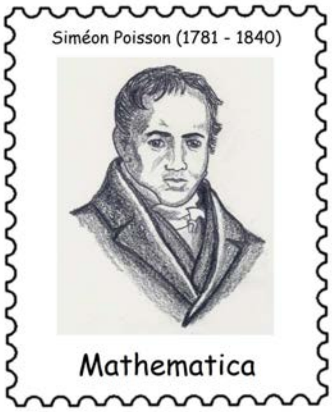
SIMÉON DENIS POISSON (June 21, 1781 – April 25, 1840)

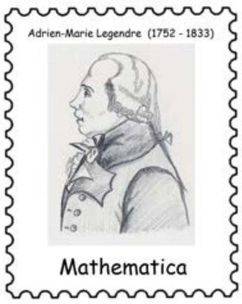
by HEINZ KLAUS STRICK, Germany



In the period before the French Revolution, those in France who did not belong to the nobility had a difficult time in establishing themselves in a professional career. Such a situation was experienced by SIMÉON DENIS POISSON's father, who, following his service as a soldier in the army, had to be satisfied with a minor administrative position in the provinces. When the Revolution altered the existing power structures, he seized his chance and took over an administrative office in the regional government. (drawings © Andreas Strick)

He then set out to take advantage of his new and influential position to secure the professional future of his son. He determined that a suitable career would be that of a surgeon, and so the fifteen-year-old SIMÉON was sent as an apprentice to a relative in Fontainebleau. But it was not long before it became clear that his son possessed neither an interest in medicine nor sufficient manual dexterity. Indeed, SIMÉON had considerable difficulty in physical coordination and could not possibly have been a suitable candidate for the career of a surgeon.

As an interim solution, it was decided to send the boy to school. There, SIMÉON impressed his teachers with his eagerness to learn and his rapid progress, particularly in mathematics, so that they advised him to register for the admissions examination at the *École Polytechnique*, in Paris. And although he had had no systematic education, he passed the examination in 1798 with the year's top score.



His new teachers, PIERRE-SIMON LAPLACE and JOSEPH-LOUIS LAGRANGE, immediately recognized the youth's extraordinary mathematical talent and cordially nurtured the young student. At the age of 18, POISSON wrote an article, which, after being reviewed by ADRIEN-MARIE LEGENDRE, was published in a respected professional journal.

The only branch of mathematics in which POISSON had difficulty was geometry, since he was unable to make the required drawings. Even though the area of descriptive geometry played an important part in the education programme of the *École Polytechnique*, due to the influence of GASPARD MONGE, that fact in no way hindered his rapid advance at university.

Following the publication of a paper on the theory of equations and ÉTIENNE BÉZOUT's method of elimination, he was awarded a university degree without having to take a final examination and was immediately engaged as a tutor at the *École Polytechnique* – following a proposal from LAPLACE.

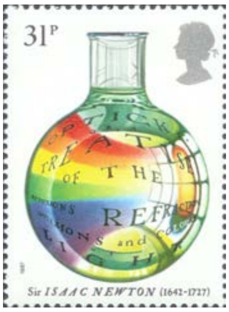
In 1802, he was appointed an assistant professor, and in 1806, when JOSEPH FOURIER could not refuse NAPOLEON's request that he accept the office of prefect of the département of Isère, POISSON was named his successor as professor of physics.

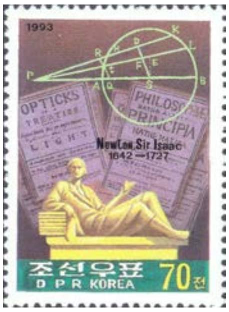
Poisson was interested primarily in applications of mathematics to physics. However, aware of his limited manual dexterity, he did not attempt the experimental verification of his theories. He published articles on perturbations in the orbits of the planets, a topic that had been previously considered by Laplace and Lagrange, and verified Isaac Newton's conjecture on the flattening of Earth at the poles. In 1811, he published the two-volume work *Traité de mécanique*, which was reissued in 1833.

In the course of time, the number of his offices increased: in 1808, he joined the *Bureau des Longitudes*; in 1809, he accepted a position as professor of mechanics a the new faculty of sciences; in 1815, he became an examiner at the *École Militaire* and at the *École Polytechnique*.

