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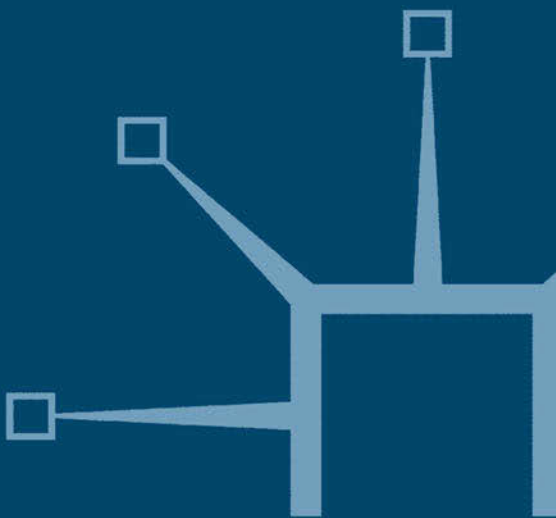
Blaise Pascal

Mathematician, Physicist and Thinker about God

Donald Adamson



BLAISE PASCAL

Also by Donald Adamson

THE GENESIS OF *LE COUSIN PONS*

DUSTY HERITAGE

THE HOUSE OF NELL GWYN

BALZAC: *Illusions Perdues*

LES ROMANTIQUES FRANÇAIS DEVANT LA PEINTURE ESPAGNOLE

Translations of Balzac:
LA RABOUILLEUSE
URSULE MIROUËT

and of Maupassant:
STORIES

Blaise Pascal

Mathematician, Physicist and Thinker about God

Donald Adamson

'Qu'on ne dise pas que je n'ai rien dit de nouveau, la disposition des matières est nouvelle. Quand on joue à la paume, c'est une même balle dont joue l'un et l'autre, mais l'un la place mieux'
(Thought 696)*

'Let no one say that I have said nothing new; the arrangement of the material is new. When playing tennis, both players use the same ball, but one plays it better'

M
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To the memory of my beloved mother

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Contents

List of Illustrations

List of Figures

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DONALD ADAMSON

1

Introduction

Blaise Pascal was born on 19 June 1623 at Clermont (in 1630 the city was to be amalgamated with Montferrand and become Clermont-Ferrand): he was the third child and only son of Étienne Pascal's four children; their mother died in 1626. Clermont was a city steeped in the history of Christendom: at the conclusion of an ecclesiastical council held there in 1095, Pope Urban II had blessed the departure of the First Crusade.

Pascal's father's and mother's families had long been established in Auvergne.[1] The roots of his paternal grandmother's family of Pascal can be traced back as far as 1443: originally resident at Le Pertuis, they were granted armorial bearings in 1480. Blaise's paternal grandfather Martin Pascal was a taxation commissioner for Clermont who later rose to be private secretary to the wife of King Henri III and in 1587 became Treasurer of France for the generality of Auvergne at Riom. His father had been a presiding judge at the taxation court in Montferrand. Later, after a premature period of early retirement in Paris, he moved to Rouen where he became a senior commissioner of taxes.

From 1632 until 1639 the young Pascal lived with his family in Paris but did not attend any school or university, being principally educated by his father, who in turn had been educated by his father (in Greek, Latin, mathematics, history, philosophy, theology and canon and civil law: 45): Étienne thus became a man of wide scientific and mathematical interests, and the inventor of what is known as Pascal's *limaçon* (i.e., the conchoid of a circle with respect to one of its points, which he applied to the problem of trisecting an angle). The 'rigor and originality' of the boy's education, writes C.M. Cox,[2] 'can be likened only to the discipline of John Stuart Mill'.[3] He is said, at the age of eleven, to have produced a 'Treatise on Sounds', since lost (4).

