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IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

Addendum

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INTRODUCTION

1. In accordance with a recommendation of the Committee on the Peaceful Uses of Outer Space at its thirty-eighth session,[1] Member States have submitted information on the following topics:

(a) Those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of developing countries;

(b) Spin-off benefits of space activities.

2. Information on those topics submitted by Member States as of 31 October 1995 is contained in document A/AC.105/614. Information submitted between 1 November and 15 December 1995 is contained in document A/AC.105/614/Add.1.

3. The present document contains information on those topics submitted by Member States between 16 December 1995 and 25 January 1996.

[1] *Official Records of the General Assembly, Fiftieth Session, Supplement No. 20* (A/50/20), para. 156.

REPLIES RECEIVED FROM MEMBER STATES*

ARGENTINA

[Original: English]

I. National space programme

A. SAC-B light satellite

Space activities demand significant intellectual investment. Profiting from the data collected by means of space technology resources, the development of space communication systems or the access to and use of the extraterrestrial space for other purposes require process formulation and development and the management of data obtained through scientific methods or within the framework of scientific research projects.

SAC-B is an Argentine-American satellite designed to advance the study of solar physics and astrophysics through the examination of solar flares, gamma ray bursts, diffuse X-ray cosmic background, and energetic neutral atoms.

SAC-B, a 181-kg. spacecraft, will be launched into orbit by a Pegasus-XL rocket. It will carry SAC-B to an altitude of 550 km. and a circular orbit inclined at 38 degrees to the Earth's equator, which will ensure an orbital lifetime of at least three years.

The scientific payload of SAC-B comprises an Argentine instrument, the Hard X-Ray Spectrometer (HXRS), developed by the Institute of Astronomy and Space Physic to measure the temporal evolution of X-ray emissions from solar flares and non-solar gamma bursts; a combination of detectors to measure soft X-rays emitted by solar flares and gamma ray bursts provided by the National Aeronautics and Space Administration (NASA) (Goddard X-Ray Experiment-GXRE); a diffuse X-ray background detector using CCD (charge couple device) technology (CUBIC) from Penn State University; and an Italian instrument to measure energetic neutral atoms (ISENA).

The SAC-B mission will be controlled from a ground station located in Buenos Aires, Argentina. This facility comprises the Telemetry, Tracking and Control (TT&C) Station and the Mission Operations Control Center. The TT&C station has a 3.6-m. autotracking antenna, and it enables range and Doppler measurements and Master Clock Reception (GPS). The Control Center consists of two fully redundant Sun workstations linked to the receiving and transmitting equipment as well as to PC-486 terminals, which will control the satellite.

SAC-B is carried out as an international cooperative project between Argentina's National Commission of Space Activities (CONAE) and the United States of America's National Aeronautics and Space Administration. The Secretariat of Science and Technology of Argentina participates in the financing of the project, through the National Council of Scientific and Technical Research (CONICET).

CONAE is responsible for the design and construction of the SAC-B spacecraft, the HXRS instrument, the ground station operation, and the scientific data distribution. NASA will provide two scientific instruments, launch services on a Pegasus launch vehicle and support for initial orbit monitoring and emergency backup throughout the mission. By a separate agreement established with Argentina, the Italian Space Agency (ASI) will provide the solar arrays plus a scientific instrument. The Brazilian National Institute on Space Research is providing the facilities for the system qualification tests of SAC-B, and a Brazilian co-investigator with the Argentine instrument.

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*The replies are reproduced in the form in which they were received.

II. Economic benefits of national space activities

Space activities have proved to be a setting for the development and full growth of new technological concepts that, in a further stage, when adopted by the production sectors in society, have borne the rigors of a free and competitive market. The telecommunications systems based on artificial satellites are the best example of this; after going through a stage of experimental development, they were assimilated by the companies providing such services and these companies were the ones taking care of the diffusion and application of this new technological concept. The present trend in this field is that, in the short and medium term, the promotion of advanced matters in this technology must remain within governmental agencies, while development work related to the optimisation and service expansion is left in the hands of the private sector. Service is presently aimed at giving priority to satellite voice and data telecommunications, a field in which CONAE's responsibility is limited to offering services as a "space architect" (selection of design and engineering options). However, CONAE will have to develop technologies associated to other non-massive data transmission services involving economic significance and social relevance (education, safety, isolated human settlements, maintenance of extensive networks such as gas pipelines, high-voltage lines, etc.).

The areas that will show the most direct economic impact in the short and medium term are:

- The follow-up and quantification of agricultural and forestry production.
- The follow-up and surveillance of fishing activities.
- The supervision of floods and natural disasters.
- The evaluation and survey of soil and underground exploitation works.
- The monitoring and supervision of environmental problems.

Additionally, there are other secondary markets connected with remote sensing that, due to the early phase of their use in the country, are hard to estimate:

- The market of geographical data systems and their related databases (Applied Data Systems (ADS)).
- Global climatic reporting and forecasting.
- The market of special sensors.

In addition to constituting a valuable base of general information, the use of remote sensing data in agricultural exploitation may give way to more accurate forecasting of future harvests, to better control of promotion loans and of tax collection, and to better use of subsidies on natural disasters. As an example, it may be mentioned that, when correlated with climatic factors, a detailed historical database on agricultural production should serve as a basis for a market of agricultural insurance, an activity that is now emerging.

In the area of fishing, the use of satellite data may result in more effective campaigns and in fuel savings due to the satellite positioning of areas of high fishing density. Appropriate satellite data is also indispensable for the surveillance and control of fishing licences concerning operations in the Argentine Sea and for the supervision of over-exploitation of fishing resources. Remote sensing in the field of mining would result in significant savings in exploration campaigns.

The development of space technologies to be envisaged within the framework of the National Space Programme will produce the maximum and most immediate social and economic return. This can be attained by focusing efforts towards its use in:

- Contributing to education and to improving the population's quality of life, particularly in distant and marginal areas.
- Creating new capabilities and sources of employment at industries producing goods with a high added value.
- Obtaining advantages for the local production system, thus allowing for the entry of our industry into a highly competitive international market.

- Promoting new businesses that allow for an expansion of the national production scope.

The most suitable way to attain such goals is the application of a strategy involving the concentration of efforts and specialisation, through the identification of well-defined objectives and of attractive technological and commercial spots, where an international level of excellence and of originality can be reached and maintained.

