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European space looks forward to the 1980s

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THE new unified European Space Agency (ESA) is scheduled to come into being next month. It will carry on with the execution of various space programmes which have already been decided on and initiated in the framework of ESRO (the European Space Research Organisation).

The accomplishments of ESRO so far have been mainly in the field of scientific space missions, and the seven scientific satellites launched between 1968 and 1972 have all been remarkably successful. This record of technical success has resulted in a number of scientific achievements, mainly in magnetospheric physics and astronomy but also in solar physics and aeronomy. In particular, remarkable ultraviolet observations of stars have been made with high spectral resolution, as well as one of the first attempts at measuring celestial γ rays.

Four of the satellites launched are still in orbit and operating successfully. In particular two highly eccentric orbit satellites, HEOS A1 and HEOS A2, which measure the properties of magnetospheric plasma, solar wind and the interplanetary magnetic field out to some 30 Earth radii. ESRO IV, in a near-Earth orbit, measures a variety of charged and neutral particles, their temperature, density and composition–particles typical of the upper ionosphere as well as those of solar origin. TDIA, apart from its detectors for solar, X and γ rays, as well as celestial X and γ rays and primary cosmic rays, has two ultraviolet telescopes aboard for high resolution stellar spectroscopy and celestial scanning.

The development programme at present being carried out and the one planned for the near future include sophisticated missions which will pursue the exploration of the Earth's environment with investigation of the magnetosphere, using the GEOS spacecraft (a geostationary satellite to be launched in 1976) and IME (International Magnetospheric Explorer to be launched in 1977 as a part of a three-spacecraft collaborative mission with NASA).

Both will measure typical magnetospheric parameters but GEOS is characterised by its extremely high data flow and advanced experimental techniques; IME together with the other NASA spacecraft will provide a tool for a synoptic study of the magnetosphere where spatial variation of local parameters is separated from the temporal one.

In the field of astronomy the European community of astronomers is to participate in the joint United Kingdom/NASA IUE (International Ultraviolet Explorer) geostationary mission which is to carry a high resolution ultraviolet telescope and spectrometer to which the European scientists will have access through a Data Acquisition ground facility in Spain. Also in astronomy, but this time not ultraviolet, are the ESRO missions COS-B, carrying a γ-ray telescope and EXOSAT carrying an X-ray telescope; the latter mission will no doubt bring X-ray astronomy a step further, thanks to the excellent angular resolution that can be obtained by using lunar occultation.

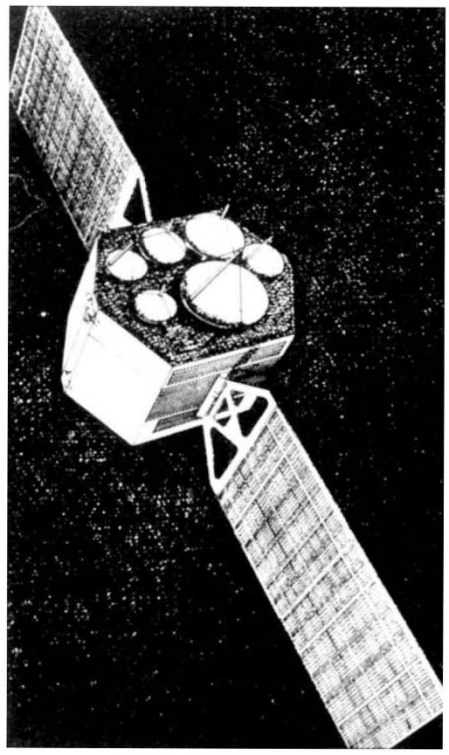
Looking to the still more distant future, the scientists are now studying missions of various kinds and one of the dilemmas they will eventually face is brought about by the development of Spacelab. This facility will have features distinctly different from those the scientists have been used to in previous missions: the substantially larger payload capability will enable them to accommodate large instruments and crew but the orbital limitations will make *in situ* magnetospheric measurements beyond, say, 1,000 km altitude impossible. Furthermore the duration of missions will be limited but repetition of them will probably be quite frequent, and man's presence aboard will make the missions more flexible. The requirement for long period monitoring will no doubt remain and automatic satellites in many fields of research will complement the measurements on board Spacelab.

