was a Redstone missile lengthened to hold more propellant and the engine was modified to burn a new fuel—hydyne, a mixture of unsymmetrical dimethylhydrazine and diethylene triamine. The second stage was a cluster of eleven solid-propellant rockets and the third stage fitting inside the ring of the second stage comprised three solid fuel rockets. Von Braun stabilised the system by spinning it rapidly during flight and on its first flight from Cape Canaveral in September 1956 this remarkable vehicle reached an altitude of 682 miles and travelled 3,400 miles.

Ironically and almost immediately the Army was ordered to concentrate on short range missiles while the control of the ICBM programme passed to the Air Force. External events, however, once more determined a different destiny for von Braun.

In 1954 he showed that it would be possible to launch an earth satellite using the Redstone rocket assemblies as in the Jupiter missile. His scheme, under the code name Project Orbitor, was considered by an advisory group under Assistant Secretary of Defence Donald A. Quarles who outvoted the idea by 7 to 2 at a meeting on 9 September 1955, in favour of Project Vanguard, an alternative proposal from the Naval Research Laboratory. The official record states that the decision was based on technical recommendations of the advisory group. More probably the phrase covers the persuasion of President Eisenhower that the military association and the constraints of the secrecy classification on the Jupiter C rocket would be harmful to the peaceful intent of the satellite project. In the event Vanguard, based on sounding rocket technology and aside from the main stream development of the U.S. military ballistic rocket, inadequately financed and with no appropriate priority, was an almost total disaster.

In the turmoil created by the success of Sputnik One on 4 October 1957 von Braun again pressed his case from Huntsville that he should be allowed to use the army's Jupiter missile to launch a satellite. Three weeks after the launching of Sputnik he was given three and a half million dollars with a target date of 30 January 1958. Once more he triumphed—on 31 January the Jupiter rocket placed Explorer 1, the first American satellite in Earth orbit which within a few days discovered the zones of trapped particles around the Earth (the van Allen zones). The decade of intense technological rivalry between the US and USSR following these events would have borne a radically different aspect if von Braun's advice had been followed in 1955.

After these events the Eisenhower administration took immediate action to create a unified US space effort. Following the advice of a committee under James R. Killian steps were taken to create a strong civilian-orientated agency to direct the manned and unmanned exploration of space. The National Aeronautics and Space Act became law on 29 July 1958. Successively this National Aeronautics and Space Administration absorbed the 8,000-strong National Advisory Committee for Aeronautics, the Vanguard and NRL groups, the 2,800 staff of the Jet Propulsion Laboratory of CalTech and then in January 1960, President Eisenhower decreed that the vital army group, with 4,600 personnel under von Braun should be transferred from army to NASA control. On 1 July 1960 the transfer was effected when the President personally visited and dedicated the facility as the George C. Marshall Space Flight Center with von Braun as director.

Four years earlier von Braun had begun studies of rockets which would be far more powerful than the Redstone combinations. He knew that the rockets required for intercontinental missiles would never provide the thrust required to place man into space. In August 1958 he already had approval to develop a multiple Redstone/Jupiter combination with a thrust of 1.5 million pounds, and by the time of his absorption into NASA he had a priority rating for the development of vehicle known as Saturn 1. In October 1961 this 162 ft long carrier rocket weighing a million pounds had its flawless test launching from Cape Canaveral. By January 1964 a 3,700 pound test payload was placed in orbit. Thereafter von Braun progressed majestically and incredibly to the targets of the Apollo programme and to the fulfilment of his vision.

These early Saturn vehicles were mere stages towards the mammoth Saturn 5, the development of which was approved by NASA in January 1962. Standing 364 ft high, Saturn 5 weighed over six million pounds and could send 47 tons of payload to the Moon or place 140 tons in Earth orbit. The landing of Armstrong and Aldrin on the Moon in July 1969 was an operation of extraordinary complexity; an immense collaborative enterprise which von Braun and the Huntsville team made possible by designing this multi-million pound thrust rocket. From assembly to the count-down the monitoring system alone needed 10 miles of tape storing over 2.5 million words.