The space programme must be considered as a part and continuation of the efforts for technological development already being carried out in our country. From the very start, it must profit from an important threshold of scientific and technological knowledge already gained through the activities performed by the former CNIE (National Commission of Space Research) and by other local scientific and technological institutions, such as INTA (National Institute of Agricultural Technology), INTI (National Institute of Industrial Technology), CONICET (National Council of Scientific and Technical Research), CNEA (National Atomic Energy Commission), universities and other agencies. The space programme must be supported by a flexible research and development infrastructure optimising CONAE's infrastructure and by the use of resources assigned to space activities. For that reason, it must interact with whatever public and private institutions and work teams are deemed necessary, by means of a flexible organisation that may be adapted to correspond with the progress attained. The guidelines established to meet these requirements are:

- Offering society a complete cycle of space data, promoting their best utilisation.
- Developing space technologies for environmental protection.
- Promoting the use of space technology for social, production, scientific and educational purposes.
- Developing light satellites for remote sensing, scientific use and communications, supplementing those available internationally and responding to specific national demands.
- Promoting actions supplementing those in the private sector concerning initiatives with a technological and innovation content, or the use, diffusion and utilisation of space data.
- Encouraging the training and qualification of human resources and of organisations contributing to and participating in the space programme.
- Assisting in promoting national participation and initiatives aimed at enhancing the tasks of international forums where juridical regulations related to space activities are discussed and prepared.
- Promoting international cooperation actions and Argentine participation in multinational cooperation programmes converging with local long-term policies.
- Favouring joint international actions and programmes with shared goals that contribute to regional integration within the framework of MERCOSUR.
- Complying with the legal mandate of contributing the technical and scientific elements needed for shaping coordinated and joint actions with other State agencies.

III. Juridical matters and international relations

International cooperation is a key issue as far as space technology is concerned. Argentina has already had lengthy and active cooperation with Brazil, France, Germany, Italy and the United States, and is presently planning joint projects with Denmark, Spain and other countries. CONAE will encourage these lines of cooperation, as far as they converge with the development work scheduled in the national space programme and involve concrete projects aimed at well-defined goals. Any initiatives or proposals for international cooperation implying diversification of efforts will be considered by CONAE to be of secondary importance.

CONAE will place special emphasis on strengthening regional cooperation in space matters. It will look forward to expanding the goals and to optimising the tasks scheduled in the present programme, encouraging active cooperation within the framework of MERCOSUR. It will promote the use of supplementary infrastructural resources and development means in the region, schedule the performance of mutual assistance actions, contemplate supplementary development work and explore the possibilities of performing joint space missions.

With its own actions and as far as it converges with its objectives, CONAE will support the initiative for research on Global Change, which is presently acquiring institutional and international cooperation dimensions, with the IGBP (International Geosphere Biosphere Programme) and other institutions. This research work will demand a highly significant effort in the space field and is important for the rational management of renewable natural resources and of the region's biodiversity, as well as for forecasting social and economic changes that may affect the country and the hemisphere.

IV. Scheduled space activities

The main areas of space activity foreseen in Argentina involve both scientific and technological research work and applications.

These scientific and technological projects will enable progress to be made in the preparation and management of space missions, as well as in the design of satellites and of on-board instrumentation. Likewise, this activity will make possible the consolidation of international cooperation links in the space field.

Application activities will be primarily devoted to a remote sensing programme and to telecom-munication matters supplementing those offered locally and internationally in data, voice and television communications.

Activities in remote sensing include both the reception and distribution of images from international systems and our own image generation within the optical range (visible and infrared) and microwaves appropriate for local requirements and of great social relevance.

As part of the land infrastructure, provisions are being made for the installation of a multipurpose ground station aimed at satisfying both remote sensing and radioastronomy demands.

Concerning the production of our own images and data, provisions have been made for the development of satellite systems to be compatible with the scientific and technological research work, through the SAC (Satellite for Scientific Applications) line of light satellites.

The development of satellite systems involves the design of chambers and sensors and of computation instruments required for receiving, storing and processing the data produced, thus integrating the main links of the Space Information Cycle (SIC). The use of the infrared spectrum is relevant to the oceanographic applications, as well as to environmental monitoring (forest fires and volcanic activity). With regard to the visible optical range, the medium-term trends in the international arena involve an increase in the number of spectral observation channels, so as to make it more specific to and versatile for various applications which have been contemplated in the third SAC satellite. Finally, as a long-term development objective, studies are to be performed on laser applications in space.

In the short term, the remote sensing programme will be supplemented with observations in the microwave range by means of radar. This is an important method, since it allows for capturing images regardless of the solar light on the site and the meteorological conditions. This is particularly relevant for the monitoring of the Argentine Sea, the Province of Tierra del Fuego and the Antarctic, which are regularly covered by thick cloud layers. Radar observation can also be used for soil studies (particularly for soil humidity measurements), an area in which INTA has long and valuable experience. Microwave range observation are obviously applicable in matters related to national agricultural production and to the monitoring of fishing in the South Atlantic.

The microwave observation programme is a starting-point for the analysis and development of alternatives to the low-consumption radar, a major condition if the best use is to be made of the experience gained with the SAC line of light satellites. This observation programme will be carried out with the SAOCOM (Satellites for Observation

and Communications) satellite family series, in which the radar's useful load will be shared with that in communications, as described below.

The applications foreseen in the field of communications are aimed at solving deficiencies in extensive areas of the country as far as communications elements are concerned. Adequate use of space communication technologies may result in solutions to many of the problems in rural environments and schools, in remote police stations and in distant hospitals and health-care centres. They are also applicable in the maintenance of extensive power distribution networks and gas and oil pipelines. This service must be aimed specifically at data transmission, electronic mail, connections with isolated settlements, and links with low-cost land platforms for the collection, control and recording of the most diverse types of data, such as agrometeorological, environmental, hydrological and industrial application data. These matters are marginal for the telecommunications market in private hands, but they are considerably significant from strategic, economic and social standpoints. Simultaneously, economically-sustainable innovative technological development projects may be carried out in this area on SAOCOM-type satellites.

V. Courses of action

The projects and activities defined above constitute a scheduled programme of actions to involve CONAE. For planning, discussion and analysis purposes, they will be encompassed in the following five courses of action, thus associating each one of them with an equal number of broad segments in space activities:

- Land infrastructure
- Satellite systems
- Data systems
- Access to space
- Institutional development and basic tasks.

