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(b. Ulm, Germany, 5 May 1580; d. Ulm, 1635)

mathematics.

The Faulhaber family lived in Ulm from the middle of the fifteenth century and had been vassals of the abbot of Fulda from 1354 to 1461. Like his father, who died in 1593, Faulhaber first learned weaving. Ursula Esslinger of Ravensburg, whom Faulhaber married in 1600, bore him nine children, several of whom distinguished themselves as mathematicians. His son Johann Matthaüs, born in 1604, learned weaving from his father before he turned to mathematics. In 1622 he accompanied his father to Basel to survey the fortifications and became director of the assignment following his father's death. A second son, also named Johann, born in 1609, was captain in the Corps of Engineers at Ulm.

His natural abilities led Faulhaber from weaving to mathematics. His first teacher in Ulm was the writing and arithmetic teacher David Saelzlin. The mathematicians of the sixteenth century concerned with algebra called themselves Cossists (from the Italian *cosa*, or "thing," which was used to designate the quantity being sought). Max Jaehns calls Faulhaber one of the most significant of the Cossists and the first to take algebra into equations higher than the third degree.¹

His education did not make Faulhaber proficient in Latin, but with laborious effort he translated the Latin texts that he needed, lent by Michael Maestlin in Tübingen, as we learn from his letter of 16 April 1617 to Matthäus Beger, in Reutlingen:

...since then I have taken the trouble to get the most distinguished books in German... as a person who never studied Latin and only now have attained some understanding of the language... to translate from Latin into simple German so that I now have at hand in German the books of Euclid, Archimedes, Apollonius, Serenus, Theodosius, Regiomontanus, Cardano....

After Faulhaber had helped Johann Kraft, arithmetic master in Ulm, to publish an arithmetic text, he founded his own school in Ulm in 1600.²

From 1604 on, Faulhaber received a salary of 30 guildens for running this school, but it was withdrawn in 1610 for a few months because he was concerning himself more and more with physical and technical inventions and developing an extensive literary activity that took him away from his pedagogic duties. Above and beyond this, he incurred the displeasure of the municipal council because he published *Neu erfundener Gebrauch eines Niederländischen Instruments zum Abmessen und Grundlegen, mit sehr geschwindem Vortheil zu practiciren* without the permission of the office responsible for supervision of the schools. About this time Faulhaber set up the formulas for the sum of the powers for natural numbers up to the thirteenth power, a problem with which [Leonhard Euler](#) was later concerned in a general way. He knew of the expression for the final difference of the arithmetic series obtained by raising the terms of an arithmetic series of the first order to a higher power.³ More and more his school became an educational institute for higher mathematical sciences, and an artillery and engineering school was later added. In the pedagogic field Faulhaber's particular merit was in the dissemination of mathematical knowledge for general use. His arithmetic text, *Arithmetischer Wegweiser zu der hochnutzlichen freyen Rechenkunst* (1614), is a very clear textbook for the period. In the early editions he got as far as the "rule of three"; in later editions he treated all of the computations for ordinary use and even the fundamentals of equations. His writings on algebra are difficult to interpret because he used symbols that are no longer common. His particular concerns in these works are the theory of progressions, theory of magic squares, and the nature of numbers.

Like Michael Stifel, the Augustinian monk and promotor of calculation with logarithms, Faulhaber was noted for his mystical consideration of pseudomathematical problems. He attempted to interpret future events from numbers in the Bible: from Genesis, Jeremiah, Daniel, and Revelation. Together with the master baker from Ulm, Noah Kolb, he predicted the end of the world by 1605 and was put in jail for this in 1606. On the basis of his confession that he had not acted with evil intent, but from an irresistible impulse of conscience, he was released. As early as seven years later he again believed that he could see "numeri figurati"—figured numbers—in certain numbers from the Bible, and his view that God had used pyramidal numbers in the prophecies of the Bible was expressed in *Neuer mathematischer Kunstspiegel* (1612). Faulhaber meditated on the numbers 2,300 (Daniel VIII: 14), 1,335 (Daniel XII: 12), 1,290 (Daniel XII: 11), 1,260 (Revelation XI: 3), and 666 (Revelation XX: 2). These are the same numbers with which Stifel concerned himself.⁴