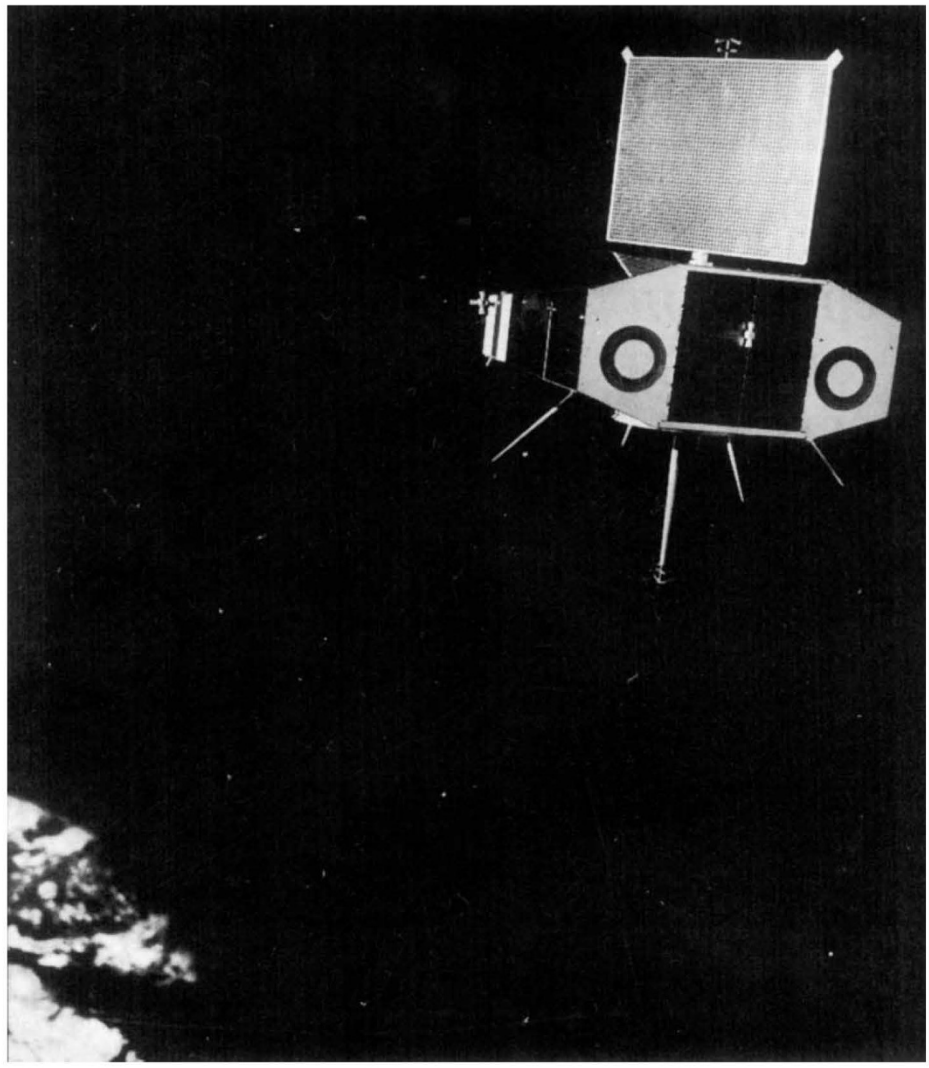
Astronomy remains one of the main areas of interest with continuing investigations in the ultraviolet, X-ray and γ-ray regions of the spectrum and extensions into the infrared.

Future missions being studied aim at infrared observations using either automatic satellites for sky surveys, or a larger Spacelab-borne telescope with good pointing accuracy for measurement of emission and absorption lines. Furthermore advanced missions in ultraviolet and X-ray celestial spectroscopy are envisaged, mainly using Spacelab. Solar physics with high spectral and spatial resolution remains at the centre of interest, using both Spacelab-borne telescopes and automatic satellites, depending whether the misison objective is a detailed, high resolution study of phenomena that cannot be observed from the ground or continuous monitoring of the solar disk. Also a Spacelab-borne facility for magnetospheric, ionospheric and atmospheric research is being considered, as well as automatic satellites for measurements of fields and particles out of the ecliptic plane or far out in the Solar System.