A. Land infrastructure

This course of action contains all the tasks performed by CONAE with regard to ground stations for follow-up, telemetry and control of Earth links with satellites or spacecraft, laboratories for integration, tests and simulations and testing tables for satellite or spacecraft subsystems.

This includes the laboratories to be installed in the Teófilo M. Tabanera Space Centre at Falda del Carmen, Province of Córdoba, and the telemetry and control systems for the follow-up of the satellites to be launched. It also comprises the performance of a feasibility study and the startup of the facilities recommended for obtaining CONAE's own data or that offered internationally (Landsat, Spot, etc.) as well as for radioastronomical observations.

B. Satellite systems

This course of action includes all satellite missions, including the construction of satellites and platforms or space stations, as well as their subsystems for control, power generation, sensoring, communications etc.

As for experience gained in projecting and building satellites, Argentina will have a successful pro-gramme of light satellites, each weighing up to a ton, for scientific, remote sensing, communication and other purposes. In our country, there are presently specific requirements in the areas of remote sensing and telecommunications that will not be satisfied by the systems offered internationally and that may be better satisfied by our own light satellites.

On an immediate basis, missions will be performed with mixed-purpose satellites, for remote sensing and scientific research. Further on, this framework will be expanded to include satellites for microwave observation and communications (SAOCOM).

C. Data systems

This item comprises all the actions aimed at collecting, receiving and storing data from space systems, including the development and operation of hardware and software systems, of computer networks and of data centres.

Both public agencies and private enterprises in our country have gained considerable experience in communication and computer network technology, as well as in the best use of images and of satellite data. Consequently, our country may well face development work concerning communications software and hardware, systems for database management, systems on geographically referenced applied data, database systems for computer-aided design and manufacturing and event software for highly diverse types of engineering calculations. These are elements by which space activities may transfer their benefits to society, since they contain a great multiplying effect, allow for easy capitalisation of efforts and imply moderate investment costs.

On an immediate basis, this course of action shall emphasize the expansion of the service rendered by the Regional Center of Satellite Data (CREDAS) and the development of software concerning geographical data and image processing simulation.

D. Access to space

Any actions performed that allow access to space by the various satellites included in the space programme are included under this item. Examples include feasibility studies and development, use and exploitation of spacecraft, which allow for the exploration and best use of extraterrestrial space.

This development work will be carried out within the framework of full transparency and taking into account the possibilities offered by international cooperation programmes, in accordance with Argentine policy on non-proliferation and with the international commitments assumed by our country in this area.

On an immediate basis, the possibility of using the local experience in conceptual engineering for the development of a new generation of spacecraft will be evaluated. Such spacecraft should be used for supplementing previous undertakings concerning light satellites and should prove to be economically feasible, so that progress can be made towards a prototype within the first decade in the next century. A constant follow-up of the international market in this sector will allow an assessment to be made of the best opportunities for the concentration of material and human resources in these matters of the space programme.

Any future undertakings regarding access to space will be in agreement with the guidelines under which CONAE was created, that is, rejecting any use of space activities for military offensives.

E. Institutional development and basic tasks

This course of action involves all the actions with regard to relations with other national and foreign institutions for the promotion, diffusion and utilisation of space techniques or for project development involving international cooperation. CONAE's tasks related to the training of human resources, through its Mario Gulich Institute for Advanced Space Studies and other educational activities are also included under this item, especially its contribution to distant education programmes.

F. Development of human resources

The performance of training activities for human resources, aiming at satisfying the demand emerging from the actions scheduled in the space programme, is considered essential. In order to undertake these tasks, CONAE will promote the development of its Mario Gulich Institute for Advanced Space Studies, so as to transform it into an interdisciplinary centre for the teaching of space sciences and of other related areas of knowledge.

The Institute will operate with the Teófilo M. Tabenera Space Centre at Falda del Carmen, Province of Córdoba, providing courses specially tailored for satisfying CONAE's needs, as well as those of companies involved in space activities. These courses will also be made available to students who are not directly associated with CONAE or with enterprises in this field. The Institute will be given the juridical form considered most appropriate in order to attain maximum self-financing.

FRANCE

[Original: French]

I. Space activities in France

France's space programmes have a large international cooperation component, whether multilateral, in particular under the aegis of the European Space Agency (ESA), or bilateral. France thus has ongoing contacts with countries that have an extensive space sector, but is also developing scientific and technical cooperation activities with newcomers in the space field.

This report gives an overview of France's space-related activities from the period of mid-1994 to mid-1995.

Space-related work in France currently employs about 16,000 people, over 13,000 of whom are in the industrial sector. Launcher-related activities are the most important, followed, as regards applications, by radiocommunications and Earth observation.

The French space industry is dominated by some 60 companies. The 20 largest account for nearly 95 percent of this industrial activity, while 70 percent of jobs are in the group of four space contractors (Aérospatiale, Alcatel Espace, Matra Marconi Space and Société Européenne de Propulsion).

II. The main civilian programmes

A. Space transportation and orbital infrastructure systems

1. ARIANE programme

The development of the ARIANE launcher family, under the aegis of the European Space Agency (ESA) and supervised by the French National Centre for Space Studies (CNES), has provided us with a high-performance transportation vehicle, produced and marketed by Arianespace, which also provides launch services. Increasingly powerful versions have been developed, ranging from ARIANE-1, launched for the first time on 24 December 1979, to ARIANE-4, capable of launching 4.7 tons into geostationary transfer orbit in its most powerful configuration.

By 20 November 1995, the ARIANE launchers had clocked up 73 successful launches out of 80, including test launches. Since 1988 ARIANE-4 has been launched 52 times with 49 successful launches, and has placed 63 satellites in orbit.

The new ARIANE-5 launcher has a dual purpose: first, to make the ARIANE family more competitive by enhancing performance levels, reducing launch costs, improving reliability and increasing the useful diameter under the fairing, so that ARIANE-5 will be capable of launching into geostationary transfer orbit either two 3,000 kilogram satellites simultaneously or a single satellite of up to 6,800 kilograms; second, to satisfy Europe's need for a low-orbit facility using manned vehicles or space station sections. The development of ARIANE-5 began in late 1987. The first test launch is planned for late April 1996 (flight 501) and the second for September 1996 (flight 502), before commercial operation can begin.

