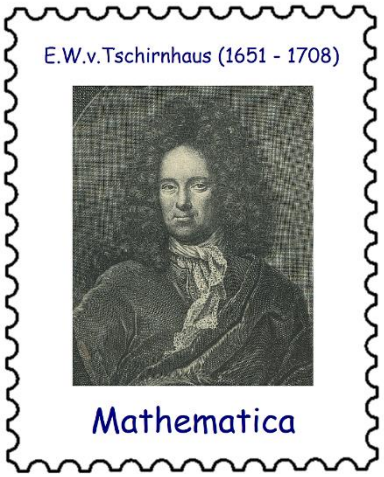
EHRENFRIED WALTER GRAF VON TSCHIRNHAUS (April 10, 1651 – October 11, 1708)

by HEINZ KLAUS STRICK, Germany



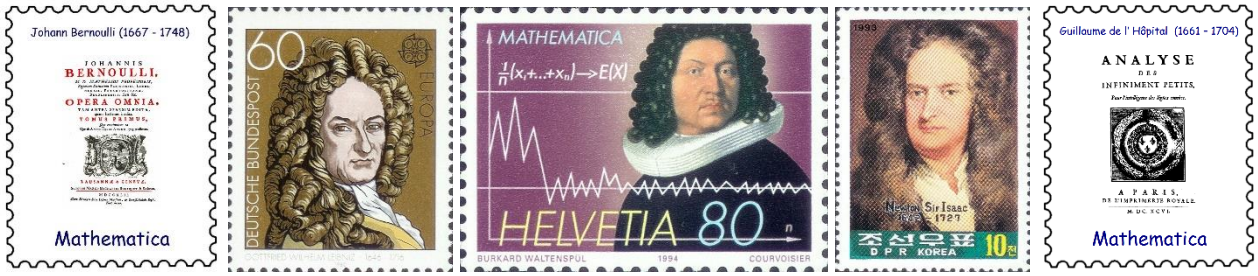
Portrait of TSCHIRNHAUS with kind permission of Staatl. Schlösser, Burgen und Gärten Sachsen gGmbH, Albrechtsburg Meissen

In June 1696 JOHANN BERNOULLI, professor in Groningen, posed the following problem to the "most astute mathematicians in the whole world" in the *Acta Eruditorum* published in Leipzig:

If two points A and B are given in a vertical plane, the moving point M is to be assigned a path AMB on which, starting from A, it reaches B in the shortest possible time by virtue of its own gravity.

So the so-called *brachistochrone* (*brachistos* = shortest, *chronos* = time) is sought. Even after the submission deadline was extended, it became apparent that only a few mathematicians were capable of tackling the problem:

GOTTFRIED WILHELM LEIBNIZ, JOHANN BERNOULLI's brother JACOB (who at the same time still generalised the problem), ISAAC NEWTON (who submitted his solution anonymously, but was recognisable by the way he solved it – *tanguam ex ungue leonem* [I know the lion by his claw], as JOHANN BERNOULLI noted), GUILLAUME FRANÇOIS ANTOINE DE L'HÔPITAL and EHRENFRIED WALTER GRAF VON TSCHIRNHAUS.

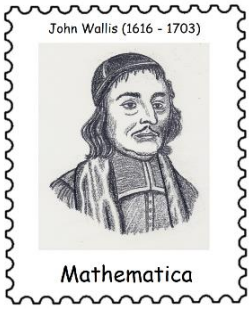


TSCHIRNHAUS was born in 1651 in Kieslingswalde (Upper Lusatia, today Sławnikowice in Poland) as the son of a Saxon nobleman, and was educated by private tutors before being prepared for university at the age of 15 at the *Gymnasium* in neighbouring Görlitz.

From 1668 onwards, TSCHIRNHAUS studied mathematics, philosophy, physics, medicine and law at the University of Leiden and took private lessons with PIETER VAN SCHOOTEN, who introduced him to the mathematics and philosophy of RENÉ DESCARTES. His studies were interrupted in 1672 by LUDWIG XIV's invasion of the Netherlands (Dutch War, 1672 - 1678).

In 1674, TSCHIRNHAUS was introduced by his school friend PIETER VAN GENT to the discussion circle of the philosopher and religious critic BARUCH DE SPINOZA in The Hague, whose *Tractatus theologico-politicus* had been banned by the Church only a short time before.

With a letter of recommendation from SPINOZA, he travelled to England and met ROBERT BOYLE, JOHN WALLIS and ISAAC NEWTON, among others, through the secretary of the *Royal Society*, HENRY OLDENBURG.



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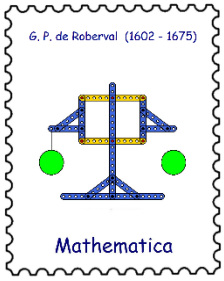
TSCHIRNHAUS then travelled on to Paris, where he met CHRISTIAAN HUYGENS and GOTTFRIED WILHELM LEIBNIZ. LEIBNIZ enabled him to see the not yet published writings of RENÉ DESCARTES, as well as the papers left behind by BLAISE PASCAL (died 1662) and GILLES PERSONNE DE ROBERVAL (died 1675).