Von Braun witnessed the fulfilment of a youthful dream in his fifty-eighth year. No longer did it seem technical fiction that he wanted to proceed even further along this path. He had designs to get man even further into space. First he would have strapped on solid rocket motors to the first stage of Saturn 5, then to get the men to Mars he planned to replace the existing liquid hydrogen–oxygen third stage by a nuclear engine. But this remained a dream; NASA was forced to cut the space programme and within a few years of the climax of Apollo 11, von Braun had the chagrin of witnessing the dismantling of the facilities and the dispersal of the men who had made Saturn a reality.

In 1970 von Braun was made Deputy Associate Administrator for Plans in NASA, an office which he held until his retirement at the age of 60 two years later. He then joined Fairchild Industries as Vice President for Engineering and Development but became ill with cancer and retired finally a few months before his death.

Von Braun was an extraordinary symbol of the age. His vision was of a nature which the establishment looked upon as science fiction but by single-minded persistence he astonished the world by succeeding through the labyrinth of war and peace, first as a German and then as an American citizen. Although von Braun was granted American citizenship in 1955 and rescued the Americans from their despair in the face of the Soviet Sputnik, there were those who could not forget that he laboured for the Nazis. But for von Braun the transformation was complete. He built his rockets to get men away from the earth—his imprisonment during the Peenemünde era resulted from an unwise remark that the V2 would help towards space travel—and he succeeded.

Bernard Lovell

D. W. Holder

AT the time of his death on 18 April 1977, Professor Holder had been Head of the Department of Engineering Science at Oxford for close on sixteen years. In that time the laboratory had expanded at both the undergraduate and postgraduate level and much of the planning for this growth stemmed from his own initiatives.

He was educated at Imperial College in the Department of Civil Engineering between 1941 and 1943 and subsequently in the Aeronautics Department under Sir Leonard Bairstow. After graduating he immediately joined the Ministry of Aircraft Production at the Aircraft and Armament Experimental Establishment at Boscombe Down but soon transferred to the Aerodynamics Division at the National Physical Laboratory where he remained until 1961. His promotion from the junior grades to Deputy Chief Scientific Officer in 1957 was rapid and his career at the NPL spanned some of the most dramatic changes seen in aeronautics.

At the end of World War II, little was known about the behaviour of aircraft at transonic and supersonic speeds but the next decade was to change all that and Douglas Holder played an important role from the outset. The first problem was to design and build the wind tunnels which would enable the aerodynamic phenomena to be investigated. The Aerodynamics Division chose to use induced flow tunnels and a series of these ranging from the original pilot model 9 inches by 3 inches in cross section to 36 inches by 14 inches was constructed.

Before 1949 research on flow at Mach numbers close to unity had been impossible because of the reflection of the normal shock from the tunnel wall. Extensive studies of slotted walls were conducted in the UK and the USA and Holder's group at NPL made substantial contributions to this new technique which could eliminate tunnel interference effects. In addition to this work on tunnel design he made, with Gadd and Pearcey, important advances in shock wave boundary layer interaction and aerofoil design so that the division as a whole established an enviable international reputation.

Following closely on this pioneering research on transonic and supersonic aerodynamics Holder next led the development of a series of shock and wind tunnels for the study of flight at hypersonic speeds, i.e. above about Mach 7. Completely new techniques were needed to drive such facilities and Holder, now head of all high speed aerodynamics at NPL, took a major role in planning and designing these devices. The flow durations in shock tubes and shock tunnels range from tens of microseconds to a few milliseconds but Holder was equally at home in this new field. He had very early demonstrated a highly developed skill in wind tunnel design and had the ability, which may be the mark of the true engineer, to make rapid estimates of all the important design parameters for a new facility. Throughout this period he published, as he had always done, widely, and some of his papers are classics of their kind.