The last development work is currently being completed in Europe and the manufacture of the sections for flights 501 and 502 is well advanced. The development trials on the Vulcain cryogenic engine are being pushed ahead in order to ensure the qualification of that essential part of the launcher without delay.

2. Space station

With regard to orbital infrastructure facilities, France is helping to define Europe's contribution to the international space station project.

The international situation has led the European Space Agency (ESA) to adjust the manned flight programme. The October 1995 meeting of the Council of Ministers produced the following programme:

- Development of the COLUMBUS orbital facility (COF).
- Development of the automated transfer vehicle (ATV) launched by ARIANE-5.
- Studies of a crew transport vehicle (CTV).
- Readying the orbital laboratory for use.

This development programme should lead on to the operating period, from 2001 to 2013.

B. Radiocommunications

After the successful launch and commissioning of the TELECOM-2A (16 December 1991) and TELECOM-2B (15 April 1992) satellites and the work being done on TELECOM-2C, which is to be launched in 1995, France Télécom and the French Armaments Office (DGA) ordered a fourth flight model, TELECOM-2D, in 1993 for launch in 1996. This is part of the effort to provide expanded services by 2005, with at least two satellites in orbit. CNES is also involved, with technical responsibility for the space segment and with responsibility for the operational status of the next two satellites, TELECOM-2C and TELECOM-2D.

In the field of telecommunication satellites, French industry has to cope with rapidly developing technologies and market requirements in a very competitive environment. The various protagonists are aware of what is at stake and have joined forces to propose a technological programme with research and development activities, groundstation development, the STENTOR satellite and the incorporation of new technologies in industrial product lines.

In October 1994, the French Government decided to go ahead with the STENTOR programme. The initial definition studies will be followed by programme implementation, aimed at the launching of the satellite by ARIANE-5 in the year 2000. STENTOR, with a mass of between 1,600 and 1,800 kilograms and a power of the order of 1,800 W, will make maximum use of the latest technologies.

With reference to data collection and beacon location services, the ARGOS programme is being pursued with the National Oceanic and Atmospheric Administration (NOAA) of the United States of America.

ARGOS has been used increasingly in the last decade and this trend is set to continue in the coming years with the implementation of major international ocean and weather study programmes.

CNES, which is responsible for the ARGOS space segment, has called on industry to develop the second-generation instruments that will be carried on the platforms of the American NOAA Advanced TIROS satellites. As from 1996, these new instruments will triple the data-processing capacity. The satellites will extend the service life beyond the year 2004.

The COSPAS-SARSAT search and rescue programme can be used to detect and pinpoint moving objects (particularly aircraft and ships) involved in disasters. The programme involves extensive international cooperation and, so far, 20 countries have joined the four founding suppliers of the space segment: Canada, France, Russian Federation and United States.

Since 1982, the COSPAS-SARSAT programme has been instrumental in 1,649 rescue operations, in which 5,041 persons have been rescued (as at 31 December 1994). One hundred thousand 406 MHz and about 555,000 121.5 MHz distress beacons are now in use around the world.

Satellite navigation systems are of considerable interest to the international civilian community, particularly civil aviation. The American Global Positioning System (GPS) can no longer keep pace, particularly in civil aviation, with the need for location accuracy, security, availability and continuity of service and must be supplemented. The use of geostationary satellites to supplement the GPS constellation, a technical concept resulting from several years of concerted effort by CNES and the French General Directorate for Civil Aviation, has finally been accepted internationally as the reference solution, above all by the International Civil Aviation Organization (ICAO). This configuration has been named the Global Navigation Satellite System, first generation (GNSS-1).

The European Commission, EUROCONTROL and ESA have taken the initiative of combining their efforts to develop a European satellite navigation programme that is beginning this year.

C. Earth observation

In the field of earth observation, France occupies a special and strong position with the Experimental Earth Observation System (SPOT) high-resolution optical imaging satellite programme, developed with Belgium and Sweden. It was decided that the best approach was to develop and maintain an evolving operational network, run by a single commercial entity, SPOT IMAGE, a subsidiary of CNES.

The SPOT system already has three satellites in orbit, SPOT-1, -2 and -3. In 1995, the operation availability level was remarkable, because of the combination of the excellent performance of the SPOT-3 satellite, launched on 26 September 1993, and the availability of SPOT-2, used to supplement SPOT-3 by direct reception stations,

as indicated by SPOT IMAGE. After almost 10 years in orbit, SPOT-1 still provides high-quality images and is a backup satellite that can be used by the direct reception stations within a few days.

The constellation will develop further with SPOT-4, due to be launched in late 1997. The lifetime and recording capacity of SPOT-4 are superior to those of its predecessors and it will have a new spectrum band in the infrared range. In addition, it will carry the “Vegetation” payload co-funded by the European Union, Belgium, France, Italy and Sweden. This wide-field and mid-resolution (1 km) imager will be used for repetitive and general continuous observation of the continental biosphere.

In October 1994, the Government decided to go ahead with the development of two new satellites, SPOT-5A and SPOT-5B. The former should be launched in 2002 and the latter in 2007. The decision guarantees users SPOT service continuity until 2012, essential for the lasting development and diversification of the operational applications and services with a value-added component, as well as environmental monitoring.

D. Earth sciences and environment

The STELLA laser reflecting satellite, launched in late September 1993 with SPOT-3, and the DORIS positioning system, carried on SPOT-2, -3, -4, -5A and -5B and on the ESA's ENVISAT mission, along with the participation by CNES in the Danish OERSTED programme to study the Earth's magnetic field, are expanding research in Earth sciences. The use of DORIS in monitoring movements of the planet's tectonic plates has been informative and will be continued in the SPOT, TOPEX-POSEIDON and ENVISAT programmes.

The ALISSA project, in collaboration with the Russian Federation, primarily designed to provide a detailed description of the upper part of cloud systems, is to be placed aboard the Priroda module on the Mir station this year.

Work has begun on producing two instruments for the European ENVISAT-1 mission. DORIS, already on SPOT-2, -3 and -4, and TOPEX-POSEIDON will consolidate our precision orbitography studies, while SCARAB will be used to continue the radiation budget observations started on the Russian Meteor series satellites.

In 1996 the POLDER imaging polarization reflectance measuring instrument will be sent up on NASDA's ADEOS satellite, as part of a first joint project with Japan, and then on the ADEOS-2 satellite, due to be launched in 1999.