Pascal was also strongly influenced by the informal scientific discussion group initially presided over by the elderly Minim friar Marin Mersenne, one of the most gifted and enquiring men of his

age. In 1639,[4] and again (after his return to Paris) from 1648 onwards (**I 169**), he would accompany his father to some of the regular Saturday meetings of this group; here he met Roberval, Le Pailleur,[5] Mylon, Carcavi,[6] Auzout, Mydorge and sometimes Desargues and Gassendi. He was not only a studious boy but also, in mathematics, a child prodigy. Without help or instruction from anyone he mastered the primary elements of Euclid (4–5), and tradition has it[7] that even as a boy he devised one, or more than one, method of demonstrating, without fully proving, that the sum of the angles of a plane triangle is exactly equal to two right angles.[8] At the age of fourteen or fifteen he became a fervent admirer of the geometrician Gérard Desargues. Prior to publishing an *Essay on Conic Sections* in February 1640,[9] when sixteen years of age, he had already – about June 1639 – discovered the theorem of the Mystic Hexagon ('Pascal's Theorem').

From *circa* December 1639 until May 1647 Pascal lived with his father and sisters in Rouen as Étienne Pascal had been appointed to assess and collect taxes in upper Normandy.[10]

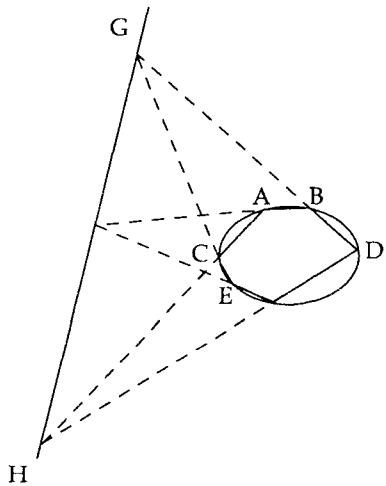
The basic designing and production of a calculator for his father's use in the course of these duties took Blaise almost three years, from 1642 to 1645, during which time (in the intervals of his illness) he seems to have devoted all his energies to the task. In 1645, in an open letter to the Chancellor of France, Pierre Séguier (349–53), he outlined its advantages and methods of operation. With one possible exception, he became the first person ever to manufacture and market a desktop mechanical calculator. Even so, they were unwieldy and fairly expensive products, most of them costing about 100 *livres*,[11] i.e., approximately £500 at present values: the price of a modern desktop computer. By 1652 fifty prototypes had been produced, but few machines were sold,[12] and manufacture of Pascal's arithmetical calculator ceased in that year.

So ended the second phase of his scientific career.

Pascal had been brought up by his father in a strict religious atmosphere characterized by regular prayer and frequent church-going. In 1646 Étienne Pascal, having injured his thigh, was tended at home by two young brothers who were devout followers of the parish priest of Rouville, just outside Rouen: Rouvillism was a religious movement strongly influenced, in its fervour and intensity, by the Jansenists Arnauld and Saint-Cyran. Daily contact with these young men deepened the family's religious commitment; this experience is sometimes known as Pascal's 'first conversion'. The

Figure 1.1 Pascal's Theorem of the Mystic Hexagon

Pascal showed that if a hexagon is inscribed within a conic, the three points of intersection of opposite pairs of sides (AB/EF, BD/CE, AC/DF) of that hexagon will always lie on a straight line GH.



Pascal's own formulation of the Mystic Hexagon was apparently more complex.

From notes taken by E.W. von Tschirnhaus and Leibniz (and now at the Niedersächsische Landesbibliothek, Hanover), it would seem that a double hexagon is inscribed within a conic.

The theorem of the Mystic Hexagon does not feature in the *Essay on Conic Sections.*

young men's influence was greatest upon Blaise and his younger sister Jacqueline, who took the veil in May 1652 and made her final profession in June 1653; he had objected to her entering upon the religious life, even to the extent of refusing for a whole year to pay the 'dowry' which the convent of Port-Royal expected of all its professed nuns.

In January–March 1647 Pascal and two friends engaged in fierce debate with the parish priest, and disaffected Capuchin friar, Jacques Forton about the nature of the Holy Trinity and the causality of the world. This dispute led to the downfall of the Archbishop of Rouen's coadjutor, Jean-Pierre Camus, Bishop of Belley,[13] and to Forton's removal from his benefice on grounds of heresy.

