, nutrition, formation, and growth.

³⁰ For a summary of ibn Sina's views on the souls and their faculties, see E. Gilson, "Les sources gréco-arabes de l'augustinisme avicennan," *Archives d'Histoire Doctrinale et Littéraire du Moyen Âge*, Vol. IV, 1929, pp. 5-149.

³¹ In general, the Muslims depended more upon the Greeks in the study of animals than that of plants. Whereas Aristotle's works on animals were studied extensively, the botany of Theophrastus was nearly ignored. Muslim authors had already created a science of plants drawing their terminology mostly from the Qur'ān and Arabic poetry before the first important Greek text on plants, that is, the famous work of Dioscorides, was translated into Arabic.

The plants have been divided usually into trees, shrubs, grass, and those intermediate between trees and shrubs and shrubs and grass. A most extensive discussion of this division is found in the seventh section of the *Ṭabī'iyāt* of the *Shifā'* where each type is clearly defined; for example, the tree is defined as a plant which stands on its stem or trunk, the shrub the stem of which spreads over the earth, and the grass or herb that which has no stem. Ibn Sina divides plants also according to the climates of regional territories in which they grow, that is, of the desert, of the semi-tropical regions, etc.

In Mustaufi Qazwini's *Nuzhat al-Qulūb* a distinction is made between trees of which only the leaves and fruit are renewed yearly and the seed-bearing plants of which everything changes every year except the roots. The trees are divided into those that bear fruit and those that do not.³² Furthermore, the seed-bearing plants are divided into the four classes of aliments (*aghdhīyah*): (i) those which are daily used for food and create one of the four humours (*akhlāt*)—cold, warm, dry, or moist—that soon becomes a part of the body; (ii) medicines and spices only a little of which can be eaten for medical purposes and which are mostly cold and wet; (iii) perfumes (*maṣhmūmāt*) which have a good odour and are derived mostly from flowers; and (iv) miscellaneous plants in which the qualities of aliments and medicines are present but in a lesser degree.

Most authors dealing with the classification of plants also treat of their morphology. We find an extensive treatment of this kind in the *Shifā'* where ibn Sina divides the parts of plants into primary and secondary organs. The primary or essential organs are root, trunk, branches, bark, wood, and pith or core and the secondary organs, fruit, leaves, and blossoms. In a somewhat different manner, the *Ikhwān al-Ṣafa* divide the plant into nine parts—root, vessel, branch, bough, leaves, colour, fruit, shell, and germ—and hold that only perfect plants possess all the nine of them.

Both ibn Sina and the *Ikhwān* make continuous comparison of plants with the animal world; in the case of the *Ikhwān* as well as in the case of many later authors comparison is also made with the celestial bodies so as to draw attention to the symbolic correspondence existing between various cosmic orders.³³

³² See the botanical section of the *Nuzhat al-Qulūb*, *Shirāzi*, Bombay, 1311/1893, pp. 87ff., where sixty-nine fruit-bearing trees and sixty-six fruitless ones are described in alphabetical order. Qazwini, like many other Muslim natural historians, gives not only the description of a tree, the quality of its fruit and its wood and the location where it is found, but also its medical uses, its nature, that is, whether hot or cold, dry or moist, and its appearance in literature and sacred books. As for seed-bearing plants, Qazwini follows a similar procedure, describing altogether 280 kinds, each class arranged alphabetically.

³³ The famous scientist and compiler, Bīrūnī gives a good example of this astrological correspondence. He writes: "The various organs of a plant are distributed to different planets. Thus the stem of a tree is appropriated to the Sun; the roots to Saturn, the thorns, twigs, and barks to Mars; the flowers to Venus; the

In their comparisons of plants with animals, Muslim authors were quite aware of the presence of male and female parts of plants which in most cases are united in the same plant but which in higher plants like the palm become differentiated. Ibn Sina draws an analogy between seeds of plants and eggs of birds each of which has a centre that is the source of life and a periphery which provides food for the new generation. Likewise, he compares the growth of the branch of a tree from the trunk with the birth of a new generation in the animal world.

In the classification and description of plants, one can hardly fail to mention ibn al-Baiṭār, the greatest of the Muslim botanists. Basing himself on al-Ḡhāfiqī and other previous authors like Dioscorides and Galen and making many observations of his own, he described extremely carefully over 1,400 plants from Andalusia, his homeland, as well as from the rest of the Islamic world. Furthermore, in the *Kitāb al-Mughni*, following the example of ibn Sinā's *Qānūn*, he gave the medical uses of these plants. The influence of ibn al-Baiṭār was felt everywhere within the Islamic world from Morocco to India. Three centuries later, the Moroccan botanist, al-Ḡhassānī, was to give the best classification of plants found anywhere in Muslim literature, drawing mostly upon the information accumulated by ibn al-Baiṭār.

