

Zeitschrift: L'Enseignement Mathématique
Herausgeber: Commission Internationale de l'Enseignement Mathématique
Band: 33 (1987)
Heft: 1-2: L'ENSEIGNEMENT MATHÉMATIQUE

Artikel: SKETCH OF THE EVOLUTION OF (NONCOMMUTATIVE) RING THEORY
Autor: Kleiner, Israel

Bibliographie
DOI: <https://doi.org/10.5169/seals-87895>

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

Download PDF: 27.04.2026

ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>

REFERENCES

Most of the references given here are to *secondary* sources. Extensive references, especially to *primary* sources, may be found in [3], [13], [29], [40], [61], [66], and [80].

- [1] ABIAN, A. *Linear Associative Algebra*. Pergamon Press, 1971.
- [2] ALBERT, A. A. *Modern Higher Algebra*. Cambridge University Press, 1938.
- [3] ——— *Structure of Algebras*. Amer. Math. Soc., 1939.
- [4] ——— (ed). *Studies in Modern Algebra*. Math. Assoc. of America, 1963.
- [5] ARTIN, E. Zur Theorie der hyperkomplexen Zahlen. *Hamb. Abh. Math. Sem.* 5 (1927), 251-260.
- [6] ——— The influence of J. H. M. Wedderburn on the development of modern algebra. *Bull. Amer. Math. Soc.* 56 (1950), 65-72.
- [7] ARTIN, E., C. NESBITT and R. M. THRALL. *Rings with Minimum Condition*. Univ. of Michigan Press, 1944.
- [8] BELL, E. T. Fifty years of algebra in America, 1888-1938. *Amer. Math. Soc. Semi-centennial Addresses, Vol. II*, A.M.S., 1938.
- [9] ——— *The Development of Mathematics*. McGraw-Hill, 1945 (2nd ed.).
- [10] BIRKHOFF, G. Current trends in algebra. *Amer. Math. Monthly* 80 (1973), 760-782.
- [11] ——— (ed.). Proceedings of American Academy workshop on the evolution of modern mathematics. *Hist. Math.* 2 (1974), 425-624.
- [12] ——— (a) The rise of modern algebra to 1936 and (b) The rise of modern algebra, 1936 to 1950. In: *Men and Institutions in American Mathematics*, ed. by D. Tartwater *et al.*, Texas Tech. Press, 1976, pp. 41-63 and 65-85.
- [13] BOURBAKI, N. *Eléments d'Histoire des Mathématiques*. Hermann, 1969.
- [14] BREWER, J. W. and M. K. SMITH. *Emmy Noether: A Tribute to her Life and Work*. Marcel Dekker, 1981.
- [15] CARTAN, H. and S. EILENBERG. *Homological Algebra*. Princeton Univ. Press, 1956.
- [16] CHEVALLEY, C. *Fundamental Concepts of Algebra*. Academic Press, 1956.
- [17] CLOCK, D. A. A New British Concept of Algebra: 1825-1850. PhD Dissertation, Univ. of Wisconsin, 1965.
- [18] COHEN, A. *An Introduction to the Lie Theory of One Parameter Groups*. D.C. Heath & Co., 1911.
- [19] COLLINS, J. V. An elementary exposition of Grassmann's "Ausdehnungslehre". *American Math. Monthly*, a series of articles in Vols. 6 (1899) and 7 (1900).
- [20] COZZENS, J. H. and F. L. SANDOMIERSKI. *Noncommutative Ring Theory*. Lecture Notes in Mathematics No. 545, Springer-Verlag, 1975.
- [21] CROWE, M. J. *A History of Vector Analysis*. Univ. of Notre-Dame Press, 1967.
- [22] CURTIS, C. W. and I. REINER. *Representation Theory of Finite Groups and Associative Algebras*. J. Wiley & Sons, 1962.
- [23] DAUNS, J. *A Concrete Approach to Division Rings*. Heldermann Verlag, 1982.
- [24] DICK, A. *Emmy Noether: 1882-1935*. Birkhäuser, 1981.