The extent to which this mystic arithmetic had affected Faulhaber can be seen in his books *Andeutung einer unerhörten neuen Wunderkunst...* (1613) and *Himmlische geheime Magia...* (1613). In the latter book he attempted to solve the hidden riddles of his sealed numbers by a peculiar transposition of the German, Latin, Greek, and Hebrew alphabets, a puzzle in which he refers

to the tribes Gog and Magog mentioned in Revelation XX: 8. This biblical interpretation being contrary to Christian teachings, he drew the enmity of the clergy upon himself, and at their instance he was warned by the magistrate in Ulm that he should no longer print such interpretations without the knowledge and permission of the censor, upon pain of losing his [civil rights](#). Since other theologians, such as Hasenreffer, the chancellor of Tübingen University, also sent warning letters to the Ulm city council, the prohibition of *Himmlische geheime Magia* was intensified.

Faulhaber also devoted himself to alchemy, which he practiced as a believer in Johann Valentin Andreae's *Chymische Hochzeit des Christiani Rosencreutz*, first published anonymously about 1604. On 21 January 1618 he wrote to Rudolph von Bünau: "... I am not sparing any efforts in inquiring about the commendable Rosicrucian Society..."; and on 21 March 1621, to Bünau: "... with the help of God, I have come to the point where I can make 2 grains of gold out of 1 grain of gold in a few days, which is why I give praise and thanks to the Almighty, and although one-tenth is supposed to become 10, up to now, I have not been able to get it any further and have worked it with my own hands."

These mysterious arts brought Faulhaber into contact with Duke Johann Friedrich von Württemberg. In 1619 he obtained permission to teach his arts and sciences freely in the duchy, and he continued to have that permission until after he again distributed his forbidden writings about Gog and Magog.

The reputation of Faulhaber's mathematics school extended so far that Descartes studied with him in 1620.⁵ According to Veesenmayer, Descartes had already corresponded with Faulhaber concerning questions of plane [analytic geometry](#)⁶ and had been stimulated to write *Discours sur la méthode...* (1637).⁷ Descartes called him a "mathematicum insignem et imprimis in numerorum doctrina versatum et præceptorem."⁸

Faulhaber's lasting accomplishment was the dissemination and explanation of the logarithmic method of calculation. The dissemination of the logarithms associated with Stifel, Bürgi, and Napier occurred through his chief work, *Ingenieurs-Schul*, the *Appendix oder Anhang... Ingenieurs-Schul*, and the *Zehntausend Logarithmi...* He gives the logarithms of the numbers 1–10,000 to seven places and the values of the six natural goniometric functions to ten places. Along with the solution of plane and spherical triangles, with the applications to fortification and astronomical geography, we find the reason in the *Appendix*: "... that the entire foundation and correct basis of the logarithms from which they originate and are made, are briefly indicated and explained..." In addition, it was the first publication of the Briggs logarithms in German.⁹ Faulhaber devoted himself to the stereometric analogue to the [Pythagorean theorem](#), which he found and to which he was led by an apocalyptic number, 666. He first published this theorem as a numerical example in his "Miracula arithmetica," which is part of the *Continuatio des neuen mathematischen Kunstspiegel* (1620). Descartes, who probably learned it from Faulhaber, reproduced it in 1620: "In tetraedro rectangula basis potentia aequalis est potentistrium facierum simul." If one imagines a rectangular system of coordinates intersected by an [inclined plane](#); if A , B , and C are the areas of the right triangles that occur on the planes of the coordinates; and if D is the area of the triangle determined by the intersections of the axes on this intersecting plane, then $D^2 = A^2 + B^2 + C^2$.

