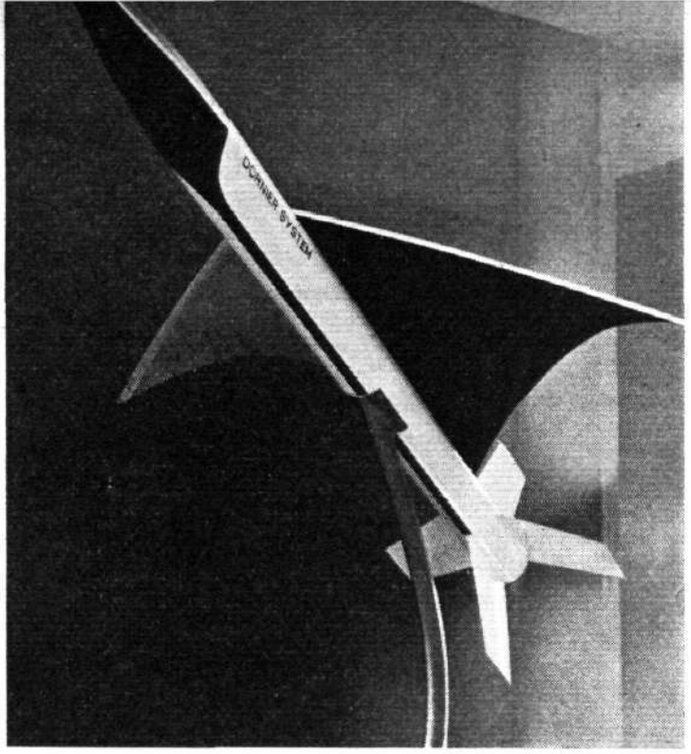
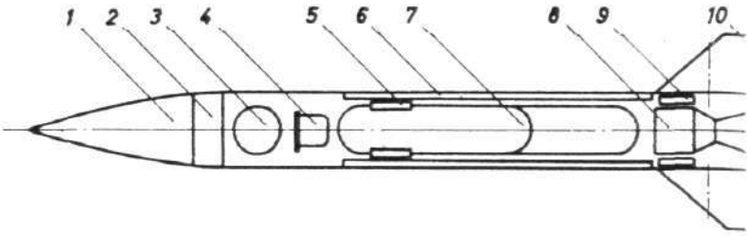


Missiles and Spaceflight



Left, a model of Dornier Type 122 recoverable rocket shown at Stuttgart. Above, typical cross-section of rocket in launch configuration. 1, payload container; 2, electronics; 3, compressed air for actuator; 4, fuel pump system; 5, deployment actuator; 6, Paraglider; 7, fuel tanks; 8, combustion chamber; 9, fin actuator; 10, stabilizing and steering fins

GERMAN SPACE PROJECTS DESCRIBED

ROCKET stages, recoverable sounding rockets and design proposals for a multi-purpose satellite were among the West German projects described at the European Spaceflight Symposium in Stuttgart last month. Extracts from the opening review by Dr L. R. Shepherd were printed in last week's issue; this continuation article covers a number of the technical papers and the banquet address by Mr Arnold Frutkin, Director of International Programmes of the US National Aeronautics and Space Administration.

Among those who presented technical papers at the symposium were several German-born scientists now working in the United States. They comprised Dr E. Stuhlinger, Marshall Space Flight Center (*Research Problems of Space Flight*); Dr G. Haase, Bell Aerosystems (*Zur Zusammenarbeit der Amerikanischen und Europäischen Raumfahrtindustrie*); Dipl-Ing H. H. Koelle, Marshall Space Flight Center (*Development Trends in Space Transportation Systems*); Dipl-Ing H. Horn, Marshall Space Flight Center (*Application of an "Iterative Guidance Mode" to a Lunar Landing*); and Dipl-Ing H. Thomae, Marshall Space Flight Center (*A Technique for Optimization of Ascent Trajectories and Propellant Loadings of Multi-stage Space Vehicles*).