- [25] DICKSON, L. E. Definition of a linear associative algebra by independent postulates. *Trans. Amer. Math. Soc.* 4 (1903), 21-26.
- [26] ——— *Linear Algebras*. Cambridge Tracts in Mathematics No. 16, Hafner, 1971 (orig. 1914).
- [27] ——— On the relation between linear algebra and continuous groups. *Bull. Amer. Math. Soc.* 22 (1915), 53-61.
- [28] ——— *Algebras and their Arithmetics*. Dover, 1960 (orig. 1923).
- [29] DIEUDONNÉ, J. *Abrégé d'Histoire des Mathématiques, 1700-1900, Vol. I*. Hermann, 1978.
- [30] DRAXL, P. K. *Skew Fields*. Cambridge Univ. Press, 1983.
- [31] FRAENKEL, A. Über die Teiler der Null und die Zerlegung von Ringen. *Jour. für die Reine und Angew. Math.* 145 (1914), 139-176.
- [32] GOLAN, J. S. *Localization of Noncommutative Rings*. Marcel Dekker, 1975.
- [33] GRAY, M. *A Radical Approach to Algebra*. Addison-Wesley, 1970.
- [34] GUSTAFSON, W. H. The history of algebras and their representations. In: *Representations of Algebras*, ed. by M. Auslander & E. Lluís, Springer Lecture Notes in Math., 1982, pp. 1-28.
- [35] HANKINS, T. L. *Sir William Rowan Hamilton*. The Johns Hopkins Univ. Press, 1980.
- [36] HAPPEL, D. Klassifikationstheorie endlich-dimensionaler Algebren in der Zeit von 1880 bis 1920. *L'Enseignement Math.* 26 (1980), 91-102.
- [37] HARKIN, D. The development of modern algebra. *Norsk Mat. Tidsskr.* 33 (1951), 17-26.
- [38] HAWKES, H. On hypercomplex number systems. *Trans. Amer. Math. Soc.* 3 (1902), 312-330.
- [39] ——— Enumeration of non-quaternion number systems. *Math. Ann.* 58 (1904), 361-379.
- [40] HAWKINS, T. Hypercomplex numbers, Lie groups, and the creation of group representation theory. *Arch. Hist. Ex. Sc.* 8 (1971/72), 243-287.
- [41] ——— The theory of matrices in the 19th century. In: *Proc. Intern. Congr. Math.* (Vancouver), 1974, pp. 561-570.
- [42] HAZLETT, O. On the classification and invariante characterization of nilpotent algebras. *Amer. Jour. Math.* 38 (1916), 109-138.
- [43] HERSTEIN, I. N. *Noncommutative Rings*. The Carus Math. Monographs No. 15, Math. Assoc. of Amer., 1968.
- [44] JACOBSON, N. *The Theory of Rings*. Amer. Math. Soc., 1943.
- [45] ——— *Lectures in Abstract Algebra, 3 Vols.* D. Van Nostrand Co., 1951, 1953, and 1964.
- [46] ——— *Structure of Rings*. Amer. Math. Soc., 1956.
- [47] ——— *Lie Algebras*. John Wiley & Sons, 1962.
- [48] ——— *Basic Algebra I, II*. W. H. Freeman & Co., 1974 and 1980.
- [49] KLEINER, I. The evolution of group theory: a brief survey. *Math. Mag.* 59 (1986), 195-215.
- [50] KLINE, M. *Mathematical Thought from Ancient to Modern Times*. Oxford Univ. Press, 1972.
- [51] KOPPELMAN, E. The calculus of operations and the rise of abstract algebra. *Arch. Hist. Ex. Sc.* 8 (1971/72), 155-242.
- [52] KRUSE, R. L. and D. T. PRICE. *Nilpotent Rings*. Gordon & Breach, 1969.
- [53] KUROSH, A. G. The present status of the theory of rings and algebras. *Uspekhi Matem. Nauk.* 6 (1951), 3-15.

