

## «A Comparative study of th Khayyam's treatise on Musique»

• S. Sepanta

The present article is involed with the comparative description of the Omar Khayyam's treatise on musique. At the time of Khayyam (d. 1131) a musical scale based on tetrachordal patterns. A tetrachord was divided into four intervals. Khayyam classifie 21<sup>st</sup> tetrachord with a series of mathematical figures. In the present essay, The writher deciphered the tetrachords and found the intervals and converted into cents. The writer also compared the scales of Khayyam's age with the contemporary Iranian traditional musique, and mentioned some relevant melodies in the contemporary Iranian music in western notation.



work. Hence, Khayyam has been the real inspirer of non-Euclidian geometries.

In this article I have tried to study how Khayyam's theories were disseminated.

## «Omar Khayyam and Architecture»

• A. Özdurad

Omar Khayyam, an outstanding poet and a genius in mathematics, was one of the greatest intellects that the Islamic world had produced. His already known talents have won him great prestige both in the West and the East. There is another aspect of him, which is not yet as widely recognised, that I concentrate on most of my studies: his involvement in the ornamental arts and architecture.

In an untitled treatise, Omar Khayyam tells us how he discovered a special right-angled triangle the hypotenuse of which is equal to the sum of the perpendicular and the short side. It was, as his words suggest, a question asked at a meeting between mathematicians and artisans that prompted him to find the solution and to write a treatise about it. He solved the problem by way of cubic equations and also offered an estimated approximate solution. The verging construction of the very same problem appeared nearly two hundred years later in an anonymous Persian work on ornamental geometry. This elegant solution served there as the basis of a delicate ornamental pattern.

Almost contemporary with the Omar Khayyam's untitled treatise, North Dome of the Great Mosque of Isfahan was constructed. In this building of admirable proportions, I discovered that the design was generated from Omar Khayyam's triangle. As he himself was present in Isfahan at the time and the design indeed required the expertise and imagination of a talented and many-sided mathematician, I argued that the designer could be no one else but Omar Khayyam.

## «Khayyam and Non-Euclidian Geometries»

• J. Aghayani-Chavoshi

Euclid founded his geometry on three principles:

1. Definitions    2. Axioms    3. Postulates

Euclid's fifth postulate, which is known as "principle of parallelism", was not as axiomatic as his other principles. So from the very ancient times, Greek mathematicians tried to prove it and set it as a geometric theorem. Result of the Greek scientists' investigations reached Islamic mathematicians during the Middle Ages. These scientists, in turn, tried to prove this principle. The most well-known of these efforts belong to Nairizi, Shanni, and Ibn al-Haytham. A century after Ibn-al-Haytham, Khayyam studied the "Principles of Euclid's Geometry with a critical eye and found the fifth principle unsatisfactory. Hence, like preceding scientists, he tried to prove it, or at least, substitute it with simpler principles. Khayyam, who was both a mathematician and a philosopher, criticized the works of the preceding scientists. He criticized and refuted both Nairizi and Jowhari's works on logical grounds and considered Ibn-al-Haytham's effort on the account that he [Ibn-al-Haytham] had included movement in geometry. Afterwards, he himself suggested theorems to substitute Euclid's fifth principle by using a quadrilateral with two equal sides and right angles known as Saccheri quadrilateral. Interestingly enough, unknowingly Khayyam discovered several theorems in non-Euclidean geometry.

In Europe the first significant effort to prove the Euclid's fifth postulate belongs to Saccheri, the Italian mathematician. He, too, studied Khayyam's quadrilateral and came to nearly the same results as those of Khayyam's. Although he didn't succeed in proving the postulate of parallelism either (which is a non-provable principle), Saccheri unwarily discovered the first non-Euclidian theorems.