In 1961 he was invited to take the Chair of Engineering Science at Oxford to succeed Thom who was then retiring, and became at 37 the fourth holder of that post. The early sixties saw in Oxford, as in the UK as a whole, a rapid expansion of university engineering departments and under Thom a major development had been initiated. Holder took over this work and guided it through to completion. Although he continued to take a keen interest in fluid dynamics he also saw the importance of maintaining and extending a broad base of knowledge and there are now two new chairs in structures and electricity, largely due to his foresight and persistence.

His long association with aeronautics at the NPL made him an obvious choice as a consultant for industry and government and he was also much in demand in educational establishments. He was elected FRS in 1962 and served on many of its committees as well as its Council between 1969 and 1971. His wide range of activities outside Oxford constantly suggested new lines of research and development and together with Professor R. B. Duthie he established in Oxford a centre for orthopaedic engineering and encouraged work in physiological fluid dynamics.

Outside of Oxford his government advisory work was at the highest level and must remain obscured by confidentiality although he will be remembered for his chairmanship of the enquiry into Precision Approach Radar following the Gatwick disaster in 1969 and later, in 1971, his involvement at ministerial level in the technical decisions on the future of the RB-211 engine.

By nature he was reserved and the extent of his influence in both aeronautics research and engineering education is a testimony more to his patient and persuasive skills than to any justifiable forcefulness in argument. He was an exceptionally able administrator and dealt with what would appear a crippling work load with quiet efficiency. He was always ready to listen to his staff and research students and to encourage them to pursue new lines of investigation and he was generous to a fault to those who were in difficulties, although few around him would be aware of his very personal interventions. In this respect he was particularly effective on the University Staff Committee where he will long be remembered for his patient and skilful administration.

In his views of the part that universities should play in the industrial life of the country he was ahead of his contemporaries and with such wide experience and extensive contacts he often put his finger on promising lines of new work long before they were apparent to others. There are, alas, only a few of his calibre and he will be sadly missed in both university and industrial bodies.

D. L. Schultz

Yves Guitton

PROFESSOR YVES GUITTON died on 6 July 1977 in Perpignan (France) at the age of 46. He leaves a wife and two sons. Head of the Laboratory of Plant Physiology, he was also chairman of the University Group for the Biology of Development and Parasitology and Vice-president of the University of Perpignan.

With a wide-ranging scientific background, involving organic chemistry, nuclear energy research and microbiology, he entered plant physiology and biochemistry because he felt the development of this field to be essential for the future. His doctoral thesis was devoted to the metabolism of arginine during the germination of *Pinus*, and his contribution to the study of amino acids and nitrogenous substances was invaluable to French biochemistry.

In 1966 he was appointed to the newly-created University of Perpignan, addressing himself to a problem which intrigued him: the role of nucleic acids in developmental processes. Arriving alone in his new laboratory, geographically isolated from the scientific community, Professor Guitton nevertheless created within ten years a laboratory equipped for all techniques of molecular biology. The research team which he built up is a leading group in French physiology, collaborating with others both at home and abroad.

His recent contributions concern the metabolism of mRNA during the first hours of seed germination, mRNA stability and development-related changes in chromatin structure and composition. With his collaborators he was the author of around fifty publications in French and international journals.

In addition to his brilliant scientific career he involved himself with equal enthusiasm in his outside interests. An excellent footballer in his youth, he turned his attention to tennis after a serious accident, rapidly reaching a high standard. Many will remember his arrival at scientific conferences complete with tennis racquet, looking for partners among his American and British colleagues. In politics he was a highly active member of the Socialist party, deeply involved in the problems of his city.

For those who knew him Yves Guitton will be remembered not only for his exceptional achievements, but perhaps even more for his enthusiastic approach to all which concerned him and his warmth and friendliness in any company. His premature loss will be deeply regretted by his many friends in the scientific community and in his city.

Michel Delseny