

65. J. J. Sylvester, "A Word on Nonions," *Johns Hopkins University Circulars* 1, 241-242 (1882); 2, 46 (1883).
66. K. E. Iverson, see Reference 37, p. 32.
67. W. S. Jevons, *Pure Logic, or the Logic of Quality Apart from Quantity*, London (1864).
68. W. S. Jevons, "On the Mathematical Performance of Logical Inference," Royal Society, *Philosophical Transactions* 160, 497-518 (1870).
69. R. Harley, "The Stanhope Demonstrator, an Instrument for Performing Logical Operations," *Mind* 4, 192-210 (1879).
70. A. Smee, *The Process of Thought Adapted to Words and Language, Together with a Description of the Relational and Differential Machines*, Longman, Brown, Green, and Longmans, London (1851).
71. C. S. Peirce, "Logical Machines," *American Journal of Psychology* 1, 165-170 (1887).
72. A. De Morgan, *Formal Logic: or, the Calculus of Inference Necessary and Probable*, first published in London in 1847, A. E. Taylor, Editor, reprinted by Open Court Company, London (1926).
73. Sylvester had not only been a colleague of De Morgan's, but at the age of 13 had been De Morgan's pupil. He was the second person to be awarded the De Morgan medal (1887). The first was Cayley (1884). Cayley received a Royal Medal from the Royal Society in 1859, as Sylvester did in 1861. Sylvester received the Copley Medal in 1880; it is the highest honor possible from the Royal Society.
74. K. E. Iverson, see Reference 2, pp. 23-25.
75. M. Kline, *op. cit.*, p. 1189.
76. K. E. Iverson, *op. cit.*, p. 24.
77. K. E. Iverson, *op. cit.*, p. 73.
78. A. D. Falkoff, K. E. Iverson, and E. H. Sussenguth, "A Formal Description of System/360," *IBM Systems Journal* 3, No. 3, 198-263 (1964).
79. S. Stevinus, *Statics and Hydrostatics* (1586).
80. W. W. Rouse Ball, *A Short Account of the History of Mathematics*, 4th Edition originally published in 1908, Dover Publications Inc., New York (1960), pp. 245-246.
81. M. Jammer, *Concepts of Force: A Study in the Foundations of Dynamics*, Harvard University Press, Cambridge, MA (1957). Reprinted by Harper Torchbooks, New York (1962), pp. 123-132.
82. I. Newton, *Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World*, translated by Andres Motte in 1729. Revised and edited by Florian Cajori, University of California, Berkeley, CA (1946).
83. M. Jammer, *op. cit.*, pp. 85-93.
84. J. Kepler, *Astronomia Nova ... De Motibus Stellae Martis* (1609).
85. R. Small, *An Account of the Astronomical Discoveries of Kepler: Including an Historical Review of the Systems Which Had Successfully Prevailed Before His Time*, J. Mawman, London (1804). Reprinted by University of Wisconsin Press, Madison, WI (1963), p. 198.
86. Harris, *Universal Dictionary of the Arts and Sciences* (1704).
87. While still an undergraduate, he was appointed to the Chair of Astronomy in Dublin, soon afterwards becoming Astronomer Royal of Ireland. Schrödinger called him "one of the greatest men of science the world has produced," and Whittaker said that "after Isaac Newton, the greatest mathematician of the English-speaking world is William Rowan Hamilton."
88. E. W. Hyde, *Grassmann's Space Analysis*, Mathematical Monograph, No. 6, 4th Edition, John Wiley & Sons, New York (1906).
89. F. Kline, *op. cit.*, Vol. 2, Chapters 2 and 3.
90. M. J. Crowe, *A History of Vector Analysis: The Evolution of the Idea of a Vectorial System*, Chapter 3, University of Notre Dame Press, South Bend, IN (1967).
91. J. J. Sylvester, "On the 8-Square Imaginaries," *Johns Hopkins University Circulars* 1, 203 (1882).
92. K. Menninger, *op. cit.*, pp. 53-54.
93. J. J. Sylvester, "On the Involution and Evolution of Quaternions," *Philosophical Magazine* 16, 394-396 (1883).
94. J. J. Sylvester, "Sur les Quantités formant un Groupe de Nonions analogues aux Quaternions de Hamilton," 2nd paper, *Comptes Rendus* 98, 273-276, 471-475 (1884).
95. B. Peirce, *Linear Associative Algebra*, memoir read before the National Academy of Sciences in Washington, 1870. Reprinted with notes and addenda by C. S. Peirce, in *American Journal of Mathematics* 4, 97-229 (1881).
96. C. W. Misner, K. S. Thorne, and J. A. Wheeler, "In Gravitation: Chapter 41," *Spinors*, W. H. Freeman and Company, San Francisco, CA (1973).
97. A. Kyrala, *Theoretical Physics: Applications of Vectors, Matrices, Tensors, and Quaternions*, W. B. Saunders Company, Philadelphia, PA and London (1967).
98. W. Pauli, "Pauli Lectures on Physics," *Wave Mechanics* 5, English translation, Charles P. Enz, Editor, The MIT Press, Cambridge, MA and London, p. 158.
99. P. A. M. Dirac, *The Principles of Quantum Mechanics*, Oxford University Press (1935), pp. 67-70; 4th Edition (1958), pp. 149-151.
100. C. W. Misner, *op. cit.*, pp. 1135-1158.
101. J. W. Gibbs, "On Multiple Algebra," address before the Section of Mathematics and Astronomy of the American Association for the Advancement of Science by the Vice President, American Association for the Advancement of Science, *Proceedings* 35, 37-66 (1886). Reprinted in *The Scientific Papers of J. Willard Gibbs, Ph.D., LL.D.*, Vol. 2, Dover Publications Inc., New York (1961).
102. In 1839, at the age of 25, Sylvester was elected a Fellow of the Royal Society. Although, in his own phrase, he was "one of the first holding the faith in which the Founder of Christianity was educated to compete for high honours in the Mathematical Tripos at Cambridge," he could not obtain his B.A. degree until 1872, after all religious tests had been abolished. At different times he was Professor of Physics in London, where he was a colleague of De Morgan's; Professor of Mathematics at the University of Virginia, where he left in haste after successfully defending himself with a sword-cane against the brother of a student whose work he had criticized; and Professor at the Royal Military Academy.
103. The currently popular movement that enjoys "debunking history and toppling eminent Victorians" has not spared Sylvester and Cayley. Hawkins (see Reference 104) says that "the significance of Cayley's memoir on matrices of 1858 has been grossly exaggerated." Sylvester is not even mentioned. Those interested may, however, consult References 105 and 106.
104. T. Hawkins, "The Theory of Matrices in the 19th Century," International Congress of Mathematicians, Vancouver, 1974, *Canadian Mathematical Congress* (1975), pp. 561-570.
105. A. Cayley, *Collected Mathematical Papers*, 13 volumes, Cambridge University Press, London (1889).