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Artikel: SOME NOTES ON THE ALGEBRA OF AB KMIL SHUJ': A FUSION OF BABYLONIAN AND GREEK ALGEBRA

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Kapitel: D. Fusion of Babylonian and Greek Algebra.

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Abū Kāmil was the first Muslim algebraist to work with powers of the unknown higher than the square. In his algebra he uses the second, third, fourth, fifth, sixth and eighth powers of x. The names of these higher powers are based on the addition of exponents as we know them today. The development of this method of reckoning with exponents did not progress in a straight line. Hundred of years later symbols were still being used which were based on the systems of exponent multiplication [33].

D. Fusion of Babylonian and Greek Algebra.

From the passages of Abū Kāmil quoted above, it is evident that he was influenced by traditions which ultimately may be traced back to Babylonian and Greek Sources. On the one hand it is a further development of al-Khwārizmī's method, originally Babylonian, and on the other a utilization of the best algebraic innovations of the Greeks. It is possible that the latter were known, in part, to Abū Kāmil, through the works of Heron. The influence of Heron has already been established in the case of the great Hebrew geometer, Abraham Savasorda (12th century), as seen in his *Encyclopedia* [34]. It is interesting that Savasorda [35] who pioneered a new approach to geometry and Abū Kāmil who did the same for algebra should both have been influenced, directly or indirectly, by the great Alexandrian, Heron.

In turn, Abū Kāmil, as did Savasorda, exerted great influence upon al-Karkhī [36] and Leonardo Fibonacci, both of whom made use of many problems found in Abū Kāmil's algebra. In spite of the fact that Leonardo had squeezed Abū Kāmil's algebra dry of almost all his examples, nevertheless, enough material remained in the text so that Mordecai Finzi of the fifteenth century deemed it worthwhile to translate it into Hebrew and to insert further comments of his own.

In the painful growth of the integration of mathematical abstraction with its counterpart, the schematization and understanding of the practical basis, we have the seed of the forward development of mathematical science. With Abū Kāmil, mathematical abstraction attained recognition, not for its own sake, but because of its value when properly integrated with a more practical mathematical methodology.

NOTES AND REFERENCES

[1] The author is indebted to Temple University for a research grant which aided in the preparation of this paper.

[2] Cf. M. Levey, " Beginnings of Early Chemical Equipment: Some Apparatus of Ancient Mesopotamia ", *J. Chem. Educ.*, 32, 180-184 (1955); " Evidences of Ancient Distillation, Sublimation and Extraction in Mesopotamia ", *Centaurus*, IV, 23-33 (1955).

[3] An excellent example of this may be found in Maqbūl Aḥmad, " A Persian Translation of the Eleventh Century Arabic Alchemical Treatise 'Ain Aṣ-ṣan'ah Wa 'Aun Aṣ-ṣana'ah. " (*Mem. As. Soc. Bengal,* VIII, No. 7, pp. 419-460 (1929); Stapleton, Azo and Ḥusain, " Chemistry in 'Iraq and Persia in the Tenth Century A. D.", *idem*, VIII, No. 6, pp. 317-418 (1927); also Stapleton, " Alchemical Equipment in the Eleventh Century, A.D. ", *idem*, Vol. I, No. 4, pp. 47-70 (1905) for apparatus used and its implication for the importance of experimental work in chemistry (p. 65 bot.).

[4] Almost half of al-Khwārizmī's *Algebra* is devoted to problems arising directly from the inheritance laws of the Muslims.

[5] Alfred North Whitehead, " Science and the Modern World ", p. 48, gives another viewpoint, " . . . the utmost abstractions are the true weapons with which to control our thought of concrete fact ".

[6] Thomas L. Heath, " The Thirteen Books of Euclid's Elements ", I, p. 382 ff. (1908).

[7] Besthorn and Heiberg, " Codex Leidensis 399, 1. Euclidis Elementa Ex Interpretatione Al-Hadschdschadschii Cum Commentariis Al-Narizii ", Partis II, Fasc. I (Hauniae: 1900), pp. 27, 29. Translated by the present author from the Arabic with errors corrected. Corrected figure is given.

[8] Besthorn and Heiberg, p. 29, incorrectly have, " Sed ex II, 2 summa duorum spatiorum . . ." The figure for this demonstration is incorrectly given. G should be placed in the center of Line AB as a step of the proof would require.

[9] Cod. Heb. 225-2, Staatsbibliothek München, fol. 112*a*.

[10] München Cod. Heb. 225.2, fol. 113*a*.

[11] *Ibid.*, fols. 113*a*, 113*b*.

[12] For a full discussion of root and its practical significance, cf. S. Gandz, " The Origin of the Term ' Root ' ", *Am. Math. Monthly, 33*, pp. 261-5 (1926); *35*, pp. 67-75 (1928). Cf. also Solŏmon Gandz, " The Mishnat Ha Middot, The First Hebrew Geometry of About 150 C.E. ", in Quellen und Studien zur Geschichte der Math., A. Quellen, II (Berlin, 1932), *passim*. The term " root " in most cases meant " square basis ", that by whose multiplication we get the square area.

[13] More literal translation by the author from the Arabic edited by F. Rosen, " The Algebra of Mohammed Ben Musa " (London,