France is also planning to contribute to the World Climate Research Programme by developing two operational systems, namely the Topex/Poseidon Follow-On (TPFO) and the Infrared Atmospheric Sounder Instrument (IASI).

TPFO is a series of altimetric mini-satellites designed to provide reasonably-priced continuity of the TOPEX/POSEIDON observations. France is examining this possibility, in cooperation with the United States, as part of a line of products to construct mini-satellites from modular elements.

French and Italian research is currently being carried out into the definition of the IASI infrared sounder. IASI is part of the basic payload of the operational meteorology (METOP) satellites. By providing profiles of temperature, humidity and certain minor constituents of the atmosphere, it will contribute usefully to the World Climate Research Programme and answer the most pressing needs of operational numeric weather forecasting.

In the first few months of 1995, the French scientific community participated in the third stage of the European stratospheric balloon programme - the Second European Stratospheric Arctic and Mid-Latitude Experiment (SESAME) - aimed at studying the stratospheric ozone layer over the Arctic.

E. Space sciences

The past year was marked by a number of events.

The French and Russian SIGMA-GRANAT programme is being concluded in an exemplary manner. Under the terms of this programme, France supplied the telescope for the gamma-ray study of the sky. The scientific results obtained, in nearly four years' observation, are a step forward in our knowledge of the universe and, in particular, the centre of our galaxy.

The ULYSSES probe, an example of cooperation between Europe and the United States, flew by the south pole of the Sun. This had never been done before and the data are being examined.

France is also involved in the international Global Geospace Science (GGS) programme to study the Sun's influence on the Earth's environment. This programme uses several satellites, including WIND, which was launched in November 1994.

There will also be several important exchanges in the short term. French engineers and scientists are making the necessary preparations.

The European Infrared Space Observatory was placed in orbit in November 1995. The CLUSTER programme to measure the fine structure of the Earth's magnetosphere is due to be launched on board test flight 501 of the ARIANE 5 launcher in 1996. The Solar and Heliospheric Observatory (SOHO) programme which, with CLUSTER, is the initial cornerstone of the Horizon 2000 programme of (ASE), to measure Earth/Sun interaction, was launched in December 1995 by the United States.

Cooperation with the Russian Federation includes the first launch of the INTERBALL magnetosphere study programme, which should take place in the coming months. Similarly, preparations for the MARS experiment have been proceeding, with delayed launch targets in 1996 or 1998, the dates of the next favourable planetary windows.

Considerable work has been done on preparations for future missions, in particular the European X-ray Multi-Mirror Mission (X-ray astronomy) and Integral (gamma radiation) programmes, the international Cassini/Huygens mission to explore Saturn and Titan, or the European Rosetta mission to collect comet samples.

F. Physical sciences, life sciences and manned flights

Recent developments in this area in France include the introduction of gravitational physics, whose objectives are similar to those of astrophysics. More conventional subjects, such as condensed matter physics in a weightless environment, more application-oriented subjects, such as the behaviour of fluids in orbit, have been the subject of several experiments in the past year.

The life sciences field is threefold: biology and basic physiology, space medicine, as applied to manned flight programmes, and exobiology, which is also emerging from the programmes to explore the solar system. Several projects have been conducted in these different disciplines.

In addition to a programme of sub-orbital experiments, the physical sciences and life sciences projects have benefited from the use of recoverable satellites (principally the Gravitational Cell Biology Facility (IBIS) aboard the Russian Photon 10 capsule) and manned missions. An example was the Spacelab International Microgravity Laboratory (IML-2) mission in July 1994, with a considerable French contribution, both in the field of bilateral cooperation and through the experiments conducted by ESA. Mention should also be made of the Ramses project, involving cooperation between Belgium, France, Spain and the United States, to improve our understanding and mastery of the separation and purification of proteins in orbit.

France also has its own manned flight programme and is preparing the French and Russian Cassiopée mission, scheduled for 1996, for which two French astronauts have been selected. They began their training at Star City in January 1995. A French astronaut was chosen as backup for the IML-2 mission, while another French astronaut flew on behalf of ESA aboard the shuttle Atlantis on the international ATLAS-3 mission.

NORWAY

[Original: English]

I. Recognition of the importance of Norwegian space activities

As this Annual Report makes clear, Norwegian space activities are growing at a healthy rate, and the prospects for the future are promising. The level of space activity per capita is very high, and it is highly export-oriented.

Membership of ESA is an important element in the further development of this sector. The Office of the Auditor General has recently submitted a report to the Norwegian Parliament (Document No. 3:8 1994-95), which discusses the experience of four years' membership of ESA's Audit Commission. The report concludes that ESA is an important industrial gateway to Europe, and that membership of ESA enables Norway to participate in several aspects of the European political network, not least in the global collaboration within environmental monitoring. The report also refers to good results so far for Norwegian industry, and points out that Norwegian participation in ESA provides advanced tasks relative to the financial involvement. On this basis, it concludes, Norwegian efforts in relation to ESA should be maintained at least at their current level.

The Auditor General's report recommends that the national ground infrastructure for space activities should be further developed, referring specifically to Andøya Rocket Range and Tromsø Satellite Station. Such development is already under way, both at these two companies and in connection with other organizations such as EISCAT, which is completing the construction of its new radar on Svalbard this year. It is well known that the world's highest concentration of infrastructure for auroral research already exists in Northern Norway and on Svalbard, because of the natural advantages. The installations give considerable economic and scientific return of the national inputs. Collaboration with the Swedish Space Corporation on the ownership side of Earth observation services means that the Swedish-Norwegian infrastructure is the biggest in Europe in this area; major challenges and prospects lie ahead of us, including the prospect of new activities on Svalbard.

The positive results of investing in and operating space-related ground infrastructure underline the appropriateness of the national objective of playing a leading role in the provision of this type of infrastructure.

The Auditor General's conclusions are a clear recognition of ESA as a means to achieve economical growth, of the work of the Norwegian actors, and of the national goals and strategies that underlie the national efforts.

II. Report of the Board of Directors

A. Introduction

The Norwegian Space Centre is a foundation consisting of three units: the Oslo Headquarters is responsible for the national coordination of space activities and Norway's interests vis-a-vis ESA, and it is primarily financed via the budget of the Ministry of Industry and Energy. Andøya Rocket Range and Tromsø Satellite Station are run on a commercial basis, and their revenues are derived from national and international contracts.