It is interesting that all the founders on non-Euclidian geometry such as Riemann, Lobachevsky, and others were familiar with Saccheri's work. On the other hand, comparison of Khayyam's theorems with those of Saccheri's will lead us to the result that they are, with an insignificant difference, similar. So Saccheri must have been aware of Khayyam's

## «Omar Khayyam's ontology»

• H. Naji-Isfahani

The most fundamental aspect of a philosopher's thought lies in the way he deals with epistemological questions. Since the peripatetics and almost all the medieval philosophers considered the problem of knowledge self-evident, they focused on ontological arguments. Therefore, to grasp their system of thought, it is necessary to understand their approach towards the question of existence and its injunctions.

As a philosopher, Khayyam who was much indebted to Aristotelian philosophy, has at points deviated from the ontological system of the peripatetics and has introduced new ontological arguments. Although the introduction of such arguments do mark a development in the history of ideas, yet, when considered within the framework of Khayyami philosophy, they exhibit contextual and intrinsic inconsistencies.

This article tries to present an overall view of this philosopher's system of thought on the one hand, and to pinpoint the fallacies therein on the other.

In this connection, making an analysis of the concept of mentally posited existence in both concept and connotation, as expressed in "Risalah al-Wujud", I draw attention to the contradictions in Khayyam's arguments when discussing the concept of generality of existence as compared to the essence (the concept of the addition of existence to the quiddity) in his treatise entitled "Risala al-dia... Following that, I have dealt with his misunderstanding of the "single and uniform (universal) meaning of existence". Further, I have made a critical assessment of Khayyam's argument regarding the ways in which effect requires cause, and ultimately, the emanation of multiplicity out of unity. Since, a great confusion has occurred in this philosopher's thought between the concepts of possibility on the one hand, and between the concepts of necessity-by-itself and necessity-by-something-else on the other.

both from two nearby towns in Khurāsān, expressing exactly the same views and making the same divisions in his *Deliverer from Error*<sup>3</sup>. “The Truth”, Ghazālī argues, “cannot lie outside these four groups. These are the people who tread the paths of the quest for truth. If the truth is not with them, no point remains in trying to apprehend the truth”.<sup>4</sup> More importantly, Khayyām’s main criticism regarding the philosophers corresponds to that of al-Ghazālī. Both criticize the philosophers in failing to preserve the conditions of proof in their arguments on the Divine knowledge and consequently fail to apprehend the truth.

Thus, questioning the very ability of philosophers, if not philosophy itself, in its quest after the ultimate Truth, our sage explicitly recommends another way which could lead the seeker to this Truth and that is none other than the way of the Sufis.

Worth mentioning as well is the fact that even in discussing the important philosophical theme of this treatise, i.e. “the Chain of Being”, Khayyām does not fail to draw, from a philosophical point of view, an ethical conclusion.

Later, in the closing paragraph, he brings up the same point in a different form and from a mystical perspective. He attempts to communicate his conviction that the knowledge of the hierarchical order of Being, though a pure philosophical notion, is capable of bringing man to his own true self, by encouraging him to speculate. Ultimately, this speculation can prepare him for a mystical journey in quest for truth. Thus, one can find a subtle internal connection between the philosophical and the mystical elements of this treatise.

For Khayyām, philosophy may partially prove useful in preparing the man’s way for the knowledge of Truth. Nevertheless, grasping the Ultimate Truth may be achieved solely through mysticism, in a state when by purification of the heart, which the center of human soul, the veils are revealed and the Truth reflects is itself into the man’s heart.

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(3 Watt, W. Montgomery, *The Faith and Practice of Al-Ghazālī*, Lahore (Pakistan), 1963.

(4 Ibid., P. 27.

(in *Madīna al-fādila*)<sup>1</sup>, Ibn Sīnā and most other Islamic philosophers, it occupies the tenth in the rank of transcendental entities emanated from Him.