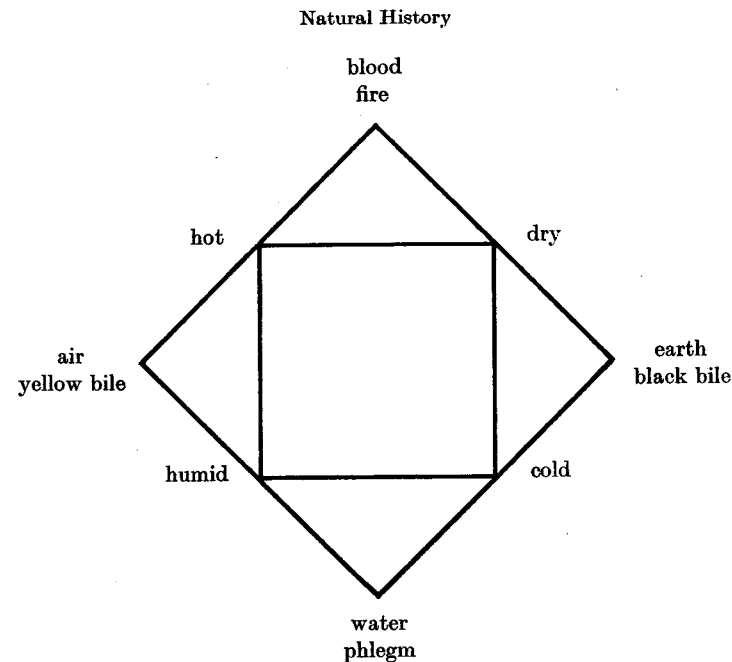
In the study of animals, like that of plants, interest evolved around the constitution of plants and their classification and description. The temperament (*mizāj*) of animals including man was studied in the light of the qualities and nature of which the other kingdoms are possessed. Their relation with the bodily humours may diagrammatically be represented as follows.³⁴

The animal constitution has been understood in terms of the equilibrium of the four humours each of which is connected with a particular internal organ. The organs in turn have been studied in the light of their function of preserving internal equilibrium. Likewise, the effect of plants both as food and as medicine upon animals has been considered with respect to their nature, that is, coldness, moisture, etc., which the two kingdoms share in common. This is one example of the underlying unity in terms of which the diversities of nature have been understood.

fruit to Jupiter; the leaves to the Moon; and the seed to Mercury" (*Elements of Astrology*, tr. R. Ramsay Wright, Luzac & Co., London, 1934, p. 236).

The correspondence between plants or animals and the planets is not to show astral "influences" as is done in contemporary astrology which is only a residue of the real subject known by the same name in medieval times. It is to show rather that the physical world is a symbol of the intelligible world, that there is an analogy between the archetypes symbolized by the planets and their earthly shadows which are the physical forms.

³⁴ This is a schematization of ideas presented in ibn Sinā's medical poem as well as in the *Qānūn* to which we have already referred. Pathology based on the doctrine of humours is a heritage from the Hippocratic tradition of medicine as systematized by Galen.



In the classification of animals, as in that of plants, several principles have been followed, some of them based upon Aristotle's works on animals. Al-Jāhīz in his *Kitāb al-Hayawān* divides animals according to how they move. There are, according to him, four classes of animals: those that walk, which include men, quadrupeds, beasts of prey, and insects; those that fly, which include wild birds, hunting birds, and gnats; those that swim; and those that crawl. The Iḵhwān al-Ṣafa give several types of classification. One type is similar to that of al-Jāhīz and divides animals into those living in the air like birds and insects; those living in the sea, like fish, crabs, frogs, and snails; those living on land like the quadrupeds; and those dwelling in the earth like worms.³⁵ Another classification is according to the perfection of the senses, that is, the lowest animals having only the sense of touch; grubs and others having the senses of touch and taste; marine animals and certain land creatures occupying dark places having the senses of touch, taste, and smell; insects having all the senses except sight; and finally perfect animals having all the five senses.