Andøya Rocket Range is responsible for the operation of the rocket range and the development of ancillary services. Its principal activities consist of launching scientific rockets on contract to research groups that carry out campaigns dedicated to studies of the middle and upper atmosphere.

Tromsø Satellite Station is responsible for operation of the COSPAS/SARSAT rescue service on behalf of the Ministry of Justice, as well as for acquisition of Earth observation data and related services in connection with national and ESA programmes.

B. Activities in 1994

The principal objectives of the Norwegian space sector are to create an annual rate of industrial growth of 15 percent, to meet the needs of national users, achieve leading international positions in space research, and play a leading role in space-related ground infrastructure activities.

Membership of the European Space Agency (ESA) is an effective means of achieving these goals. The areas of concentration are those in which Norway is capable of making an international contribution, and are based to a great extent on national prerequisites and requirements.

The total turnover of Norwegian space-related products and services increased by 4 percent between 1991 and 1994. ESA contracts with Norwegian companies have also increased significantly during the past few years. Registered contracts rose to 13 percent higher than the level of participation can "demand", and that shows that Norwegian industry and business have managed to obtain a very good position relative to European competitors and that they have demonstrated their competitiveness. These contracts include a larger share of advanced technology than most other countries that cooperate with ESA. Collaboration with ESA has also resulted in a number of spin-off effects in the shape of profitable deliveries of products and services to other markets both within the space sector and in other industries. By 1994, the investment of effort in ESA since 1985 had resulted in an industrial turnover more than four times the size of the financial investment involved. The Board regards this as a very satisfactory result.

More than 50 percent of the national Earth observation programme is currently financed by user groups. A preliminary evaluation of this programme has given a good basis for future work. In collaboration with national actors a national plan has been drawn up for the development of new services via preoperational running of marine and environmental applications, and based on the use of radar satellites.

The further development of space activities based on ground infrastructure in Northern Norway is assuming ever greater importance. In the course of the past few years, Tromsø Satellite Station has considerably increased its turnover, and it made another solid profit in 1994. In 1994, Tromsø Satellite Station laid the foundations for a contract regarding rights to acquire data from the Canadian RADARSAT radar satellite.

The turnover of Andøya Rocket Range has also increased, and the Range also made a good profit in 1994. International marketing is producing results and a further development of the range of activities is expected. The new ALOMAR lidar observatory for middle atmosphere observations, particularly for continuous ozone measurements, is the object of a great deal of international interest. It commenced operations in 1994.

In Norwegian space research, scientific priorities and their financing are the responsibility of the Research Council of Norway, while the Norwegian Space Centre provides technical and managerial support, primarily via ESA projects. In 1994, the Research Council carried out an independent evaluation of Norwegian space research with the help of an international group. Although this evaluation came to positive conclusions, the financial contribution of the Research Council of Norway has been reduced to a level at which it is impossible for Norwegian scientists to participate in new ESA projects starting in 1995-98. A solution to this problem is urgently required.

C. Collaboration with the Swedish Space Corporation

Tromsø Satellite Station is facing important challenges, for example in connection with the preparation of a business concept based on Canada's new RADARSAT radar satellite.

In order to achieve greater breadth and weight in the Earth observation market, the Norwegian Space Centre has signed a collaborative agreement with the Swedish Space Corporation. The collaboration implies the establishment of Tromsø Satellite Station as a limited company, which will be jointly owned by the Norwegian Space

Centre and the Swedish Space Corporation. The agreement was approved by the Norwegian Ministry of Industry and Energy on 3 March 1995.

D. Plans for the future

In autumn 1995, ESA once again held a meeting of its Council, at which the continuation of major programmes such as the space science and space station programmes, as well as follow-up programmes for Ariane-5, were resolved. There is some uncertainty regarding the scope and content of these programmes. The telecommunications and Earth observation programmes will continue with acceptable timetables and budgets.

The Norwegian Space Centre will primarily utilize the ESA programmes to continue its efforts to meet national objectives. The Norwegian Space Centre will continue to implement measures that have the aim of concentrating on those main actors and areas of activity that make the greatest contribution to achieving national goals. One such area is satellite-based navigation, in which the Board has recommended that Norway should participate in a relevant new ESA project (Artes 9). The Norwegian Space Centre will thereby involve itself to a greater extent in this area, which is expected to assume ever greater national and international significance. It is of particular importance to exploit the potential involved in the development of new services.

The Board regards it as being of decisive importance to maintain national space-related projects to meet user requirements, and as "locomotives" in the development of national industrial competitiveness. For this purpose, it is essential to continue the Space Centre's national support programmes for industrial development and the development of services and infrastructure at least at the level gained in 1995 after extraordinary grants. The Norwegian Space Centre will continue to utilize the support programmes to promote cooperation among national actors, and to further encourage companies that have shown themselves to be capable of competing in international markets and which have developed the necessary technological competence and market orientation. The Norwegian Space Centre is placing increasing emphasis on ensuring that the good results of ESA collaboration will lead to further industrial growth on commercial conditions, and extra funding was allocated for this purpose in 1995.

Andøya Rocket range will intensify the marketing of its services to user groups in Germany, Japan and the United States. As a result of the expansion in commercial activity, the number of staff was increased at both Tromsø Satellite Station and Andøya Rocket Range in 1995.

In spring 1995, the Norwegian Space Centre took measures to bring the establishment of space activity infrastructure on Svalbard a stage further. A preliminary evaluation of the possibility of setting up a satellite station was made available in mid-March 1995. Rocket launches from Svalbard await the permission of the Governor of Svalbard.

E. The Board

The Board of the Norwegian Space Centre held six meeting in 1994.

F. The Council

The Council is an advisory body for the Norwegian Space Centre's management and Board. It is made up of representatives of industry, users and research. The Council held two meetings in 1994.

G. Organization and personnel

Andøya Rocket Range had a staff of 27 at the end of 1994. The number of staff at Tromsø Satellite Station at the end of 1994 was 26. Headquarters' activities were reorganized on 1 February 1994 and now focus more sharply on the primary national goals. In 1994, the number of staff at Headquarters was 21.