At Rouen, Clermont-Ferrand and in Paris, between October 1646 and September 1648, and from then on until March 1651, Pascal either conducted or caused to be conducted various experiments on atmospheric pressure and the existence of vacuums.[14] The most important of these experiments was carried out on 19 September 1648 by his brother-in-law Florin Périer on the Puy de Dôme; another notable one was conducted from the tower of the church of Saint-Jacques de la Boucherie (399). Gassendi has also described[15] how Pascal carried a gradually distending balloon, made from a carp's bladder, to the very top of the Puy de Dôme, thus satisfying himself that air was a compressible substance.

Although he did not discover the actual principle of the barometer[16] (credit for which belongs to Torricelli), Pascal supplied, as early as 1647, virtually incontrovertible proof that vacuums existed. He also showed that the height of the column of mercury in a barometer decreases as it is carried upwards through the atmosphere. From this discovery it followed that a vacuum existed above the atmosphere, thus contradicting Descartes's denial of the existence of vacuums and his contention that all space is filled with matter.[17]

On 23 and 24 September 1647 Pascal received visits from Descartes. These, it seems, were Pascal's only encounters with the philosopher who was already renowned both for his *Discourse on Method* and for his analytical or co-ordinate methods of applying algebra to geometry. They were much less happy occasions than the meetings between Spinoza and Leibniz in 1676, though Leibniz later played down the closeness and friendliness of those exchanges. Descartes admired the mechanical calculator but, disbelieving in the existence of vacuums, engaged in heated argument with Pascal on

that subject. In the following month (4 October 1647) Pascal reported some of his recent scientific activities in the pamphlet *New Experiments Concerning Vacuums*. Soon after the Forton dispute Pascal's atmospheric experiments led to a second but only slightly less acrimonious controversy with the Jesuit (and neo-Aristotelian) priest Étienne Noël (October–November 1647;[18] March or April 1648)[19] in which Noël, though accepting the theory of atmospheric pressure, denied the existence of vacuums whilst Pascal defended both: in the second case with perhaps undue vigour as he himself had been ready, in *New Experiments Concerning Vacuums*, to accept the notion of Nature's limited abhorrence of the void (368). He published a further account of this scientific activity (*Narrative Account of the Great Experiment on the Equilibrium of Liquids*) in October 1648.

Pascal's achievements in physics entitle him to be regarded as one of the founders of hydrostatics and hydrodynamics.

Not long after his father's death, which occurred on 24 September 1651, Pascal wrote to his sister and brother-in-law Gilberte and Florin Périer about the meaning of death for the Christian believer (490–501: 17 October 1651).

From May 1653 until October 1654 he was almost constantly engaged in scientific enquiry, both in mathematics and in physics; he again attended meetings of his scientific discussion group (**III 431**),[20] now chaired by François Le Pailleur and perhaps occasionally by Claude Mylon. In his *Treatise on the Equilibrium of Liquids* (*circa* 1653) he formulated what came to be known as Pascal's Principle, or law, of pressure. This treatise is a complete outline of a system of hydrostatics, the first in the history of science; it embodies his most distinctive and important contribution to physical theory. The results of his early work on the void were now incorporated into a theory of the statics of fluids. Dealing with the effects of the weight of the atmosphere largely in terms of the principles enunciated in the earlier treatise, he went on to write a *Treatise on the Weight of the Air Mass* (*circa* 1654) which, when finally published, led to the measurement of altitude from barometric pressure[21] and to many further inventions. Pascal also put the finishing touches to treatises on geometry (e.g., *The Generation of Conic Sections*, essentially completed by 1648), and in his *Treatise on the Arithmetical Triangle* conducted important research into combinatorial analysis. He also studied probability theory (in his celebrated correspondence with Pierre de Fermat, June/July–25 September 1654), the factor-

ization of multiples and the summing of powers of series of numbers in arithmetical progression.

So ended the fourth period of Pascal's scientific activity, particularly important in that the Fermat correspondence and the *Treatise on the Arithmetical Triangle* have been the foundations of the science of statistics – with all the many benefits (and perhaps a few disadvantages!) which that science has conferred upon modern life.