Faulhaber usually gives the solutions of his mathematical problems only in hints. Among the problems treated in the first part of his *Ingenieurs-Schul*, the question concerning an irregular circle-heptagon (p. 168) attained some measure of fame because the well-known nineteenth-century mathematicians Moebius and Siebeck concerned themselves with it. Faulhaber inscribed within a circle a heptagon with sides of lengths 2,300, 1,600, 1,290, 1,000, 666, 1,260, and 1,335, then asked how the radius of this circle could be found and how many degrees and minutes each angle contained. The numbers again are those of Michael Stifel. Faulhaber does not say how he solved this problem, but in the *Ingenieurs-Schul* (ch. 13, p. 157), he gives the result according to which the radius of the circle is "found to be."¹⁰

Faulhaber's prestige as a fortifications engineer is based on his many assignments in this field. Besides Duke August von Brunswick-Lüneburg, his services were sought by Duke Johann Friedrich von Württemberg, Cardinal Dietrichstein of Nicholsburg (near Vienna), King Gustavus Adolphus of Sweden, and the cities of Randegg, Schaffhausen, and Fürstenberg. Unfortunately, in this area too his full development was hindered by his religious fanaticism. On 5 December 1618 he entered the service of Landgrave Philipp von Butzbach, who sought him as an adviser, but he continued to live in Ulm. He wanted to make "all his inventions" known to the landgrave except his work in "munitions," i.e., in fortifications, which he was forbidden to divulge by the municipal council of Ulm.¹¹ Soon thereafter Faulhaber concerned himself anew with his interpretations of biblical numbers, and in April 1619 his mathematical and astronomical writings to the landgrave suddenly ended. Perhaps it was because the prince, who was firmly grounded in Christian teachings, believed that he had deceived himself about Faulhaber, or perhaps it was, as Faulhaber claims, that he was supposed to give the prince secrets which he had to consider in total confidence. In spite of this, the landgrave remained interested in his former adviser. In 1622 he received news about Faulhaber through Konrad Dietrich, superintendent in Ulm; and we learn from his letter of 23 March 1625 that Faulhaber "has been reconciled with an honorable councilman in Ulm and has promised in the name of the Almighty to let his whims fall."¹²

The full picture of Faulhaber's character is revealed from the controversies into which he was drawn. To be sure, we do not find his scientific importance reduced, but he nevertheless appears shady in view of the interplay of serious perception and speculative fantasy. Having been ordered by the municipal council of Ulm to publish an almanac for the year 1618, he used the ephemerides of [Johannes Kepler](#). In it Kepler listed two rare constellations that were supposed to appear before and after 1 September, which means that the appearance of a comet cannot be regarded as excluded. In his almanac Faulhaber predicted a comet for 1 September 1618, on the basis of a consideration of the longitude and latitude of Mars and the moon. When one of

the greatest comets of that era appeared in November 1618, Faulhaber no longer doubted the efficacy of his secret numbers and had this opinion published through his friend J. G. Goldberg.¹³ Attacked as vehemently by Hebenstreit and Zimpertus Wehe in Ulm as he was defended by Matthaues Begerin Reutlingen, Faulhaber appealed to the municipal council in Ulm and the ecclesiastical authorities, who decided in his favor.

He had a lively contact with [Johannes Kepler](#). Upon the order of the magistrate, in 1622 he and Kepler designed a gauging kettle for the measurement of length, volume, and weight, which was cast by Hans Braun in 1627.¹⁴