TSCHIRNHAUS was fascinated by the experiments that the engineer and fireworks expert FRANÇOIS VILLETTE carried out with burning mirrors, and he developed his own ideas about them.

The journey continued via Lyon, Turin, Milan, Venice and Bologna to Rome, and then back again via Paris, The Hague and finally to Hanover, where LEIBNIZ had in the meantime taken up his duties as court counsellor to Duke JOHANN FRIEDRICH. After returning to his estates in Kieslingswalde, TSCHIRNHAUS experimented with spherical and paraboloid mirrors.

On another trip to Paris, he was elected a member of the *Académie des Sciences*. However, his hope that this would be associated with a lifelong pension from the French king was not fulfilled.

He returned to Saxony and married the daughter of an influential member of the Saxon court. While his wife took care of the administration of the estates, he continued his scientific studies.

From 1682 to 1699 he published (mainly to claim priority) a total of 22 articles in the *Acta Eruditorum*, among them intermediate results of his research on burning mirrors, but also his ideas on the general solution of equations of higher degree.

When TSCHIRNHAUS found a new way to solve equations of the third degree equations by a suitable substitution (today called the *TSCHIRNHAUS transformation*), he was convinced that this method was generally applicable and, although LEIBNIZ explicitly pointed out errors to him, in 1683 he published a paper in which he claimed to have found a solution method for arbitrary *n*th degree equations.

That one can eliminate the coefficients of the second highest power in the general equation $x^n + a_{n-1}x^{n-1} + a_{n-2}x^{n-2} + ... + a_1x^1 + a_0 = 0$ by the substitution $y = x + \frac{1}{n}a_{n-1}$ had been known for a long time. For example, a general cubic equation $x^3 + a_2x^2 + a_1x + a_0 = 0$ can be reduced to the reduced form $y^3 + b_1y + b_0 = 0$.

However, TSCHIRNHAUS found an ingenious method of also eliminating the linear term, so that only one equation of the type $z^3 + c = 0$ remained to be solved. This method works for equations of the 3rd degree, but becomes extremely confusing for equations of the 4th degree and can no longer be used for equations of higher degrees.

In 1686/87 TSCHIRNHAUS published two works that were reprinted several times (*Medicina Corporis* and *Medicina Mentis* – the term *Medicina* here stands for philosophy in general). In the edition of 1695 he added the supplement *Artis inveniendi praecepta generalia* (General Rules for the Theory of Invention) to the title. For TSCHIRNHAUS, experience was at the beginning of all philosophising – it was the basis and starting point of every invention (discovery of truth). This method of arriving at knowledge without uncovering causal connections led him astray several times (not only as in the above example in mathematics).

In his experiments with burning mirrors, TSCHIRNHAUS surpassed all his predecessors. In 1686 he built a solar mirror of silvered copper with a diameter of 1.63 m and a focal length of 1.13 m. With this he was able to generate temperatures of over 1400° C. In the years that followed, he also worked on the production of larger burning lenses, which he had cast in neighbouring glassworks. Little by little he improved the quality of the optical glasses.

From 1692, as head of the laboratories of the Elector of Saxony, he had sufficient financial means for his research. In particular, he was interested in the production of white porcelain, for which there was a growing demand – especially because it was important for members of the nobility to show off their own wealth through collections of special glass vessels and Chinese porcelain.

In order to explore new sales markets for glass and semi-precious stones, TSCHIRNHAUS travelled to Delft and visited the *faience* manufactories there. In Paris he tried to find out how so-called soft porcelain was made there.

In 1701 JOHANN FRIEDRICH BÖTTGER, a 19-year-old employee of a pharmacy in Berlin, had allegedly succeeded in turning silver into gold. He escaped a summons to the court of the Prussian Elector by fleeing to Saxony. There an alchemical laboratory was set up for him, where he was allowed to continue his experiments under guard "for his own safety".

After a failed escape attempt, he was placed under the command of TSCHIRNHAUS in 1704: The latter was able to change the original order to BÖTTGER to produce gold, and together they were now to research the production of porcelain. In the search for suitable formulas, they achieved a breakthrough in the summer of 1708 with the help of *kaolin* (so-called porcelain earth) found in the Ore Mountains (Erzgebirge). AUGUST II (THE STRONG) appointed TSCHIRNHAUS as director of the porcelain manufactory to be founded, but before he could become active, he died as a result of dysentery.

The executor of his estate, MELCHIOR STEINBRÜCK, found important clues in TSCHIRNHAUS's papers which finally enabled his brother-in-law BÖTTGER to announce the invention of European porcelain to the King of Saxony. In 1710, a production facility is set up at Albrechtsburg Castle in Meissen and the first *Meissen porcelain* was sold at the Leipzig trade fair as early as 1713.

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https://www.spektrum.de/wissen/ehrenfried-walter-graf-von-tschirnhaus-1651-1708/1402819

Translated 2022 by John O'Connor, University of St Andrews

Here an important hint for philatelists who also like individual (not officially issued) stamps. Enquiries at europablocks@web.de with the note: "Mathstamps".