Gottfried Wilhelm Leibniz, the Universalist

The year just past, 1996, marks the 350th birth anniversary of Leibniz (1646–1716), who towers high in the Pantheon of original thinkers in the history of mankind. In a life dedicated completely to intellectual pursuits, he made fundamental and lasting contributions to an incredibly wide range of disciplines covering mathematics, logic, art of computation, mechanics, geology, jurisprudence, linguistics, philosophy and theology. This breath-taking versatility of his output puts him on the same footing as those chosen few among the scientists and philosophers (the names Archimedes, Newton, Leonardo da Vinci, Galileo immediately spring to one's mind) to whom the coveted appellation 'universalist' applies.

Gottfried Wilhelm Leibniz was born on July 1st, 1646 in Leipzig, where his father was a Professor of Moral Philosophy. During his school days he made good use of his father's library. He was enrolled in the University of Leipzig as a law student, where he was influenced by men who had revolutionized science and philosophy– Galileo, Francis Bacon, the English man of letters, Thomas Hobbes, the English philosopher and Rene Descartes, the French mathematician and philosopher. His attempts to engage Hobbes to correspond with him to settle philosophical issues met with failure, as the latter didn't take kindly to Leibniz's interpretation of his views ("certain men are wrong in ascribing license and impiety to your hypotheses"), which was nothing more than a left-handed compliment to the Englishman.

His baccalaureate thesis, *On the Principle of the Individual* (1663) already contains the beginnings of the notion of *monad*, which was to be the fundamental unit in the philosophical system he developed later. In 1666, he anticipated the modern computer by expounding the path-breaking idea that the process of thinking could be reduced to calculation. He envisioned a kind of generalized mathematics by means of which, he claimed, "we should be able to reason in metaphysics and morals in much the same way as in geometry and analysis. If controversies were to arise, there would be no more need of disputation between two philosophers than between two accountants. For, it would suffice to take their pencils in their hands, to sit down to their slates, and to say to each other (with a friend as witness, if they liked): Let us calculate!".

The University of Leipzig refused to award him a Doctorate (because he was underaged!), which he secured later from the University of Altdorf in 1666. But he turned down the offer of a Professorship there, declaring, he had "very different things in view". He joined the court of the archbishop of Mainz, and was involved in settling legal and political disputes.

In 1672 he was sent as an emissary to Paris to the court of Louis XIV. During his stay there for four years and in his travels to England he expanded his circle of scientific acquaintances. They included renowned men like Christian Huygens, a Dutch mathematician and astronomer who first helped with mathematics, Robert Boyle, John Pell and Tchirnhaus.

In 1673, he constructed an improved version of Pascal's arithmetic machine and presented it to the Royal Society, London. Leibniz's 'Stepped Reckoner' could perform the extraction of square roots in addition to the standard four basic operations among numbers. It must be mentioned that a completely reliable commercial model of this machine was released only in 1820. However, Leibniz had already made the crucial point that the binary system (base 2) is more natural to use than the decimal.

It was in 1673 that Leibniz made the greatest discovery of his life – calculus. The invention of calculus marked one of the most profound achievements of mankind in the History of Sciences and would have a permanent and far-reaching impact not only in mathematical sciences like geometry, physics, astronomy etc, but also in seemingly unrelated subjects like biology and economics. This work was published only in 1684 in his memoir *New Methods for the Greatest and the Least*. Earlier in 1665, Sir Isaac Newton had also discovered calculus. He had initially contented himself by showing his work to Gregory and Collins; his work also appeared much later. This delay in the publication in both cases resulted in an unsavoury controversy between these two eminent mathematicians as to priority in the invention of calculus. The issue was settled (for the time being) on 24th April 1712 when an examining committee of the Royal Society (of which Sir Isaac was the President) pronounced a verdict in favour of Newton. But this contentious issue of priorities was never clearly resolved and was one of the most (in)famous and vexatious disputes in the 18th century. The debate still continues!

In 1676, he proposed a new formulation of mechanics called dynamics, which replaced the conservation of momentum by kinetic energy. It was around this time that he enunciated the principle that light follows the path of least resistance.

In the same year Leibniz was employed as Librarian/Councillor to the Duke of Hanover. An interesting point to note is that he possessed neither an inheritance nor a pension; thus, among his contemporaries, he was the only philosopher who had to fend for himself! In fact, it was his straitened means which motivated him to devise his calculating machine. Due to this situation, he was forced to become a jack-of-all-trades to royalty.

With his enormous mental resources, Leibniz had no difficulty in finding time for his multifarious activities. Along with his diplomatic assignments, he was simultaneously engaged in theological discussions about the reunion of the Church (a recurring theme in his life), and in carrying out his work in geology. He is acknowledged as one of the creators of this field. His point of view that the earth was at first molten found support from Buffen, a great geologist. He had a stint as a mining engineer between 1680 and 1685. During this period he worked on hydraulic presses, windmills, lamps, submarines, clocks and a host of mechanical devices.

Between 1680 and 1683, the expansionist

policies of Louis XIV, the King of France posed an imminent threat to Germany. This provoked Leibniz to write a political pamphlet denouncing him as "The Most Christian War God". In the service of his country he devised a means of increasing the production of linen and suggested a process for the desalinization of water.

Around the same time he went back to his cherished goal of transforming human thought to symbolic manipulation. According to Bertrand Russell, Leibniz's work on mathematical logic would have been of enormous importance had he published it; and Leibniz, instead of George Boole (of Boolean Algebra fame) would be credited with being the founder of this discipline. Thus he was ahead of his times by a century and a half!

In 1685 he obtained the post of historian of the House of Brunswick and devoted himself to tracing the genealogy of the family. In this connection he travelled in Austria and Italy, where he was well received by royalty and the scientific community. His work in genealogy spurred him on this line and he set upon himself to give an account of a history of the earth, based on geological events and description of fossils. He wanted to discover facts relating to the origins and migrations of people through a study of monuments and linguistics.

In 1689 he published his essays on the dynamics of heavenly bodies and the duration of things. Leibniz was made the Librarian at Wolfenbuttel. In 1700, he founded the German Academy of Sciences in Berlin, which received royal patronage from Frederick II the Great, from 1740.

The same year he was honoured by being made a foreign member of the Academy of Sciences of Paris. In 1710, he published his famous philosophical treatise *Theodicee*, which elaborated his views on divine justice. He concludes that God chose this as the best of all possible worlds. (A sentiment very familiar to Wodehouse characters who would strongly dispute this claim!)

Peter the Great, the Tsar of Russia invited Leibniz in 1711 to Vienna. During his stay till 1714, he became a 'Reichfrat' (adviser to the empire) and was honoured with the title 'Freiherr' (baron). In 1714, he wrote his famous *Monadology* in which he synthesized his earlier work *Theodicee*.

His last years were spent in Hanover. During this time he corresponded at length with Samuel Clarke, a close associate of Newton, about the nature of space and time. In his declining years he suffered from gout and was bedridden.

This great Savant passed away on November 14, 1716, leaving behind him a prodigious output (his complete works have not yet all been published). One is awed by the sheer volume of the correspondence of this supreme intellect whose mailing list contained more than 600 names!

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