Al-Kindi, A Precursor Of The Scientific Revolution

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Summary

In this article, The life of Abu Yusuf Yaqub Ibn Ishaq Ibn al-Sabbah al-Kındi and his books are stressed. Moreover , his view of scientific knowledge is also pointed out.

Key Words: Al-Kındi, Middle Ages, History of Medicine, Medieval Science

Abu Yusuf Yaqub Ibn Ishaq Ibn al-Sabbah al-Kindi (al-Kindi, al-Kyndi, Alkindi, Alchindi - c. 803-873), one of the most interesting figures in the history of Medieval Science, was, most probably, born in al-Kufah (1), in southern Iraq, around 803, flourished in Baghdad under al-Mamun and al-Mutasim, was persecuted during the orthodox reaction led by al-Mutawakkil (847-861) and, after 861, he regained prestige with the court (2). He died in 873 (3).

Al-Kindi was interested in many subjects and wrote works of philosophy, mathematics, geometry, physics, astronomy and religion in addition to medicine. More than 270 titles are attributed to him, of which about thirty concern medicine (4).

His view of scientific knowledge can be gauged by the following passage:

> We must not hesitate to recognize the truth and to accept it no matter what is its origin, no matter if it comes to us from the ancients or from foreign people… My purpose is first to write down all that the ancients have left us on a given topic and then, using the Arabic tongue and taking into account the customs of our time and our capacities, to complete what they have not fully expressed (5).

His attitude toward science is also underlined by his views on alchemy, a practice that was commonly considered valuable in his time (6). He wrote, in fact, two tracts on the subject: "Warning against the Deceptions of the Alchemists," and "Refutation of the Claim of Those Who Claim the Artificial Fabrication of Gold and Silver." The titles speak for themselves.

In addition, al-Kindi brings a breath of fresh air to the atmosphere of the early Middle Ages by performing experiments. In a short "Treatise on the Efficient Cause of the Flow and Ebb" (*Risala fi l-Illa al-Faila li l-Madd wa l-Fazr*), he writes:

> One can also observe by the senses... how in consequence of extreme cold air changes into water. To do this, one takes a glass bottle, fills it completely with snow, and closes its end carefully. Then one determines its weight by weighing. One places it in a container… which has previously been weighed. On the surface of the bottle the air changes into water, and appears upon it like the drops on large porous pitchers, so that a considerable amount of water gradually collects inside the container. One then weighs the bottle, the water and the container, and finds their weight greater than previously, which proves the change (7).

The above is remarkable for its clarity and precision; as has been noted, it "reads like a modern laboratory experiment" (8).

Although he wrote several books on medicine, there is no evidence that he was a practicing physician. It is possible that his interest in it was dictated by his desire for knowledge. In his medical works he follows traditional, mostly Galenic paradigms. The following is an outline of epilepsy from his "Treatise on Diseases Caused by Phlegm":

> When the phlegm melts and changes to a bad irritant quality, it goes forth and ascends to the brain from a certain direction, then it sinks down through the principal veins towards the heart, and by its irritant quality it deranges the place of sense, thought and recollection in the brain. It passes through the veins towards the heart,

> and if the natural heat whose source is the heart is strong enough to dissolve it, it does so, and what happens as a consequence is epilepsy (*sar*). For the parts of the brain which we have mentioned, becoming injured, are overcome and cease to function. The disturbance which we see in the (patient's) body is owing to the conflict of the natural (heat) with the affection. When it prevails over it, it attacks and dissolves it. This is the meaning of the foam which is seen at the (patient's) mouth. When this occurs, his recovery is near (9).

In another medical work, the *aqrabadhin* (10), or "Medical Formulary," (11) al-Kindi describes many pharmaceutical preparations. Almost all simples in the *aqrabadhin* are derived from botanical sources, with only a few coming from the animal and mineral kingdoms (12).

The most important of al-Kindi's medical writings, however, is *De gradibus*, a remarkable work in which, in an original departure from tradition, he attempts to apply mathematics to pharmacology. Previously, Galen, confronted with the necessity of distinguishing between more and less powerful drugs, had devised the distinction between the four degrees of intensity of drug qualities (warmth and coldness, wetness and dryness). So, according to Galen, we could have a drug that, for example, was hot in the second degree and dry in the third, another cold in the second and humid in the fourth, and so on (13).

Galen's scale of strength was approximate and, since his time, a "degree" was understood to be a "certain quantity," two degrees "the double of one degree," three degrees the triple, and four degrees the quadruple. It was not clear how much a degree was, nor was it clear whether the term "degree" referred to the quality of the drug or to the sensation that it generated. In addition, once the degree of, let's say, coldness was agreed upon for a simple medication, what was the degree of a compound medication that contained several ingredients of different degrees of coldness? Al-Kindi, with remarkable originality and scientific foresight, decided to give those concepts a mathematical basis so that one could quantify the strength of drugs. In other words, al-Kindi was the first to attempt a serious quantification in medicine (in this case, of drug actions).