- [54] ——— *Lectures on General Algebra*. Chelsea Publ. Co., 1963.
- [55] LICHTENBERG, D. R. The Emergence of Structure in Algebra, PhD Dissertation, The Univ. of Wisconsin, 1966.
- [56] MACDUFFEE, C. C. Algebra's debt to Hamilton. *Scripta Math.* 10 (1944), 25-35.
- [57] MACLANE, S. History of abstract algebra. In: *American Mathematical Heritage: Algebra and Applied Mathematics*, ed. by D. Tarwater et al., Texas Tech. Press, 1981, pp. 3-35.
- [58] MCCOY, N. H. *The Theory of Rings*. Macmillan, 1964.
- [59] MERZBACH, U. C. Quantity to Structure: Development of Modern Algebraic Concepts from Leibniz to Dedekind, PhD Dissertation, Harvard Univ., 1964.
- [60] NOVY, L. L'Ecole algébrique anglaise. *Revue de Synthèse* 89 (1968), 211-222.
- [61] ——— *Origins of Modern Algebra*. Noordhoff Intern. Publ., 1973.
- [62] ——— Benjamin Peirce's concept of linear algebra. *Acta hist. rerum natur. necnon techn., Special Issue* 7 (1974), 211-230.
- [63] ØHRSTRØM, P. W. R. Hamilton's view of algebra as the science of pure time and his revision of this view. *Hist. Math.* 12 (1985), 45-55.
- [64] PARSHALL, K. H. In pursuit of the finite division algebra theorem and beyond: Joseph H. M. Wedderburn, Leonard E. Dickson, and Oswald Veblen. *Arch. Intern. d'Hist. des Sc.* 33 (1983), 274-299.
- [65] ——— Eliakim Hastings Moore and the founding of a mathematical community in America, 1892-1902. *Ann. of Sc.* 41 (1984), 313-333.
- [66] ——— Joseph H. M. Wedderburn and the structure theory of algebras. *Arch. Hist. Ex. Sc.* 32 (1985), 223-349.
- [67] PEIRCE, B. Linear Associative Algebra. *Amer. Jour. Math.* 4 (1881), 97-215. (Contains comments by C. S. Peirce.)
- [68] PYCIOR, H. M. The Role of Sir William Rowan Hamilton in the Development of British Modern Algebra, PhD Dissertation, Cornell Univ., 1976.
- [69] ——— Benjamin Peirce's *Linear Associative Algebra*. *Isis* 70 (1979), 537-551.
- [70] ——— George Peacock and the British origins of symbolical algebra. *Hist. Math.* 8 (1981), 23-45.
- [71] ——— Internalism, externalism, and beyond: 19th century British algebra. *Hist. Math.* 11 (1984), 424-441.
- [72] SHOFIELD, A. H. *Representations of Rings over Skew Fields*. Cambridge Univ. Press, 1985.
- [73] SMITH, G. S. De Morgan and the laws of algebra. *Centaurus* 25 (1981), 50-70.
- [74] SPITTISWOODE, W. Remarks on some recent generalizations of algebra. *Proc. London Math. Soc.* 4 (1871-73), 147-164.
- [75] SRINIVASAN, B. and J. SALLY (eds.). *Emmy Noether in Bryn Mawr*. Springer-Verlag, 1983.
- [76] TACHIKAWA, H. *Quasi-Frobenius Rings and Generalizations*. Lecture Notes in Mathematics, Springer-Verlag, 1973.
- [77] VAN DER WAERDEN, B. L. *Modern Algebra*. Springer-Verlag, 1930-31.
- [78] ——— Die Algebra seit Galois. *Jahresbericht der Deutsch. Math. Ver.* 68 (1966), 155-165.
- [79] ——— Hamilton's discovery of quaternions. *Math. Mag.* 49 (1976), 227-234.
- [80] ——— *A History of Algebra, from al-Khwarizmi to Emmy Noether*. Springer-Verlag, 1985.

- [81] WEDDERBURN, J. H. M. A theorem on finite algebras. *Trans. Amer. Math. Soc.* 6 (1905), 349-352.
- [82] — On hypercomplex numbers. *Proc. London Math. Soc.* 6 (1907), 77-118.

(Reçu le 18 mai 1987)

Israel Kleiner

Department of Mathematics
York University
North York, Ontario M3J 1P3
(Canada)