BLAISE PASCAL (1623-1662)

TERCENTENARY OF THE CALCULATING MACHINE*

By PROF. S. CHAPMAN, F.R.S.

THE production of the first calculating machine was important in itself, and still more because it started the progress towards the many intricate and powerful computing machines now available. But the inventor was far greater than this invention.

Pascal's life was short, and clouded by much illness; he died at the age of thirty-nine. But his achievements were so varied and remarkable that he has become the subject of an extensive literature, ever growing as each age interprets him anew. In the words of T. S. Eliot, the history of men's opinions of Pascal, and of other men of his stature, is a part of the history of humanity.

What were Pascal's achievements, and what manner of man was he? He was a mathematician and geometer, who at the age of sixteen made the first great advance in synthetic geometry since remote antiquity; by his famous theorem on a hexagon inscribed in a conic section he won the recognition of the most learned men of his time. But he was not simply a man of books, pen and paper; he was eminent as an experimental physicist, for his studies on the equilibrium of fluids, on the pressure of the air, and on the creation of a partial vacuum; he also designed the hydraulic press, constructed long afterwards by Bramah. Further, he was a practical inventor, as we specially remember here. He it was who invented the wheelbarrow in its present form; previously there had been hand-carts, like the coster's barrow, but Pascal designed the one-wheeled barrow, and applied the same idea to the sedan chair.

This mathematician, physicist and inventor was well taught by his father in languages and philosophy. Of good family, their home life was one of culture and fine manners, and they were accustomed to the society of the noble and eminent; father and son had much in common.

The father died when Pascal was twenty-eight, and for two years he lived in style, mingling with the men of wealth and position around the court of the Grand Monarch, and sharing many of their pleasures —music, the ballet, the chase, the gaming table, the conversation of women, the fascinating affairs of war and the State. Besides being a good spender of money, Pascal knew how to add to his wealth by business enterprise.

But at thirty he turned from these activities and distractions. Hitherto a faithful Catholic living in the world, he now became deeply concerned with religion, partly through the influence of his younger sister. She, a young woman of great strength and beauty of character, had already entered the religious community of Port-Royal, the centre of a puritan reform movement within the Roman Church, inspired by Jansen, the Bishop of Ypres. A year after these stirrings of deeper feeling, Pascal had an ecstatic religious experience, and for the remaining eight years of his life he was closely linked with the abbey and schools of Port-Royal.

He still lived in his own house, and retained much of his wealth. But he mortified his flesh by an ascetic rigour even beyond that which his physicians imposed to relieve his increasing ill-health. His asceticism, however, like that of St. Francis of Assisi, was accompanied by lovingkindness to others.

Among the vanities of the world which Pascal now renounced were his mathematics and his science. But he did not wholly abandon them. From time to time, through intercourse with such friends as Fermat and Mersenne, and sometimes simply as a distraction from pain, his thoughts returned to these pursuits, in which his mind moved with perfect ease and grace. Almost without effort he made new discoveries in the geometry of the cycloid and in the theory of probability; he even engaged in scientific controversy on questions of priority.

In these last eight years, however, he won new fame as a writer on religion. Strife arose between the Jesuits and the Jansenists. The Jesuits charged the community of Port-Royal with heresy, and the austere Jansenists attacked a Spanish group of Jesuits whose casuistry they regarded as dangerous to morality. Pascal engaged in the controversy, and wrote eighteen letters called the Provincial Letters. French literary critics acclaim these prose writings as of capital importance in the foundation of French classical style. As polemic, says T. S. Eliot, they are unsurpassed, not by Demosthenes, or Cicero, or Swift.

In his last two years, Pascal meditated writing an intellectual defence of Christianity, and made copious notes for it. He died before beginning the actual writing, but these notes were published, after his death, as the famous "Pensées" of Pascal. Even these fragments reveal him as a great literary artist, whose intellectual passion for truth made him utterly dissatisfied without a spiritual explanation of human life. He brought to this work his great powers as a man of science, though he did not, like some scientists, suggest that his own faith was sufficient warrant in itself for Christian belief by the common man. Voltaire and Condorcet might regard Pascal's religious writings as the product of a mind disordered by ill-health, but in these poignant days, so tragic especially for our sister-nation, to which these three great men belonged, Pascal's "Pensées" have a renewed interest, though some of his presuppositions are now shared by few educated men.

Pascal was proudly conscious of his intellectual powers, but he became also profoundly humble as a sinful man before God, and in his last years he was filled with loving concern for the poor. His wish to supply their material needs spurred his practical genius to start a company for putting public vehicles, omnibuses, on the streets of Paris, for the convenience of the people, and to gain profits, no longer for himself, as in his earlier years, but for almshouses and hospitals. These buses were started during the last months of his life, and deeply engaged his attention; they seem to have achieved instant social and commercial success.

Newton, whose birth we celebrate in this tercentenary year, was a greater man of science than Pascal, but I judge Pascal to be the greater man. Newton's thoughts, like Pascal's, turned much to religion in his later years; but he followed dark paths, pondering over the prophetic Scriptures; none but the curious antiquary would to-day read his religious writings. Pascal's, on the other hand, have an abiding attraction both in their substance and their literary form. Newton was a man of virtue and plain living; but Pascal in his later years was a saint. Newton's scientific work, though great in substance, was written in poor Latin. Pascal used his native language in writing both on science and

* Address delivered at a memorial luncheon held in London on October 19.

religion, and his works belong to the great treasury of French literature.