Al-Kindi started by assuming that a simple drug in which neither of two opposing qualities, let's say hot and cold, was prominent, was temperate (that is, neither warm nor cold) and possessed one "part" of each. Then he quantified the degrees of the effects of drugs by asserting that the arithmetic progression of the grades (1^{st}, 2^{nd}, 3^{rd}, 4^{th}) corresponds to a geometric progression of the number of parts that determine the grades. For example, the degree of warmth of a given drug is determined by the mixture of warmth and coldness in the following proportions (the same proportions would apply, of course, for degrees of coldness and for other opposing qualities - i.e., humid and dry):

Degree of warmth	Parts of warmth	Parts of coldness
Neither warm nor cold	1	1
1^{st} Degree	2	1
2^{nd} Degree	4	1
3^{rd} Degree	8	1
4^{th} Degree	16	1

In other words, $W/C = 2^n$, where W = warmth, C = coldness, and n = the value of the degree (14). As mentioned before, whereas the progression of the degrees is arithmetic, the corresponding increase of the parts of warmth is geometric. By knowing the exact quantitative relation between the qualities in any given simple, al-Kindi indicated that, in a compound medicine, by multiplying the weight of each simple by the parts of warmth and cold, one could easily calculate the degrees of the compound medicine. At this point, however, the mathematical reasoning of al-Kindi becomes complicated and rather difficult to follow. Roger Bacon, in fact, describes al-Kindi's method as "extremely difficult" even if essential for the determination of the degrees of a compound:

> The degree [of a compound] can only be determined by the method taught by AL-Kindi's *De gradibus*, one extremely difficult and almost entirely unknown among Latin physicians of these days, as everyone is aware. Whoever wants to become perfect in this philosopher's art must know the fundamentals of mathematics, because the species of greater and lesser inequality, the species of ratios, and the very difficult rules of fractions are all used by this author (15).

The *De gradibus* was translated by Gerard of Cremona in the twelfth century and is sometimes referred to as *Quia primos* by its incipit (16).

Al-Kindi, by recognizing the need to quantify the effects of drugs, showed a scientific outlook that makes him one of the most remarkable scholars of the Middle Ages. In addition, his experimental approach to scientific problems makes him a precursor of the scientific revolution that was to follow, even if much later. Gerolamo Cardano (1501-1576) considered him one of the greatest minds (17).

It is of interest to speculate why he had no followers. It would appear that al-Kindi is another of those rare figures in the history of science who, before the sixteenth century, seemed to have induced a shift in intellectual inquiry toward a scientific revolution, which, however, did not materialize. Elsewhere, we have mentioned others and discussed their work in this light: Herophilus and Erasistratus, (18) the Chinese authors who performed and upheld the value of experiments (e.g., Kuei Wan-Jung, Chen Hsien-chang), (19) and Galen (20).

We will end this brief review of the contributions of al-Kindi with the following passages attributed to him:

> Close your eyes, look down, when villains become masters. Grasp your hands for disappointment and sit in the corner of your house, in solitude…
>
> The real wealth is in the heart of men and in their souls is glory. So that riches come forth from one who owns little, while another of material wealth turns penniless… (21).
>
> Their timeless wisdom makes them as valid today as they were in his time and remind us, once again, that *nil novi sub sole* (22).

Note: The content of this paper is to be found in Part II, Chapter IV, C, e, of Plinio Prioreschi, *A History of Medicine, Volume IV, Byzantine and Islamic Medicine*, Omaha, Horatius Press, 2001.

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7. Quoted by Dunlop in: D. M. Dunlop, *Arab Civilization to A.D. 1500*, New York, Praeger, 1971, p. 224.
8. D. M. Dunlop, *Arab Civilization to A.D. 1500*, New York, Praeger, 1971, p. 224.
9. Quoted by Dunlop in: D. M. Dunlop, *Arab Civilization to A.D. 1500*, New York, Praeger, 1971, p. 232.
10. The word, which means "list" or "registry," became a synonym for a registry of drugs or prescription. Kamal Muhammad Habib, "Pharmacology and Materiae Medicae [sic!] in the Medical Formulary of al-Kindi," *Hamdard Medicus*, XXIV, 92-101, 1981.
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13. Galen, *De simplicium medicamentorum temperamentis et facultatibus*. See Plinio Prioreschi, *A History of Medicine, Volume III, Roman Medicine*, Omaha, Horatius Press, Vol. III, 1998, Chapter V, C. The *De simplicium medicamentorum temperamentis et facultatibus* became available in the West after its translation into Latin, usually attributed to Gerard of Cremona (d. 1187). It is possible, however, that it could have been translated one hundred years earlier by Constantinus Africanus (d. 1087). For a discussion of this topic, see: Michael. R. McVaugh, *The Medieval Theory of Compound Medicines*, Princeton University Dissertations, 1965, pp. 12-13.
14. The table (slightly modified) is from Danielle Jacquart and Françoise Micheau, *La médecine arabe et l'Occident médiéval*, Paris, Editions Maisonneuve et Larose, 1996, p. 188. See also: *Arnaldi de Villanova Opera Medica Omnia, II, Aphorismi de gradibus*, edited by Michael R. McVaugh, Granada, Universidad de Barcelona, 1975, p. 57.
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16. See: *Arnaldi de Villanova Opera Medica Omnia, II, Aphorismi de gradibus*, edited by Michael R. McVaugh, Granada, University of Barcelona, 1975, p. 56. The text of *Quia primos* is to be found in Appendix I, pp. 269-305.
17. George Sarton, *Introduction to the History of Science*, Baltimore, Williams & Wilkins, 3 Vols. (in five), 1927-1948, I, p. 559.
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22. "Nothing new under the sun."