

SPACE-FLIGHT AND RE-ENTRY TRAJECTORIES

A SYMPOSIUM on "Space-Flight and Re-entry Trajectories", organized by the International Academy of Astronautics, was held at Louveciennes, near Paris, during June 19-21, 1961. The conference was opened by Prof. Theodore von Kármán, who has chosen to follow up his long and distinguished career in aeronautics by becoming the first director of the Academy. This symposium constituted the first meeting of the Academy, and the subject of trajectories was chosen, Prof. von Kármán said, because of its fundamental importance in the successful development of space flight. Though the Academy was now only beginning its activities, Prof. von Kármán was confident that in perhaps 100 years it would be as 'respectable' as the Academy of Sciences or the Royal Society. The present situation of astronautics reminded him of that of aeronautics when he first came to France in 1908. Then, aeronauts were regarded almost as madmen, and no one truly foresaw the later commercial and military applications of aircraft. Even the pioneer Lanchester was worried by the cost of upkeep of aerodromes, and thought they would have to be divided into two parts, to be grazed by cows in alternate years. With so many false aeronautical prophecies among his memories, Prof. von Kármán was confident of the future of astronautics.

The first scientific session, on "Trajectories for Lunar and Interplanetary Missions", began with a paper by J. M. J. Kooy (Breda, Netherlands) on "Astrodynamics and Planetary Research", which investigated the motion and uses of space-vehicles placed in orbit about a planet such as Venus. Then H. Hiller (Royal Aircraft Establishment, England) described the results of a generalized study of two-dimensional trajectories in the region of the Earth and Moon, and W. E. Moeckel (U.S. National Aeronautics and Space Administration) discussed interplanetary trajectories for electrically propelled space vehicles.

The second session, on "Orbital Transfer and Rendezvous", comprised three papers on the optimization of interplanetary trajectories, by D. F. Lawden (Canterbury, New Zealand), P. Contensou (Office National d'Etudes et de Recherches Aéronautiques,

France) and B. Fraeijs de Veubeke (Liège, Belgium), and a general study of the techniques of orbital rendezvous by J. C. Houbolt (U.S. National Aeronautics and Space Administration). These subjects promise to expand greatly in the future, since both are essential to the economical performance of space missions and both pose severe mathematical problems.

In the third session, on "Near Earth Satellites", J. Kovalevsky (Bureau des Longitudes, Paris) made a general analytical review of orbital perturbations, D. G. King-Hele (Royal Aircraft Establishment, England) discussed the effect of atmospheric oblateness on satellite orbits, L. Sehnal (Ondrejov, Czechoslovakia) described luni-solar perturbations on a 24-hr. satellite, and K. Schütte (Munich) commented on the changes in the orbit of *Echo 1*.

The final session, on "Dynamics of Terminal Re-entry", was, ironically, delayed because the coach conveying the participants pursued a determinedly non-optimum terrestrial path from Paris to Louveciennes and took nearly 2 hr. to complete a journey nominally of 10 miles. In this session, A. Ferri and T. Ling (Brooklyn, U.S.A.) described the effect of varying lift on re-entry trajectories, W. F. Hilton (Hawker Siddeley, England) considered re-entry paths which avoid the zones of radiation, and errors in re-entry guidance were discussed by T. R. F. Nonweiler (Queen's University, Belfast) and L. Broglio (Rome). Finally, J. V. Becker, D. L. Baradell and E. B. Pritchard (U.S. National Aeronautics and Space Administration) investigated the methods of control for re-entry from escape speeds.

Although some of the papers seemed to be slightly out of touch with the present realities of space research, this was perhaps appropriate, or even inevitable, in a forward-looking academic symposium. Certainly the symposium as a whole can be counted a success, and the International Academy of Astronautics was wise to limit the numbers of those attending to about 80. Representatives from the U.S.S.R. were invited, but were unable to come. The papers presented at the symposium are to be published in *Astronautica Acta* later this year.

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BIOLOGY IN BRITAIN

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SINCE the War, more and more exciting discoveries have been made in biology, but the classical biology of pre-war years has changed little. New techniques and brilliant men have opened new and fundamental subjects of inquiry, which cannot be wholly contained by the separated disciplines of botany and zoology but have found equal application in both subjects. Perhaps for the first time there is now a subject that can be called 'biology'.

A British biologist visiting the United States has at least two shocks in store for him; the first is the

breadth of interest of his American colleagues and the second is the scope of the American undergraduate programme. In the United States there are departments in biology where the staff may include an ecologist, a physiologist, a biochemist, a microbial geneticist, a plant pathologist and perhaps an embryologist. An undergraduate may study zoology, botany, biochemistry, microbiology and genetics as well as chemistry. Afterwards, if he undertakes postgraduate studies, he will attend courses in an even greater variety of subjects. We may be doubtful and scoff 'superficial'