A joint meeting has been held with the Work Environment and Cooperation Committees of all three units. The Norwegian Space Centre places great emphasis on a good working environment for its staff and on a good external environment. In the opinion of the Board, the working environment is good at all three units. The environmental effects of exhaust gases from rocket launches at Andøya Rocket Range were well within accepted norms.

III. Activities

A. Industry

1994 was a turbulent year for ESA. The Space Station Programme in particular has suffered major changes and budget cuts, and this has had important consequences for the European space industry. However, Norwegian companies have emerged well from this difficult period, partly because many of their tasks dealt with early phases of the programmes, and partly because Norwegian industry is competitive. Among ESA's brighter points are the Space Transportation Programme and the construction of Ariane-5, which by and large are going according to plan. The products of Norwegian participating companies have qualified and the first deliveries have been made.

Competition is very tough, even for small contracts, and countries are much more careful than they used to be to obtain advantages and contracts for their own industries. The German authorities are exploiting the space sector to build up high-technology companies in what used to be the German Democratic Republic, and Norwegian companies have already found partners there. A number of Norwegian industrial companies have qualified as suppliers to the space segment.

Norwegian industry is participating actively in ESA's new standardization project, European Cooperation for Space Standardization (ECSS). This initiative is based on the development of a single integrated set of cost-effective standards for use in all European space programmes. The initiative has been extremely successful. France has already decided to use it as its national standard and Germany is expected to follow. Cooperation is also under way with CEN (Comité Européen de Normalisation) with the intention of making ECSS a European standard. Since the United States of America is in the process of dismantling its system of military standards, the ECSS standard will assume greater international importance. There have already been requests from China and the Russian Federation to take part in the process.

In spite of the tough competitive climate, 1994 was a good year for the Norwegian space industry. There was a growth in ESA contracts, Norway having one of the highest rates of industrial return in ESA. The accumulated sum was 13 percent higher than the level of participation suggested should be the case. This demonstrated that Norwegian industry managed to obtain a very good position relative to its competitors, and that it demonstrated its competitiveness. These contracts also had a very high "weighting factor", i.e. they included a higher proportion of advanced technology than many other nations in ESA.

The total turnover of Norwegian space-related products and services rose by 16 percent between 1993 and 1994. The mean annual increase between 1990 and 1994 was 18 percent. About 80 percent of the total was exported.

ESA collaboration has been responsible for considerable spin-offs in the form of profitable deliveries of products and services to both space-related and other markets. The Norwegian Space Centre carries out annual evaluations of what companies have achieved via their contracts for ESA. Preliminary results of these evaluations show that the accumulated spinoffs have reached a factor of 4.4. This means that total investments in ESA contracts since 1985 have generated a total turnover that is almost 4.4 times as large as the monetary input. This may be regarded as a very satisfactory result. Participants in the Norwegian space sector also emphasize the importance of ESA collaboration as a very suitable instrument for the transfer of technology, quality improvements, extended international cooperation and as a quality reference for individual companies.

B. Telecommunications

For some time, telecommunications has been by far the largest area of Norwegian space activity, making up some two thirds of the national turnover of space-related products and services. Sales in satellite communications increased by 20 percent compared with the previous year's figure. Telenor and ABB Nera are still the dominant players in this field, particularly where Inmarsat products and services are concerned. However, Norway obtained good and promising results in 1994 in other fields as well.

Nera has had great success with its user terminal for Inmarsat Standard M, which was launched at the end of 1993. This compact attaché-case satellite telephone is the first generation of truly portable satellite telephones. An important component of this terminal is an electronic circuit developed by ABB Teknologi under the terms of an ESA contract. Nera's product has been given a good reception, and the company currently has more than 30 percent of this rapidly growing market for terminals.

AME Space has continued its efforts to develop itself technologically, industrially and in market terms as a leading supplier of Surface Acoustic Wave (SAW) filters and signal-processing modules for communications satellites. This company is currently making major deliveries of electronics of this type to ESA satellites. At the same time, AME Space has signed development contracts with ESA and the Norwegian Space Centre regarding the development and adaptation of its technology for applications in the next generation of advanced communications satellites. AME Space has also signed commercial contracts to supply SAW filters to the Telekom-2 and Hotbird satellites. The company has also won contracts with both Hughes and Loral for the development of SAW filter modules for personal mobile communications.

Normarc has continued to develop and industrialize its TSAT-2000 system in close collaboration with ESA and the Norwegian Space Centre. TSAT-2000 is a cost-effective system for low-rate data transmission via satellite. In the course of the year Normarc has made an international breakthrough for TSAT-2000 via two important commercial contracts in Germany. One is for a system for monitoring gas pipelines, while the second is a communications system for service station pay terminals.

Since 1992, Nera has been a member of a European industrial consortium which supplies a satellite communication system (MERCURE) to the United Nations Environment Programme (UNEP). Final agreement on implementation of the project was reached. An important part of the system is based on Nera's satellite communication system SuperViSAT. This contract is a direct result of work done in the course of previous ESA projects, and it is an important international breakthrough for SuperViSAT.

In the course of 1994, ESA established cooperation with the Commission of the European Communities and Eurocontrol regarding a European programme on satellite-based navigation. The primary aim will be to implement a superstructure to the Global Positioning System (GPS) to improve its accuracy, reliability and accessibility. Studies will also be carried out to define a second-generation civilian system that will be capable of taking over for GPS in 15 to 20 years. Development is taking place under the auspices of ESA, as an element of the Telecommunications Programme. Norway has decided to participate in the programme in order to ensure that national users, service suppliers and industry will be able to participate in this development and exploit the programme as a platform for their commercial activity.

C. The Space Station

The International Space Station Alpha (ISSA) is a collaborative project involving Canada, Japan, the Russian Federation and the United States, as well as ESA. The integration of the individual elements of ISSA in space is planned for 1998-2002. The European space laboratory known as the Columbus Orbital Facility (COF) is due to be installed as part of the station in 2002.

Economic problems in several ESA member states have led to a reduction in the planned European contribution to the station. The proposed programme currently consists for the most part of a reduced space laboratory, COF, and

the unmanned Automated Transfer Vehicle (ATV), while the manned transportation capsule has been abandoned. The final decision regarding the development programme for the European elements was to be made at the ESA council meeting at the ministerial level in autumn 1995.

The scope of the utilization phase after development has been completed and how operating costs are to be shared among the partners are currently being defined. ESA is trying to ensure that the European contribution will be met by using Ariane-5 and ATV to supply the station. A final decision is to be made in 1998.