Afterwards, Khayyām sets forth to explain his theory of the hierarchy of Being in terms of numbers. For this purpose, he establishes a parallelism between God, different ranks of being emanated from Him and the numbers - an outlook very similar to that expressed by Ikhwān in *Rasā'il*<sup>2</sup>, and which has its roots in Pythagoreanism. In this interpretation God is said to have existed before the Universal Intellect in the same way that number one existed before two. This parallelism continues by comparing the Universal Intellect with number two, the Universal Soul with number three and so forth. In Khayyām's terminology this hierarchical "Chain of Being", in which every rank is the effect of its previous rank and the cause of its subsequent, is called "*Silsila al-Tartīb*", i.e. "the Chain of Order". Here, Khayyām's views seem to be very close to that of Ikhwān, while, in his earlier philosophical works, written many years before, Khayyām is a faithful follower of Ibn Sīnā.

At the end of his discussion on the "Hierarchy of Being," Khayyām draws an ethical conclusion or rather derives a general rule for human conduct. Since man's intellect and soul are of the same primal genus as the Universal Intellect and soul, and since the proximity of this "Essence" (man's soul) with the material body will lead to its destruction, therefore, man should endeavour to resemble his genus by keeping his "Essence" pure from the qualities of the body.

The most distinguishing feature of Kullīyāt-i Wujūd, however, lies not in its philosophical arguments, but rather in what Khayyām puts forward in the last chapter where he deals with a subject which is unparalleled among his philosophical works. In the closing lines of this treatise, Khayyām, in phrases very much resembling a sage's testament to his disciples, introduces the seekers after the cognition of God. In his division, they fall into four groups: the theologians, the philosophers, the Īsmā'īlīs and the mystics (Sufis). Evaluating their ways, he implicitly disapproves the theologians, is impartial towards the Īsmā'īlīs, criticizes the philosophers and finally confirms and recommends the Sufi path.

Strangely enough, we find Ghazālī, a contemporary of Khayyām and

(1) Al-Fārābī, Abū Nasr, *Mabādi' Ārā' Ahl al-Madīnah al-Fādilah*, ed. and trans. By Richard Walzer, Oxford, 1985.

(2) Ikhwān al-Safā', *Rasā'il Ikhwān al-Safā'*, 2 vols, ed. by Khayr al-Dīn al-Zarkālī, al-Arabīya Pub., Egypt, 1928.

## Summaries of the persian articles

### «The Universals of Existence»

• B. Hashemipour

*Kulliyāt-i Wujūd* or *the Universals of Existence* is Khayyām's sole extant philosophical treatise in Persian. Having been written in the last years of his life, it occupies a special place among Khayyām's philosophical works and has a special importance in understanding his intellectual and spiritual development. Like Khayyām's other philosophical tracts, *Kulliyāt-i Wujūd* is a very short tract which he claims to be "more useful than a voluminous work." Thus, one would expect it to contain the essence of Khayyām's philosophy of Being. More than that, in this treatise, one finds a brief survey of the fundamentals of philosophy.

The main topic discussed in this treatise, in some detail, is the "Hierarchy of Being", where Khayyām expounds his theory of emanation. In Khayyām's "emanational" theory as that of his predecessors one discerns three distinctive elements: Neoplatonic notions, Ptolemaic cosmology and Aristotelian intellects. First, we have the God or the Necessary Existent. Next, comes the Active Intellect which is the "Ordainer" (*mudabbir*) of the Universal beings and at the same time the cause of the Second Intellect which itself is the cause of the Third Intellect. This chain continues down to the Tenth Intellect. For every intellect there is a soul related to it. These intellects and souls are the "ordainers" of their corresponding orb and the cause of its movement. The movement of these orbs is produced by the love (desire) which the souls of lower ranks have for reaching the higher ones, i.e. their corresponding intellects.

This hierarchical account of Being, though common to most prominent Islamic philosophers, slightly differs from that of Fārābī and Ibn Sīnā in the way the constituents of the hierarchy, as propounded by each philosopher, emanate from one another. But more importantly, in Khayyām's account, like that of Ikhwān al-Safā (the Brethren of Purity), the active intellect is the first being emanated from God, while for Fārābī