When in 1812, it became foreseeable that there might soon be a vacancy in the *Académie des Sciences*, mathematicians friendly to Poisson saw to it that the next prize sponsored by the *Académie* would be for a work on questions of electricity, in order to boost Poisson's chances.

His work *Sur la distribution de l'électricité à la surface des corps conducteurs* appeared at just the right moment, and led to his election to membership in the *Académie*.





In 1818, the *Académie des Sciences* sponsored a competition to resolve the century-old dispute as to the nature of light. Poisson was a strong adherent of Newton's corpuscular theory and forcefully rejected the theory of the wave nature of light propounded by Huygens. As a member of the jury, he sought to refute the contest entry submitted by Augustin Jean Fresnel through the following thought experiment:

An object is illuminated by a point source of light. If the light had the character of a wave, then due to the interference pattern of the waves, there should be a spot of light visible at the centre of the shadow; yet experiment had shown the absence of such a spot.

The head of the jury, François Arago, was adamant that the experiment be carried out under rigorous conditions, and when it was, to Poisson's chagrin, a spot of light as suggested by the theory was in fact discovered, a point that now goes by the name Poisson spot (also Arago spot or Fresnel bright spot) in the scientific literature.

Altogether, POISSON published over 300 works. His name appears in a number of connections, for example the following:

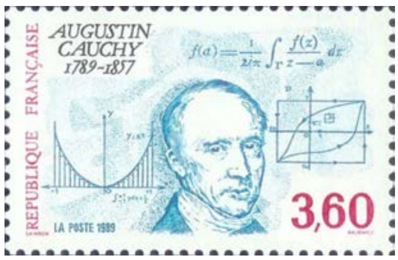
- In the theory of gravitation and electrostatics, one works with so-called POISSON equations, which are a particular type of differential equation.
- In caloric theory, one describes the connection between pressure *p* and volume *V* in an adiabatic process using POISSON's laws.
- If a body is subject to an attractive or repulsive force in the *x*-direction, then it is deformed in the directions of the *y*- and *z*-axes. The POISSON number then describes the material-specific relative change.

In his 1837 work *Recherches sur la probabilité des jugements en matière criminelle et matière civile* (research on the probability of judgments in criminal and civil matters), POISSON considered whether the application of principles of probability theory could be brought to bear to reduce the number of wrongful convictions.

In his *Ars conjectandi* (which appeared posthumously in 1713), JACOB BERNOULLI had described the phenomenon that with an increasing number of trials, the relative frequency $\frac{X}{n}$ stochastically approaches the probability *p* of the event; that is, for every $\varepsilon > 0$, one has $\lim_{n\to\infty} P\left(\left|\frac{X}{n} - p\right| < \varepsilon\right) = 1$.

In his *Recherches*, POISSON was the first to use the expression "law of large numbers". In addition, he determined that the approximation of the binomial distribution by a normal distribution becomes increasingly worse as the probability *p* of success becomes smaller, and he considered the passage to a distribution, which today bears his name, the *POISSON distribution*, that gives the probability of an event occurring *k* times in an interval of time if it is known that this event occurs, on average, λ times in this time interval: $P(X = k) = \frac{\lambda^k}{k!} \cdot e^{-\lambda}$

His successes in describing random processes were hardly noticed by his contemporaries. Only CHEBYSHEV continued his work in this area. The significance of the POISSON distribution was not fully recognized until the year 1898, when the work of LADISLAUS BORTKIEWICZ (*law of small numbers*) appeared.



Following the death of LAPLACE in 1827 and the emigration of AUGUSTIN CAUCHY (1830), POISSON became the most influential mathematician in France. Even though most of his contributions contain no original ideas but "only" take up the ideas of others and cleverly develop them further, POISSON holds a significant place as a connecting link to future generations.

In his last paper, he dealt with the effect of the Earth's rotation on the trajectories of projectiles, under the influence of the investigations of GASPARD GUSTAVE CORIOLIS. POISSON's work gave, in turn, the impetus to the research on pendulums carried out by JEAN BERNARD LÉON FOUCAULT.

France honoured POISSON posthumously by inscribing his name "for eternity" on the EIFFEL Tower alongside those of 71 other persons of significance. During his lifetime, POISSON was valued as an engaged and gifted teacher:

La vie n'est bonne qu'à deux choses: découvrir les mathématiques et enseigner les mathématiques. (Life is good for only two things: discovering mathematics and teaching mathematics.)

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Translated by David Kramer

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