An exhibition held in conjunction with the symposium included models of the propulsion unit of the third stage of the ELDO vehicle; of a high-energy propulsion unit proposed by Bölkow for a future development of the third stage of the ELDO vehicle; and of a recoverable sounding rocket, using the paraglider principle, on which Dornier is currently working.

This last development was outlined in a paper by Dr W. Kiessling of Dornier, who pointed out that the use of sounding rockets over the densely populated European area was possible only if the rocket could be guided back to a small test range. More complete meteorological and ionospheric data could be obtained if a fuller network of observation points were established, and so the development of sounding rockets which could be recovered and re-used appeared an attractive proposition for Europe.

The Dornier concept is illustrated in the heading photograph and diagram. Preliminary research and development work, and tests of the guidance system, have begun; and Dr Kiessling's paper discussed also trajectory studies, and construction, tracking and telemetry for the complete system. This is one of a number of recoverable-rocket techniques which the Federal Ministry for Scientific Research is actively investigating at the present time. A senior member of the Space Department of the Ministry said that his Ministry did not intend to sponsor conventional, non-recoverable sounding rockets.

The actual third stage of the ELDO vehicle, the design of which was finally decided on by ELDO as recently as April, is to be built by Arbeitsgemeinschaft Satellitenträger (ASAT), an association of Bölkow Entwicklungen and Entwicklungsring Nord (ERNO). It will use Aerozine 50 (UDMH and Hydrazine) and N_2O_4, with the ERNO main propulsion engine developing 2,250kg thrust. Two vernier rockets, built by Bölkow, will each develop 50kg.

The models of the actual third stage and of a proposed advanced version are illustrated on the opposite page. The latter was outlined in a paper (which we hope to report more fully in a future issue) by Dietrich E. Koelle of Bölkow. This described design studies on three proposals for high-energy third-stages of the ELDO vehicle, based on the propellant combinations H_2/O_2 and H_2/F_2 (pressure-fed) and H_2/O_2 (pump-fed). The payload capacity of the ELDO launch vehicle, Herr Koelle indicated, could be increased using a high-energy third stage from approximately 100kg to some 700kg for escape missions.

British papers presented during the technical sessions of the symposium included *Air-breathing Launch Vehicles* by Prof T. R. F. Nonweiler, Glasgow University; *System Design of Space Simulation Chambers* by R. G. T. Munday, Bristol Aircraft Ltd; *An Experimental Electron Bombardment Propulsion Unit* by Dr P. C. McNeil, Elliott Brothers (London) Ltd; *Attitude Control System of the Skylark Sounding Rocket* by P. E. G. Cope, Elliott Brothers; and *Design and Development of the Autopilot for Control of the Blue Streak First Stage* by P. L. V. Hickman, de Havilland Aircraft Co.

The paper by Munday represented work carried out by a consortium of companies (C. A. Parsons, Petrocarbon Development, Hymatic Engineering and British Aircraft Corporation) in connection with a "British Government specification for a satellite test chamber for heat balance studies."

In *Etude d'un étage nucleaire pour lanceur lourd Européen* by J. A. Dupont of SNECMA, a summary was given of this company's work during 1962 on a nuclear-powered stage for a large launch vehicle capable of placing a ten-ton payload into a low, circular, Earth orbit. Power is supplied by a graphite-moderated uranium 235 reactor in which hydrogen is heated to a temperature of 2,500°K approximately, yielding a specific impulse of some 800sec. The substitution of a single nuclear stage for both upper stages of the ELDO vehicle, M Dupont said, should make it possible to double the payload/initial weight ratio.

W. von Maydell of Bölkow described a company project for a series of five Earth satellites. Applications of the satellite for space research and as communication, meteorological and geodetic satellites were outlined. In *Das Raumtransporter-Konzept* (The