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SOME NOTES ON THE ALGEBRA OF ABŪ KĀMIL SHUJĀ': A FUSION OF BABYLONIAN AND GREEK ALGEBRA

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A. Theory and practice in the Golden Age of the Arabs.

Abū Kāmil Shuja' (c. 900) was a product of the Golden Age of the Arabs. In this period, the Arabs were more than transmitters of the ancient and Hellenistic knowledge and learning. It is to the credit of the Muslims that they made many solid contributions both in the establishment of new facts and in their utilization. In turn, this higher organization of theoretical investigation and practical learning led eventually to the path of modern scientific methodology.

In chemistry, for example, the Muslims were responsible for the tremendous growth of industrial processes, pharmacy and iatro-chemistry as well as a furtherance of the development of chemical technique and apparatus. Simultaneously, experimental chemistry thrived as it had never done previously. Not only did they maintain their interest in the theoretical aspects of chemical reactions in the laboratory, but the Muslims furthered their practical side. Many Muslim chemical MSS, therefore, often contained labeled drawings of experimental apparatus. Experimental techniques are often described elaborately together with theoretical discussions of the properties of chemical elements and substances and their reactions [3].

It should be noted that the Alexandrian chemists already had contributed much in this direction, no doubt due to the stimulus of the Egyptian and Babylonian practical learning before them. By the time of Zosimos, Greek MSS contain a number of descriptions of operations by diagram of " fusion, calcination, solution, filtration, crystallization, sublimation and especially distillation " [2].

Going back still further, it is of interest that very few written accounts detailing the methods and tools of the Sumerians and Babylonians have been discovered. This is especially true for the more practical sciences of technology such as construction of dwellings, temples or ships, hauling of heavy materials, processing of fibres and weaving of cloth, and so on.

In this climate, the growth of Arabic mathematics paralleled the development of Muslim chemistry. In Abū Kāmil, this fresh approach was made in mathematics. Abū Kāmil utilized the theoretical Greek mathematics without destroying the concrete basis of al-Khwārizmī's algebra [4]. He evolved an algebra born of the practical realities proceeding originally from the Babylonian and then fired in the crucible of Greek theory. The understanding of the necessity of practical principles in Abū Kāmil provides a basis for a sound evolution of algebraic method [5].

Abū Kāmil's text on algebra.

The author has used photocopies of the three MSS extant: Cod. Heb. 225.2, Staatsbibliothek München; Lat. 7377A, Bibliothèque Nat. Paris (cf. L. C. Karpinski, *Bibliotheca Mathematica*, XII, pp. 40-55, 1912); and Cod. Heb. 1029.7, Bibl. Nat. Paris. The latter consists of only the first part of the Algebra. The München MS, the fullest copy of Abū Kāmil's algebra is a Hebrew translation and commentary by Mordecai Finzi, an Italian Jew and member of a noted scholarly family (cf. Carlo

Bernheimer, *La Bibliofilia*, XXVI, pp. 300-25, 1924/25). Through the kindness of Prof. S. Gandz, use has also been made of his autograph copy of a copy made by Dr. Joseph Weinberg who made a German translation, " Die Algebra des Abū Kāmil Šoğa' ben Aṣlam " (München, 1935).

B. The classical equation $x^2 + 21 = 10x$.

1. *Euclid Book II, proposition 5.*

From Euclid, we have the geometric solution of the equation $x^2 + b = ax$. According to the *Commentary of Proclus* (ed. Friedlein, p. 44), this is an ancient proposition and a discovery of the Muse of the Pythagoreans.

> " If a straight lines be cut into equal and unequal segments, the rectangle contained by the unequal segments of the whole together with the square on the straight line between the points of section is equal to the square on the half."
>
> " For let a straight line AB be cut into equal segments at C and into unequal segments at D; I say that the rectangle contained by AD, DB together with the square on CD is equal to the square on CB." [6]

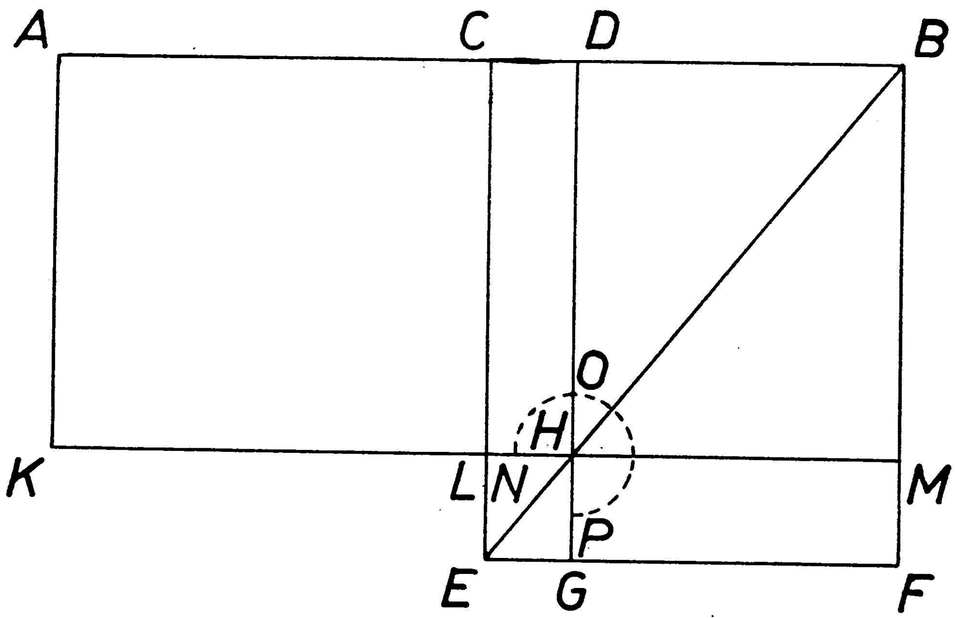

Fig. 1