Since 1971 ESRO activities have also been oriented towards space applications on which heavy emphasis has been placed. The Meteosat programme is to be Europe's contribution to the space element of the Global Atmospheric Research Project (GARP) which will be carried out in 1976 and 1977 prior to establishing a worldwide system to be part of the World Weather Watch (WWW). The geostationary Meteosat project will carry a radiometer to provide good resolution photographs of the Earth in the visible and infrared. As from late 1973 the project has been in the development stage and the satellite will be launched at the end of 1976.

OTS : orbital test satellite





EXOSAT : highly eccentric orbit satellite to be launched in 1979, carrying an X-ray telescope in the 0.1–20 keV range, using lunar occultations for high resolution determination of X-ray sources.

A geostationary satellite, the Orbital Test Satellite (OTS), is under development for telecommunications, experiments and pre-operational use, its beam covering western Europe and the Mediterranean. It is to be a precursor of an operational communications satellite system to satisfy the needs of the European Postal and Telecommunications Services in the early 1980s, some four years after the launching of OTS in early 1977.

The increased air-traffic density over nonpopulated areas and the inadequate high frequency communications now used for aircraft over such areas give rise to an obvious application of satellites for air traffic control. Aerosat a collaborative venture of ESRO and the United States aims at establishing a pre-operational system of geostationary satellites, in the first instance over the Atlantic.

Marots, the latest newcomer to the family of ESRO's applications missions, is another example of space technology's potential for communications. The spacecraft technology being developed for OTS is perfectly suitable for maritime communications. The beam of the geostationary satellite will cover a large part of the hemisphere centred on the Greenwich meridian. The spacecraft is going to be launched in mid-1977, about six months after the launching of OTS.

Two other new projects recently included in the ESRO programme are Spacelab and Ariane. The United States shuttle programme, now going ahead at full speed, will permit the placing into orbits of several hundred kilometres altitude of an aircraft-like vehicle roughly the size of the present DC9. The vehicle is recovered at the end of each mission as well as many elements of the associated boosters used for launching. The 'Sortie Module', or as it is now called 'Spacelab' (a fully equipped modular laboratory placed into the vehicle) is being developed by ESRO as part of a collaborative programme with NASA. Spacelab can consist of a combination of modular elements, assembled to either a cylindrical container some 6.5 m long and 4.5 m in diameter, or to other configurations consisting of a smaller Spacelab capsule and external pallets on which experimental equipment, such as astronomical telescopes and other sensors, can be mounted. The large volume available for experiments operated and maintained by humans, the large weight-carrying capability and the power available—all combined with a shirt-sleeve environment, with data processing and other facilities aboard—destine Spacelab to become by early 1980 the most flexible tool for space experimentation and space operations ever built.

The missing element in Europe's space capability has always been heavy launchers. The Ariane launcher (originally the French L3S, now Europeanised) is to fill the gap. A three-stage vehicle, using high energy propulsion in its third stage, will be able to place 750 kg into geostationary orbit when launched from the Kourou range in French Guiana. Four test launches are foreseen between the beginning of 1979 and mid-1980.

The almost simultaneous start of all the programmes described above, and thus the concentration of launches in 1976 and 1977, will put a strain in the next two to three years on Europe's resources devoted to space. In spite of this the interest for other space programmes remains, and several other applications are being actively studied. Data transmission from a satellite seems to offer interesting advantages and television broadcasting seems to be another obvious candidate for space application. The United States' experience in experimental surveys of Earth resources indicates that this application may be one of the more important ones in the future. ESRO is also studying the possibility of such missions.

Recently a possibility of determining, with extremely high accuracy, the position of radio emitters on the ground, on the sea or in the air (using orbiting satellites) attracted attention and a French proposal to undertake a project called Geole is being discussed. The proposal is to use such techniques for cartography, glaciology and also for mineral prospecting and exploitation.

This list is by no means exhaustive and it has been the experience of all those involved in space research that new applications are constantly being found. Space research is only 17 years old—the first Earth satellite was in 1957. It is only in the 1980s that humanity will fully make use of this new and promising field.