NOTES

1. *Geschichte der Kriegswissenschaften, vol. XXI of Geschichte der Wissenschaften in Deutschland* (Munich-Leipzig, 1890), sec. 2, ch. 4, p. 1115, par. 118.
2. Although he was the author, it did not appear under his name. Georg Veesenmayer, *De Ulmensium in arithmetica meritum* (Ulm, 1794), p. 6.
3. L. E. Ofterdinger, "Beiträge zur Geschichte der Mathematik in Ulm," in *Programmschrift des Königlichen Gymnasiums zu Ulm* (Ulm, 1866–1867).
4. Joseph E. Hofmann, "Michael Stifel," in *Sudhoffs Archiv für Geschichte der Medizin und Naturwissenschaften*, supp. 9 (1968), 2–5.
5. J. G. Doppelmayr, *Historische Nachricht von den Nürnbergischen Mathematicis und Künstlern* (Nuremberg, 1730), p. 209.
6. Veesenmayer, *op. cit.*, p. 7.
7. [Christian Thomasius](#), *Historia sapientiae et stultitiae* (Halle, 1693), II, 113.
8. Ofterdinger, *op. cit.*, p. 5.
9. MS notes for and drafts of this work are in the Ulm municipal archives.
10. A. Germann, "Das irreguläre Siebneck des Ulmer Mathematikers Joh. Faulhaber," in *Programmschrift des Königlichen Gymnasiums zu Ulm* (Ulm, 1875–1876), pp. 3–13.
11. *Ulmer Ratsprotokolle*, no. 61 (1611), fol. 674b.
12. Wilhelm Diehl, *Landgraf Philipp von Butzbach*, no. 4 of the series *Aus Butzbach Vergangenheit* (Giessen, 1922), pp. 37 ff.
13. Conrad Holzhalbuis, *Herrn Faulhabers... Continuatio seiner neuen Wunderkunen oder arithmetischen Wunderwerken* (Zurich, 1617).
14. K. E. Haeberle, *10,000 Jahre Waage* (Balingen, 1966), pp. 109–111.

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Ingenieurs-Schul... (Augsburg, 1631); and *Zehntausend Logarithmi der absoluten oder ledigen Zahlen...* (Augsburg, 1631). A holograph MS of Faulhaber's, entitled "Beobachtungen von Mund- und Sonnenringen" (1619), is in the Darmstadt Landesbibliothek, 4° 3044. Ten letters from Faulhaber to Philipp von Butzbach are in the Darmstadt Staatsarchiv, 55, 1618–1619.

II. Secondary Literature. On Faulhaber's work, see Matthias Bernegger, *Sinum, tangentium et secantium canon...* (Strasbourg, 1619[?]), which refers to *Neue geometrische und perspectivische Inventiones etlicher sonderbarer Instrument....*; and *Phantasma qua Joh. Faulhaber de ansa inauditae et admirabilis artis...* (Strasbourg, 1614), a refutation of *Andeutung einer unerhörten neuen Wunderkunst*; Benjamin Bramer, *Beschreibung eines sehr leichten Perspectiv und grundreissenden Instruments auf einem Stande...* (Kassel, 1630), which refers to *Appendix oder Anhang der Continuation des neuen mathematischen Kunstspiegel...*; Georg Galgemair, *Centiloquium circini proportionum. Ein neuer Proportionalzirkel von 4, 5, 6 oder mehr Spitzen* (Nuremberg, 1626), which refers to *Neue geometrische und perspectivische Inventiones etlicher sonderbarer Instrument....*; J. G. Goldtberg, *Fama sydereae nova. Gemein öffentliches Ausschreiben...* (Nuremberg, 1618, 1619); *Expolitio famae sidereae novae Faulhabereanae...* (Prague, 1619); *Postulatum aequitatis plenissimum, Das ist: Ein billiges und rechtmässiges Begehren, die Expolationem famae Faulhaberianae betreffend...* (Prague, 1619); *Fama sydereae nova, das ist weitere Continuatio der Gottlichen neuen Wunderzeichen und grossen Miaculn...* (Nuremberg, 1620); and *Vindiciarium Faulhaberianum continuatio...* (Ulm, 1620); Conrad Holzhalbuis, *Herrn Faulhabers... Continuatio seiner neuen Wunderkünsten oder arithmetischen Wunderwerken* (Zurich, 1617); Petrus Roth, *Arithmetica philosophica...*, II (Nuremberg, 1608), which refers to *Arithmetischer cubicossischer Lustgarten mit neuen Inventionibus gepflanzet*; and David Verbez, *Miracula arithmetica zu der Continuation des arithmetischen Wegweisers* (Augsburg, 1622).

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