Pascal's invention of the calculating machine, just three hundred years ago, was made while he was a youth of nineteen. He was spurred to it by seeing the burden of arithmetical labour involved in his father's official work as supervisor of taxes at Rouen. He conceived the idea of doing this work mechanically, and developed a design appropriate for this purpose; showing herein the same combination of pure science and mechanical genius that characterized his whole life. But it was one thing to conceive and design the machine, and another to get it made and put into use. Here were needed those practical gifts that he displayed later in his inventions of the wheelbarrow and the omnibus. He must find and test suitable materials for his machine—iron, copper, ivory, ebony, wood. He must find and indeed train suitable workmen, and settle many points by actual trial. His first model was followed by others, and gradual improvements occupied much of his time for the next ten years, in which he strove indefatigably after perfection. He wished also to obtain due reputation and reward from his invention. He obtained royal protection for it, and gained the patronage of many distinguished men. In 1652 he presented one of the last of his fifty models, with a famous letter, to Queen Christina of Sweden. He also wrote a prospectus of his invention that would do credit to a modern school of salesmanship. But other men, despite the royal patent, pirated his invention; and the sight of one of these copies, "a monster", he said, fair on the outside but valueless in use, so disgusted him that he abandoned further interest in his machine.

In a sense, Pascal's invention was premature, in that the mechanical arts in his time were not sufficiently advanced to enable his machine to be made at an economic price, with the accuracy and strength needed for reasonably long use. This difficulty was not overcome until well on into the nineteenth century, by which time also a renewed stimulus to invention was given by the need for many kinds of calculation more intricate than those considered by Pascal.

Consequently until the present century the principal aid to calculation was the table of logarithms published by their Scottish inventor, Napier, in 1614, put into more practical form by Briggs at about the time of Pascal's birth, and afterwards used also in the slide-rule.

These inventions will always retain great practical value, but where extensive and elaborate calculations are necessary the economic method is to use a suitable computing machine. To-day we recall Pascal as the first originator of such machines.

ECONOMY IN THE USE OF FERRO-ALLOYS*

By Dr. W. H. HATFIELD, F.R.S.

In times of peace, particularly if they are of long duration, the qualities and characteristics of that which is produced are the result of tradition and usage, salesmanship, and the developments due to technical progress based on the application of old or new knowledge. Tradition, usage, and salesmanship slow up in measure with the inevitable progress towards the realistic efficiency possible through knowledge and the consolidation of technical progress. War and preparation for war insist upon stark efficient realism, and those who prepare for war are given more time to attain to it than those who are unexpectedly called upon to face such conditions. Also, in times of peace, international trade throws open to all countries the world's resources in raw materials and facilities on an economic basis; war rudely disturbs this state of things, and realism in production must then deal with a limited or changed availability of that upon which production can continue.

These conditions apply at the moment to the production of steel, and particularly to special and alloy steels. Concerted efforts are being made within the industry to attain maximum efficiency based on the availability and changing availability of raw materials and facilities. It will be obvious that technology and technique so developed can be, and will be, projected with advantage into post-war times.

ELEMENTS OF INTEREST IN STEEL METALLURGY.

Element	Group	Date isolated	Metal isolated by	Nationality
Hydrogen	I	1766	Cavendish	British
Copper	I	Prehistoric		
Zinc	II	Prehistoric		
Aluminium	III	1854	H. St. C. Deville	French
Carbon	IV	Prehistoric		
Silicon	IV	1854	H. St. C. Deville	French
Titanium	IV	1825	Berzelius	Swedish
Zirconium	IV	1824	Berzelius	Swedish
Tin	IV	Prehistoric		
Lead	IV	Prehistoric		
Nitrogen	V	1772	D. Rutherford	British
Phosphorus	V	1669	H. Brand	German
Vanadium	V	1830	Sefstrom	Swedish
Arsenic	V	1240	Albertus Magnus, Bishop of Regensburg	German
Niobium	V	1801	Hatchett	British
Oxygen	VI	1774	Priestley	British
Sulphur	VI	Prehistoric		
Chromium	VI	1798	Vauquelin	French
Selenium	VI	1818	Berzelius	Swedish
Molybdenum	VI	1782	P. J. Hjelm	Swedish
Tungsten	VI	1783	F. D. and H. J. D'Elhuyar	Spanish
Manganese	VII	1774	J. G. Gahn	German
Iron	VIII	Prehistoric		
Cobalt	VIII	1742	Georg Brandt	Swedish
Nickel	VIII	1751	Cronstedt	Swedish

It is perhaps of value to consider the twenty-five elements which are of direct interest in the production of steel. In the accompanying table those elements will be found scheduled. They can be divided substantially into four groups, namely, (i) the dominant alloying elements, (ii) the secondary alloying elements, (iii) appertaining and arising essentially as regards process, (iv) for protective coating.

Of these twenty-five elements, knowledge of seven—copper, zinc, carbon, tin, lead, sulphur, and last but most important of all, iron—was bequeathed to us by early civilizations, and a period of some two thousand years passed before we seriously began isolating those which are now so useful. Of the dominant alloying elements, namely, manganese, chromium, nickel, molybdenum, tungsten, cobalt and vanadium, it is of great interest to note that four of these elements were originally isolated in Scandinavia,

* Paper read on July 25 at the Conference on Mineral Resources and the Atlantic Charter arranged by the Division for the Social and International Relations of Science of the British Association.