In October 1654, however, Pascal experienced some sort of revulsion from mathematics, writing to Fermat, with much more than a touch of irony, on the 27th of that month (**III 431**) that the latter's latest discoveries in probability theory were now beyond his understanding.

It was in this same year, 1654, that Pascal's so-called 'accident on Neuilly bridge' (1365) may have occurred.[22] According to this story, he was driving across the bridge with friends when the horses of their carriage suddenly took fright, bolting over the parapet of the bridge and plunging into the Seine; the carriage itself remained precariously perched on the parapet, suspended as it were in space, until its occupants were eventually rescued. This episode is said to have had a momentous effect upon Pascal, persuading him to withdraw from the world and live entirely alone. It was, according to Kierkegaard, one of those decisive experiences – like Saul's encounter on the road to Damascus,[23] or Luther walking beside his friend struck dead by lightning, or Claudel's vesper conversion in Notre-Dame on Christmas Day 1886[24] – which 'shatter a man without killing him'.[25] Such experiences, claims Kierkegaard, propel a man irresistibly into lifelong 'service of the Absolute'. They are, he says, 'the infinite intensely concentrated in a single pressure and in a single moment of time'. Voltaire, on the other hand, stressed this 'accident on Neuilly bridge' as a way of undermining the validity of Pascal's subsequent religious conversion.[26]

On 23 November of the same year (1654) he underwent this 'night of fire', a mystical experience sometimes known as his 'second conversion', in which he affirmed beyond any doubt his deep Christian belief, also committing himself heart and soul to a life of Christian self-sacrifice. A record of this visionary experience is the *Memorial* (913*), a note written very shortly after its occurrence, two copies of which Pascal wore sewn into the lining of his doublet – and transferred from garment to garment – until the day of his death.[27] It ends with a quotation from Psalm CXIX 16: *I will not forget Thy word.*

Now began his visits to Port-Royal des Champs, some twenty-three miles south-west of Paris; it was, all in one, a convent, semi-monastic community and school of Jansenist leanings. Altogether he seems to have paid no more than five visits to this establishment, and probably as few as three or four.[28] Particularly influential upon him during these visits were Nicole, Singlin and his newly appointed spiritual director Isaac Le Maître de Saci, all of them priests and all Jansenists. The *Conversation with M. de Saci Concerning Epictetus and Montaigne* is the first fruit of Pascal's association with Port-Royal. It is the record of one or more lengthy discussions with M. de Saci, and a rebuttal both of stoicism and of scepticism and of all that is secular in man's attitude towards the world. Whilst at Port-Royal des Champs in January 1655, Pascal may also have found time to compose *The Mystery of Jesus* (919*), a contemplation of the Passion of Our Lord. About this time he may have drafted *On the Conversion of the Sinner*,[29] whose author expresses a sense of the futility of worldly things. And probably later in 1655 he drew up a detailed *Summary of the Life of Jesus Christ* under 354 headings. Also in that year, or thereabouts, he pondered the origins and growth of the Early Church. His thoughts on this subject are set down in the *Comparison between Christians of Early Times and Those of Today*.[30]

Between January 1656 and March 1657 Pascal published eighteen *Provincial Letters*, pseudonymously, under the name of Louis de Montalte. A defence of the fundamental principles of Jansenism against the laxities of the Jesuits, they were his main written excursion into religious controversy. Few people suspected him of being the author of these *Letters*, which dealt an exceedingly savage blow to the Society of Jesus, especially condemning their moral teaching and their attitude towards penitents in the confessional. Pascal may well have been visualizing his brother-in-law Florin Périer as he addressed the *Provincial Letters* to his imaginary correspondent.

On 24 March 1656 the so-called Miracle of the Holy Thorn occurred to his niece and goddaughter, the ten-year-old Marguerite Périer, who for three years had been suffering from a fistula of the eye. This led him, about September 1656, to regard miracles as a crucial feature of the defence of the Christian religion which by then he had in mind. His nine (extant) *Letters to Mlle de Roannez*, composed between September and December 1656, are a series of religious meditations, contemplative in tone. They stress the unity of