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(*b*. Amsterdam, the Netherlands, May 1628; *d*. Amsterdam, 15 April 1704)

mathematics.

Jan (or Johann) Hudde, the son of a merchant and patrician, Gerrit Hudde, and Maria Witsen, was christened on 23 May 1628. He studied law at the University of Leiden around 1648, at which time— perhaps even earlier—he was introduced to mathematics by Frans van Schooten. Besides acquainting his students with the classic works of the ancient mathematicians, Schooten gave them a thorough knowledge of Descartes's mathematical methods, as published in his *Géométrie* (1637).

Hudde's contributions to mathematics were probably made between 1654 and 1663, for there is no evidence of further mathematical work after the latter year. From then on, he devoted himself to the service of Amsterdam, as a member of the city council, juror, and chancellor. In 1673 he married Debora Blaw, a widow; they had no children. On 15 September 1672 Hudde was chosen by Stadtholder Wilhelm III as one of Amsterdam's four burgomasters. He held this office until 1704, serving altogether for twenty-one of those years (intermittently with one-year hiatuses required by law). Between his terms as burgomaster, Hudde was chancellor and deputy of the admiralty. In 1680 he received the Magnifikat for his services in the administration of the civic government. His anonymous biographer depicts him as "unselfish, honest, well-educated in the sciences, with his eyes open to the general welfare."

Hudde's teacher, Frans van Schooten, often incorporated the results of his students' work in his own books. Thus, in his *Exercitationes mathematicae* (1657) there are three essays by Hudde, including a treatise written in 1654 on the determination of the greatest width of the folium of Descartes. In 1657 Hudde participated in a correspondence among R. F. de Sluse, Christiaan Huygens, and Schooten on the questions of quadrature, tangents, and the centroids (centers of gravity) of certain algebraic curves.

Schooten's edition of the *Géométrie* (1659–1661) contains two other works by Hudde. The first, *De reductione aequationum*, may have been written in 1654–1655, according to a note in the foreword. Presented in the form of a letter to Schooten, it is dated 15 July 1657. The second, *De maximis et minimis*, is dated 26 February 1658. There also exists an exchange of letters between Hudde and Huygens (1663) on problems dealing with games of chance. This enumeration comprises all of Hudde's known mathematical works; but it is recorded in the notes of Leibniz, who visited Hudde in Amsterdam in November 1676, that Hudde still had many unpublished mathematical writings, which are now lost.

In Hudde's extant mathematical works two main problems can be recognized: the improvement of Descartes's algebraic methods with the intention of solving equations of higher degree by means of an algorithm; and the problem of extreme values (maxima and minima) and tangents to algebraic curves. In the latter Hudde accomplished the algorithmizing of Fermat's method, with which he had become acquainted through Schooten.

The solution, that is, the reduction, of algebraic equations was a central problem at that time. In 1545 Ludovico Ferrari had reduced the solution of a fourth-degree equation to the solutin of a cubic equation. In the *Géométrie* Descartes had combined equations of the fifth and sixth degrees into one genre and had given a method for the graphic determination of the roots. The contents of *De reductione aequationum* indicate that Hudde had originally tried to solve equations of the fifth and sixth degrees algebraically. Although unsuccessful in his attempt—and totally unaware of the reason for his failure—he at least compiled the cases in which a reduction of the degree is possible by separation of a factor. Correspondingly, Hudde also dealt with equations of the third and fourth degrees because their general solution presents great analytical difficulties. He gave the solution of the reduced cubic equation $x^3 = qx + r$ by means of the substitution $x = y + z$; he also gave the determination of the greatest common divisor of two polynomials by the process of elimination.

Hudde's rule of extreme values and tangents can be traced to Fermat. Expressed in modern terms, Fermat starts with the proposition that in the proximity of the maximum or minimum position x_0 of the function $f(x)$, $f(x_0 + h)$ is approximately equal to $f(x_0 - h)$. By expansion in terms of powers of h the linear member must, therefore, be omitted. For a rational function, which disappears at x_0, this means that x_0 is a "double" zero of the function. Proceeding from this proposition, Hudde was seeking an algorithmically usable rule for rational functions. His law states that if the polynomial $f(x) = \Sigma\, a_k x^{n-k}$ has the "double" zero of the function, then the polynomial $\Sigma\,(p + kq)\, a_k x^{n-k}$, with p,q arbitrary natural numbers, also has x_0 as the zero of th function. Fully stated (in Latin), the rule can be translated as "If in an equation two roots are equal and the equation is multiplied by an arithmetic progression to whatever degree is desired—that is, the first term of the equation is multiplied by the first term of the progression, the second term of the equation by the second term of the progression, and so on in regular order—then I say that the product will be an equation in which one of the mentioned roots will be found." The "double" zero of the function is, then, the zero of the greatest common divisor of the two polynomials. The greatest common divisor of the two polynomials. The greatest common divisor of th two polynomials. The greatest common divisor is found by the process of elimination that represents a variation of the well-known Euclidean algorithm. Hudde extended his dealings to include fractionalized rational functions, his method amounting to the expression (in modern terms)

His rule of tangents stands in direct relation to his process of extreme values, just as most of his other works represent applications of the results of his theory of equations, that is, the rule of tangents and extreme values.

Hudde was also interested in physics and astronomy. He spent much time with the astronomer Ismael Boulliau and reported his comet observations to Huygens in 1665. In 1663 he produced microscopes with spherical lenses; in 1665 he worked with Spinoza on the construction of telescope lenses. That he also had assembled a small *dioptrica* is seen from his correspondence with Spinoza. In 1671 he sent to Huygens mortality tables for the calculation of life annuities. During the next two years Hudde was charged by the city of Amsterdam with appraising DeWitt's formulas for the calculation of life annuities.

Perhaps the most gifted of Schooten's students, Hudde was also the most strongly influenced by him. At the time of Schooten's death in 1660. Hudde felt that he commanded a comprehensive view of the basic contemporary mathematical problems. Like Descartes he held as meaningful only such mathematical problems as could be handled through algebraic equations. After 1663 he pursued mathematics only as an avocation apart from—for him—more important civic activities.

His contemporaries saw him as a mathematician of great ability. Leibniz wrote, even as late as 1697, that one could expect a solution to the difficult problem of the brachistochrone only from L'Hospital, Newton, the Bernoullis, and Hudde "had he not ceased such investigations long ago."

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Karlheinz Haas