

# Book Reviews

## ROCKET RECORDS

### The Papers of Robert H. Goddard

Including the Reports to the Smithsonian Institution and the Daniel and Florence Guggenheim Foundation, Vols. 1-3. Edited by Esther C. Goddard in association with G. Edward Pendray. Vol. 1: 1898-1924. Pp. xx+1-560. Vol. 2: 1925-1937. Pp. x+561-1104. Vol. 3: 1938-1945. Pp. x+1105-1707. (McGraw-Hill: New York and London, 1970.) 1,440s; \$150.

"THE dream of yesterday is the hope of today and the reality of tomorrow," wrote Robert H. Goddard in 1904 at the age of 21; and for the next forty years he strove to bring the liquid-fuel rocket from dream to reality. At his death in 1945, Goddard left more than 6,000 pages of orderly and continuous records, of which a generous selection—chiefly correspondence, technical reports and entries from Goddard's daily diary—appears in these volumes, chronologically arranged and well printed. Mrs Esther Goddard and her co-editor, Dr Pendray, are to be warmly congratulated on what is not only a worthy monument to the life work of her late husband, but also a fascinating record of an inventor's career for anybody interested either in rocketry or in the history of technology.

Robert H. Goddard was born at Worcester, Massachusetts, in October 1882. His parents moved to Boston soon afterwards, but in 1898 they returned to Worcester, where Goddard remained for much of his life. His family was quite prosperous, and he was allowed to indulge in some boyish inventions, such as trying to fly hydrogen balloons made of thin aluminium sheet and firing special arrows 300 feet into the air. He was away from school because of illness between 1899 and 1901, and did not gain his first degree until he was 25; this was followed by a doctorate at Clark University in 1911. After research in physics, and a serious attack of tuberculosis, Goddard was appointed assistant professor in physics at Clark University in 1915 and full professor in 1920. He retained this appointment until 1943, although on leave of absence from 1934.

Goddard's first patent for a liquid-fuel rocket was issued in July 1914, and a month later he completed a theoretical paper on the problem of reaching great altitudes by rocket. He calculated that, with perfect efficiency and an initial acceleration of about 3g, an initial mass of about 1,000 pounds would be enough to send a mass of 1 pound to the surface of the Moon. In September 1916 Goddard asked the Smithsonian Institution for a grant towards practical work on liquid rockets: the answer was "yes", largely on the recommendation of Dr C. G. Abbot, then director of the Smithsonian Astrophysical Observatory. The Smithsonian Institution continued to finance Goddard until 1930, when he began receiving grants from the Guggenheim Foundation which continued to the end of his life. It was in March 1926, nine years after the Smithsonian grants began, that Goddard succeeded in launching the first liquid-propellant rocket, at Auburn, Massachusetts. The rocket, which weighed 5 kg at launch, was powered by gasoline and liquid oxygen, and flew to a height of 12 m and a distance

of 55 m. Goddard built steadily on this small beginning, continually improving the design of combustion chambers, nozzles, propellant flow systems and methods of stability and control. In 1932 came the first flight with control by gyroscopic stabilization and vanes in the exhaust jet, and in 1935 the first supersonic flight. Subsequently he worked on turbopumps for propellant delivery, variable-thrust motors and nozzle-cooling techniques. Goddard did not develop very large rockets, because he was primarily concerned with upper-atmosphere sounding rockets rather than weapons; but nearly every feature of the German V2 was covered by his patents and first used in his rockets.

For forty years Goddard worked alone, apart from a few assistants, in face of scepticism from the public and most scientists, uncertainty about next year's finance, and repeated failures of the rockets. But he never wavered in perseverance or enthusiasm, and the laconic diary entries scarcely vary as the years roll by: "1916 June 24: Tried to fire short nozzle in small tank in morning. . . . 1944 Aug. 25: Tried starts morning and afternoon". What inner drive kept him going so steadily, free from doubt or despondency? Goddard does give one clue to help us in answering this unanswerable question. His thoughts first turned towards rockets and space in 1898 after reading H. G. Wells's *War of the Worlds*, with its story of Martian invaders and its "wonderfully true psychology"; and the experience that directed his life came in the following year, on October 19, 1899, to be precise, when he climbed a cherry tree at the family home, Maple Hill: "It was one of the quiet, colorful afternoons of sheer beauty which we have in October in New England, and as I looked toward the fields at the east, I imagined how wonderful it would be to make some device which had even the possibility of ascending to Mars, and how it would look on a small scale, if sent up from the meadow at my feet". From then on, October 19 was marked each year in his diary as "Anniversary Day", when he would if possible return to the cherry tree, almost as if he were a knight of old renewing his vows. Shelley's lines,

I do remember well the hour which burst  
My spirit's sleep: a fresh May-dawn it was . . .

apply to many single-minded and inner-directed artists or inventors, and Goddard is among them, even if his May morning was an October afternoon. But Goddard also conforms to Edison's dictum that genius is 1 per cent inspiration and 99 per cent perspiration, for he was careful and methodical as well as enthusiastic: the fatal explosions that marred so many early experiments with rockets are conspicuous by their absence in his work. On the other hand, his methodical approach did tend to narrow his interests. He lacks the breadth of vision shown by the greatest inventors like James Watt, and, in spite of his insight into the future of space flight, Goddard's writings are a little too plain and workmanlike, and deficient in verve or excitement. Nevertheless Goddard deserves a high place among the single-minded inventors who have concentrated on a single vehicle and have driven it successfully along that hard road from hope to reality.

D. G. KING-HELE

## EHRENFEST'S CHARACTER

### Paul Ehrenfest

Vol. 1: The Making of a Theoretical Physicist. By Martin J. Klein. Pp. xvi+330. (North-Holland: Amsterdam and London, 1970.) 70s; \$8.40.

THIS first volume of the biography of Paul Ehrenfest takes the reader from the date of his birth in Vienna in 1880 to just beyond the end of the First World War in 1920.