CHARLES MARIE DE LA CONDAMINE (January 28, 1701 – February 4, 1774) and

PIERRE LOUIS MOREAU DE MAUPERTUIS (September 28, 1698 – July 27, 1759)

by HEINZ KLAUS STRICK, Germany

The following 1986 stamp commemorates two adventurous expeditions that began in 1736.

On behalf of the French *Academy of Sciences*, CHARLES MARIE DE LA CONDAMINE led a group of scientists to South America to determine the distance between two parallels of latitude along a meridian.

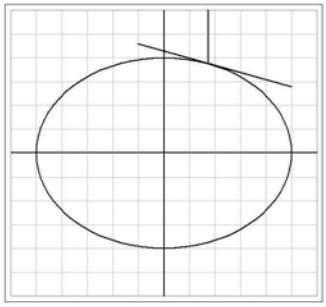
PIERRE LOUIS MOREAU DE MAUPERTUIS led another group to Lapland with the same mission. The stamp also shows quadrants as measuring instruments and images of the earth's "sphere" with parallels.

The aim of the two expeditions was to find out by measuring whether the earth was flattened towards the poles, as ISAAC NEWTON had claimed, or towards the equator, as JACQUES CASSINI had believed. CASSINI was sure of his case, believing that he had found evidence of this by surveying the line between Paris and Perpignan. JACQUES CASSINI continued the work of his father, the famous astronomer GIAN DOMENICO CASSINI, who had discovered the divisions in Saturn's rings.

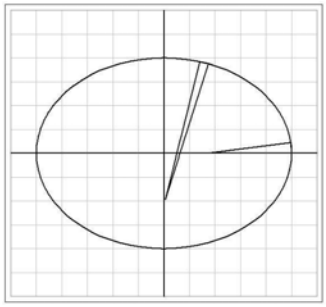
As early as 1672, the French mathematician and astronomer JEAN RICHER had noticed that his pendulum clock, which worked precisely in Paris, ran at about 2½ minutes per day slower in Guyana (South America), which indicated that the Earth's gravitational pull was stronger in Paris (i.e. at a shorter distance from the centre of the Earth).

However, NEWTON's theory of gravity was not yet generally accepted at that time ...

The geographical latitude of a place is measured by measuring the angle between the tangential plane of the earth's surface (i.e. in the direction of the horizon) and the extension of the earth's axis (approximately in the direction of the pole star) (Fig. on the right).



In the next figure on the right, the perpendiculars to the surface at the "latitude circles" of 0° and 5° and of 65° and 70° to the (exaggeratedly flattened) surface of the earth are plotted.



If one views the arcs of the ellipse as arcs of a circle, one can see that the corresponding radii are larger near the pole than near the equator.

If the earth is flattened towards the poles, the distance between two parallels of latitude at the equator must therefore be smaller than near the poles.

The measurements near Quito (close to the equator) showed a distance between the 0th and 1st parallel of 110.61 km, in Lapland between the 66th and 67th parallel of 111.95 km.

For this distance measurement, the so-called triangulation method was used: Starting from a *base line* measured as precisely as possible, the angles at which a certain landmark, e.g. a certain tree, a church or similar, which can be seen as far away as possible, are determined as precisely as possible from the end points of this line.

According to the sine theorem one then calculates the distances of the end points from this point (= missing triangle sides) and their position in a local coordinate system. From these distances further triangles are developed. This procedure works in principle also with height differences of the measuring points. It is obvious that measurement errors can have serious effects over a total distance of 100 km (error propagation) and this was what led to the corresponding false conclusions for the father and son CASSINI.

The leaders of the two expeditions, LA CONDAMINE and MAUPERTUIS, were chosen by the *Academy of Sciences* in Paris for their scientific merits.

CHARLES MARIE DE LA CONDAMINE, after attending a Jesuit college, had initially planned a military career for himself; after experiences in the Franco-Spanish war, he decided that army life did not suit him. On his return to Paris, however, he soon became bored with the scientific life of the capital. He took the opportunity to take part in a 5-month survey trip around the Mediterranean Sea, where he could try out new instruments and measuring methods. On the basis of his publications he was commissioned to lead the expedition to the equator. Since the expedition to Spanish territories led to Quito in Ecuador (then part of Peru), two young officers with a scientific interest were also appointed, ANTONIO DE ULLOA and JORGE JUAN, sent along for support and control.

The following scientists also took part in the expedition – see the Ecuadorian stamps above:

LOUIS GODIN (French astronomer),

PIERRE BOUGUER (French polymath) and

PEDRO VICENTE MALDONADO (later appointed Governor for his merits).

The difficult conditions in the Andes, where it was necessary to carry out surveys with differences in altitude of up to 5000 m and to enter previously inaccessible areas, put great strain on the health and nerves of the expedition participants. They soon got into a dispute about the accuracy of their measurements. Only after 10 years did they return to Europe by separate routes with a wealth of scientific knowledge.

For JORGE JUAN the expedition was the beginning of his career in the Spanish Navy.

He was mainly involved in the construction of ships, but also in astronomy and he was even used as a diplomat. At the end of his career, however, he did not succeed in asserting himself when it came to building the new fleet. In 1805 at Trafalgar it became clear that the new fleet was clearly inferior to the English fleet.

- PIERRE LOUIS MOREAU DE MAUPERTUIS' expedition to Lapland:

PIERRE LOUIS MOREAU DE MAUPERTUIS came from a Breton noble family, first studying music, then mathematics; his first scientific work was on the influence of the shape of a musical instrument on the sounds it produces.

His work on differential calculus and mechanics soon earned him a high reputation and he was entrusted with the management of the expedition to Lapland.

Mosquito plagues in summer and unbearable cold in winter made the work difficult, but it lasted "only" two years.

The Swedish mathematician and physicist ANDERS CELSIUS (1701 – 1744), the inventor of the metric temperature scale, also took part in the expedition.

In those days FREDERICK THE GREAT of Prussia pursued the ambitious goal of establishing an *Academy of Science* in Berlin with famous personalities.

MAUPERTUIS seemed to him to be suitable for this purpose and he offered him the position of President of the *Academy*.

The language of the scientists in Berlin was both Latin or French, but problems arose in everyday life because MAUPERTUIS did not understand German. MAUPERTUIS published on many different topics; for example, he presented considerations that can be seen as the forerunner of the theory of evolution.

His theory of the *principle of least action* (which he himself considered to be his greatest scientific achievement) then caused a scandal: As president of the *Academy*, he had agreed to the publication of a paper which he himself had not even read, but which stated that

(1) this theory was wrong and (2) did not come from him

and this provoked the philosopher VOLTAIRE, who had also been invited by FREDERICK to his court, to write some mocking verses on the incident.

Neither LEONARD EULER's partisanship nor VOLTAIRE's dismissal from the services of the Prussian king was able to stabilise MAUPERTUIS's health. On the way to Italy, where he was going to rest, he died in the house of JOHANN BERNOULLI in Basel.

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Translated 2020 by John O'Connor, University of St Andrews