Many Muslim authors have followed Aristotle in classifying animals according to the manner of their reproduction. We find a simplified version

³⁵ Mustaufi Qazwini in the *Nuzhat al-Qulūb* follows a somewhat similar procedure dividing animals into those living on land, in sea, and in air, and subdividing each of the classes according to its more specific features.

of it in the *Rasā'il* of the *Ikhwān* where animals are divided into three classes: those that are most complete, which conceive their young, suckle them, and foster them; those which do not perform such functions but leap at the female and lay eggs and hatch them; and those which do none of the above things and come into being in putrefaction. More elaborate classifications of the same type are found in the writings of ibn Sina, ibn Rushd, and many later commentators of the *Shifā'* which contain a detailed discussion of animals.

A rather general definition of animals including the jinn³⁶ and men is given by Qazwini in his *'Ajā'ib al-Makhlūqāt*. He divides animals into seven classes. First, there is man who possesses a rational soul (*nafs nāṭiqah*) and whose body is a miniature model of the universe, a microcosm, each part of which has a spiritual meaning and purpose. For example, he stands erect because of his spiritual aspiration to transcend physical existence, and his head is round because of the perfection of the spherical figure. The second type is of the jinn who are composed of fire and appear in many forms. As Qazwini writes, God created angels from the light of fire, jinn from its blaze, and devils from its smoke. The jinn occupied the earth before the coming of man, that is, the fall of Adam, and had their own religion and prophets; but because of corruption God sent angels to purify the earth, and they were dispersed to remote islands. Satan or Iblis is himself from this species of animals.³⁷

After the jinn come the beasts of burden like the horse, then cattle like cows, then wild beasts, then birds, and finally insects and reptiles. Qazwini has further a section on "strange" animals which are primarily mythological and symbolical and finally a chapter on angels, their forms, functions, and colours.³⁸

In the description of animals, there is no book in Muslim writings that is as complete as Damiri's *Hayāt al-Hayawān* in which he is concerned with the traits, instincts, and psychology of animals and their use, medical and spiritual, for man. Following ibn al-Baitār, by whom he was influenced, he classifies animals alphabetically and then gives their description drawing on Aristotle, the natural historians, theologians, esoteric writers like Shams al-Dīn al-Būnī, Arabic poetry, and the Qur'ān and the Ḥadīth. In his description he often refers to the symbolic character of animals, like the royal quality of the lion, and, as is characteristic of similar descriptive works of natural history, intertwines the spiritual as well as the physical study of nature.³⁹

³⁶ They may be said to symbolize psychic forces.

³⁷ A similar account is to be found in the *Rasā'il* of the *Ikhwān*.

³⁸ We see in Qazwini's writings a good example of the blending of the natural and supernatural order to which we have already referred. His description of the colours and forms of animals and angels served as an inspiration for later Persian miniaturists.

³⁹ Damiri also interrupts his discussion of animals at several places in order to write about Islamic history, prayers based on the divine names, the science of *jafar* (symbolism of letters), and other subjects.

In discussing the classification and morphology of plants and animals a comparison may be made between the traditional concept of gradation and the modern notion of evolution. There is no doubt that many Muslim authors like Bīrūnī and the *Ikhwān* were quite aware of the meaning of fossils and of the fact that during other periods of the history of the earth flora and fauna of a different kind existed on the earth. Moreover, the idea of the gradation of Being or the passage of the One Spirit through all the realms of nature has been expressed by many philosophers and Sufis.⁴⁰

Some thinkers, especially the *Mashā'i* philosophers, envisage, like Aristotle, the gradation of fixed spheres, while the *Ishraqi* philosophers connect, like Plato, this gradation of spheres with the conception of archetype belonging to the transcendent "world of ideas." There is yet another school of thinkers (al-Jāhīz, the *Ikhwān al-Ṣafa*, ibn Miskawaih, Jalāl al-Dīn Rūmī, etc.), whatever their persuasion otherwise, who believe in the continuous self-development of Being from stage to stage—a position nearest to the present-day theory of evolution.

The tradition of Muslim natural history upon which we have touched briefly has had a past going back to the first Islamic century. During this long history it absorbed much of the Greek and certain of the Indian and Persian sciences and created a science which was in every way superior to what had preceded it, except the biological studies by Aristotle. This tradition was to develop as a properly Muslim science, that is, one based upon the particular genius of the Islamic perspective which is centred upon unity. This tradition is manifest in Muslim natural history in many ways, for example in the vision of the unity of nature and interrelation of all things, which Muslim natural historians asserted so often in affirming the presence of the signs of God in nature and in the study of plants and animals for the purpose of seeing divine wisdom therein.

