THRUST FORWARD

The next century of propulsion promises ground-breaking advances with steps towards cleaner engines rivalled only by the search for greater speed

GUY NORRIS / LOS ANGELES

THE FIRST 100 YEARS

Propulsion

1903 Charles Taylor's four-cylinder lightweight piston engine powers the Wright brothers' first flight

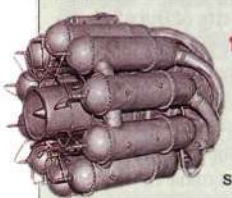
1908 Gnome rotary

1917 Liberty V-12

1925 Pratt & Whitney runs first engine, the nine-cylinder Wasp radial

1926 Armstrong Siddeley Jaguar – first use of supercharging

1936 Rolls-Royce Merlin – more than 150,000 eventually built



1937 First runs of Whittle turbojet and Von Ohain He S1 turbojet

1938 Hamilton Standard constant-speed feathering propeller

1939 Jet-powered He 178 flies for first time

1940 Jendrassik Cs-1 – first turboprop to go on test

1943 Argus propulsive pulsejet engine powers V-1

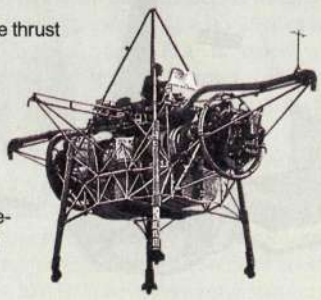
1944 Gloster Meteor 1 and Messerschmitt 262 twinjets enter service

1945 Rolls-Royce Trent – first turboprop to fly

1952 Kuznetsov NK-12 – most powerful turboprop of 20th century

1953 Rolls-Royce thrust measurement rig "Bedstead" – first jet VTOL

1959 Pratt & Whitney Canada runs first PT6 free-turbine turboprop



FLIGHT COLLECTION

Ever since the Wright brothers' home-made, four-cylinder piston engine sputtered into life in 1903, aerospace has been fundamentally reliant on propulsion technology for every major advance.

The first century's passion for power brought air-breathing engines to the once unthinkable thrust level of 100,000lb (445kN) and beyond. While the main focus for the next century will be on developing greener, cheaper engines and alternative power sources such as fuel cells, the search for speed will continue to push the frontiers. Some of this effort will be aimed at military and civil supersonic aircraft, but the true cutting edge will be the search for new powerplants, such as pulse detonation engines and high Mach number air-breathing hypersonic projects linked to military strike vehicles and access to space.

Work on green and exotic projects alike is underpinned by the vital new emphasis on affordability. The fantastic rate of aerospace progress in the first 70 years slackened in the 1980s and 1990s as money began to run out. Pundits agree that engineering achievements such as Concorde, Boeing 747 and Space Shuttle would not happen under today's tight budgets.

Affordability goals

Nowhere is this "get real" phenomenon more acutely seen than in the US Department of Defense's (DoD) switch from the largely performance-driven targets of the Integrated High Performance Turbine Engine Technology programme to the affordability goals of its successor, the Versatile Advanced Affordable Turbine Engines (VAATE) programme. By about 2020, the US goal is a family of engines from a common pair of "versatile" cores, with the potential for 10 times lower cost (development through maintenance) than today's Pratt & Whitney F119.

Crucially, VAATE's versatile core concept includes some intended spin-off to future commercial engines. The DoD projects a 10:1 ratio between civil and military engine production rates into the first quarter of the 21st century. A close relationship between the two is therefore vital to maintaining industry investment.

At the heart of VAATE, and several other engine technology programmes around the world, is the aim of developing an "intelligent engine" that can "learn" as it runs. The engine will be flexible and able to adapt, actively or passively, to changing situations, either internal (engine health), or external (different missions). The learning engine will need a smart management system with the ability to auto-optimise, self-diagnose and self-prognose. The system will rely on models of engine perfor-