This tradition, especially that part of it which preceded the seventh/thirteenth century, was to have a profound influence on Latin Christianity and on the formation of the science of natural history in medieval times. It is well known how much seventh/thirteenth-century authors like Albertus Magnus and Roger Bacon were indebted to it and how even during the Renaissance men like Paracelsus and Agrippa were constrained to draw largely on Muslim sources. In the Orient, this tradition has continued until the present century although in a much weakened form after the ninth/fifteenth century. Scholars in India and Persia as well as those in the Maghrib have continued to study nature as the unified handiwork of God in order to discover His wisdom, to see "His sign upon the horizon" as the Qur'ān states, and to learn spiritual lessons from it. Only in following this spirit has this

⁴⁰ A beautiful expression of this doctrine appears in the *Mathnawī* of Maulāna Jalāl al-Dīn Rūmī. See Book IV, verses 3637 to 3647 of the text of *Mathnawī* ed. R. A. Nicholson, E. J. Brill, Leiden, 1929.

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tradition of natural history been able to be an integral aspect of Muslim learning and remain in harmony and conformity with the spiritual and intellectual perspective of Islam.

BIBLIOGRAPHY

E. G. Browne, *Arabian Medicine*, Cambridge, 1921; D. Campbell, *Arabian Medicine*, 2 Vols., Kegan Paul, London, 1926; B. Carra de Vaux, *Les penseurs de l'Islam*, 5 Vols., P. Geuthner, Paris, 1921-27; Fr. Dieterici, *Die Naturschauung und Naturphilosophie der Araber im zehnten Jahrhundert aus den Schriften der Lautern Brüder*, Verlag der Nicolai'schen, Berlin, 1861; H. Ethé, *Die Wunder der Schöpfung*, Leipzig, 1868; ibn al-Qiftī, *Tārikh al-Hukamā'*, ed. A. Müller and J. Lippert, Leipzig, 1903; ibn Qutaibah, *The Natural History Section from a 9th Century "Book of Useful Knowledge": The 'Uyūn al-Akhbār of ibn Qutaibah*, tr. L. Kopf, E. J. Brill, Leiden, 1959; ibn Sina, *Kitāb al-Shifā' (Ṭabī'iyāt)*, lithograph edition, Teheran, 1882; *A Treatise on the Canon of Medicine, Incorporating a Translation of the First Book* by O. C. Grunner, Luzac and Co., London, 1930; Ikhwān al-Ṣafa, *Dispute between Man and the Animals*, tr. J. Platts, W. H. Allen & Co., London, 1869; *Rasā'il*, 4 Vols., Cairo, 1928; A. 'Isa Bay, *Tārikh al-Nabāt 'ind al-'Arab*, Cairo, 1944; P. Kraus, *Jābir Ibn Ḥayyān*, 2 Vols., Imprimerie de l'Institut Francais d'Archéologie Orientale, 1942-43; L. Leclerc, *Histoire de la Médecine arabe*, Paris, 1876; *Traité des simples par ibn al-Beithar, Notices et Extraits*, Vols. XXIII, XXV and XXVI, 1877 and 1883; B. Lewin, *The Book of Plants of Abu Ḥanīfah al-Dinawari*, A. B. Lundegustska Bokhandeln, Upsala, 1953; Mas'ūdi, *Meadows of Gold and Mines of Gems*, tr. Sprenger, W. H. Allen & Co., London, 1841; A. F. Mehren, *Manuel de la cosmographie du moyen-âge*, Copenhagen, 1874; *Geschichte der Botanik*, Verlag der Gebrüder Bombträger, Königsberg, 1856; A. Mieli, *La science arabe et son rôle dans l'évolution scientifique mondiale*, E. J. Brill, Leiden, 1939; A. Mingana, *Encyclopaedia of Philosophical Sciences as Taught in Baghdād in c. 817 A. D., or Book of Treasures of Job of Edessa*, Cambridge, 1935; Mustaufi Qazwini, *Nuzhat al-Qulūb*, Shīrāzi, Bombay, 1311/1893; E. Nordenskiöld, *History of Biology*, Kegan Paul, New York, 1946; A. Qazwini, *Cosmographie*, ed. F. Wüstenfeld, Göttingen, 1848-49; G. Sarton, *Introduction to the History of Science*, 3 Vols., Baltimore, 1927-48; E. Wiedemann, "Beiträge zur Geschichte der Naturwissenschaften," *Sitzungsberichte d. phys. w. med. Soc.*, Erlangen, 1904-29.

Chapter LXVII

MEDICINE

A

INTRODUCTORY

It was not until nearly a hundred years after the conquest and consolidation of their empire that the Muslims turned their minds towards creative pursuits. It is remarkable in this context to find how quickly they directed their activities to productive ploughshares and prolific pens. Soon the Muslim Empire extended