Norwegian development activities have primarily been concentrated on the involvement of Informationkontroll and Cap Computas in VICOS (Verification, Integration and Check-out Software). In collaboration with Belgium and German companies, a system has been developed that will ensure uniform testing of the laboratory module, from the individual component up to the complete unit. VICOS will also be used in the development of the American and Russian elements of the Space Station. The structure of the system makes it relatively simple to adapt for use in the development of other platforms and satellites, as well as for other complex non-space elements, and Cap Computas has already signed a contract with the United States to adapt the system to the Americans' development of space-station elements. Marintek has continued to develop logistic systems in which a range of operative scenarios are developed and tested. These activities have had visible spin-off effects in the areas of computing, testing and documentation systems, and offshore and marine activities, respectively.

Four experiments were carried out in 1994. The freon experiment from the Technical University of Norway was launched on board a Minitexus sounding rocket from Esrange. Two experiments from the Departments of Physics and Botany at the University of Trondheim flew on the Space Shuttle's IML-2 flight. A Canadian parabolic flight which included experiments integrated by the Norwegian Institute of Geotechnology was performed on an ESA Caravelle flight.

D. Space transportation

Norway's most important involvement in space transportation is via its participation in ESA's development of the new European launcher Ariane-5. The first two launches for qualification of the Ariane-5 are to take place in spring 1996. Thereafter, Ariane-5 will enter operational service in the commercial launch market. Following an interim phase, during which it will be used in parallel with Ariane-4, a rate of five launches a year is expected from the year 2000.

Norsk Forsvarsteknologi, Raufoss Technology and AME Space are carrying out important development contracts for the Ariane-5 programme in the fields of mechanical structures, space-qualified electronics and rocket engines. These contracts were won in the face of fierce competition, and the companies concerned have demonstrated that they are capable of competing with well-established European space concerns. The companies are up to schedule and are already producing elements for the first launch. Stentofon is a member of an international consortium that is developing communications equipment for the launch base in Kourou in French Guiana. This equipment forms part of a network for the reception and distribution of operational information in connection with Ariane launches. The company has already supplied similar equipment for the Ariane-5 control centre.

Although Arianespace currently has more than 50 percent of the free launch market, the entrance of new international actors has led to stiffer competition. ESA has therefore been studying follow-up activities for Ariane-5. These are regarded as essential to secure the market position of the rocket, and they include a programme for increasing the capacity of the rocket to put payloads into geostationary transfer orbit from 6 to 7.4 tons. If all goes according to plan, the programmes will be put into effect in 1996.

Norway participates in ESA's FESTIP (Future European Space Transportation Investigation Programme), which started in 1994. This programme studies the technology which will be needed to enable redeployable transportation systems which can follow Ariane-5 to be developed. Since 1991, Norway has been involved in similar

activities via its participation in the German Hypersonic Technology Programme. This cooperation has given Raufoss Technology important new opportunities to supply advanced aluminium materials to the aerospace market.

E. Earth observation

In Europe, the applications of Earth observation data were highly focused in 1994. In this connection, a concept known as the European Earth Observation System (EEOS) has been developed, with the aim of improving the utilization of Earth observation data via joint European activity. The main contributors to the concept are the EU, ESA and its members, via their national programmes. The contribution of the EU will be a user-oriented network for the exchange of Earth observation information. ESA will contribute the ground infrastructure for acquisition and processing of data from its own satellites and from other selected satellites. A division of responsibility concerning the development of new applications has still to be drawn up. Both the EU and ESA are keen to increase their activities in this area considerably. More and more of the national programmes are also focusing more sharply on operational and commercial applications.

This rise in attention has led to greater interest in bilateral collaboration with Norway, which has long been regarded as one of the most goal-oriented countries in Europe as regards the development of operational near real-time services. The principal features of the new national programme for development of Earth observation services has been given a positive international reception. In descending order of priority, the following SAR-based services are to be established, given that this can be done in a cost-effective manner:

- Ship detection for the Norwegian Navy and for the Coastguard
- Oil detection for the State Pollution Control Authority (SFT) and oil companies
- Ice mapping and monitoring for users who operate in the vicinity of the ice edge
- Wave energy and direction spectra for the Norwegian Meteorological Institute (DNMI) in order to improve the special wave service.

These priorities have been drawn up on the basis of market evaluations, national advantages, and demonstrations based on ERS-1 data carried out in 1994.

In summer 1994, Tromsø Satellite Station took over the main responsibility for the oil-monitoring service. As a result, TSS analysed more than 1,700 SAR images (equivalent to 1.7 million square kilometres) during the latter half of the year and sent reports to SFT of all possible cases of oil-slicks. SFT has been an active partner and a source of finance for the establishment of satellite data as a component of the national oil-monitoring service. Several research institutes have helped to automate the routines involved, and to utilize data from RADARSAT, a Canadian operational radar satellite which was launched in November 1995. In collaboration with SFT, TSS has started international marketing of its SAR-based oil-monitoring services.

Ice mapping and monitoring have been performed regularly in high-priority areas around Svalbard and along the ice edge. This service has been provided by Terra Orbit. The service has received positive feedback, but severe limitations in coverage and flexibility have made it difficult to obtain financing. RADARSAT is expected to offer considerable improvements in quality.

DNMI cooperates with NORUT-IT and Tromsø Satellite Station in analysing and documenting how wave energy and wave direction information can be extracted from SAR data. These parameters are of importance for maritime activities, and the results of this work are expected to improve the quality of wave forecasts. A product and service concept for ship routing has been demonstrated by DNMI and Maintek. The Norwegian shipping industry has reacted positively to the concept. Industrial partners and a market strategy have been identified. TSS has won a position as an important supplier of marine near real-time services. The station has demonstrated a number of services in close collaboration with users, R & D institutes and industrial companies.

In order to strengthen the market development of Tromsø Satellite Station close collaboration has been initiated with the Swedish Space Corporation. In 1995, the Swedish Space Corporation became a co-owner of Tromsø Satellite Station a.s (TSS) together with the Norwegian Space Centre. The Norwegian Space Centre has set up the Svalsat project, which will study the prospects for establishing a ground station for polar orbiting satellites on Svalbard. The project group has consisted of representatives of TSS, DNMI, Telenor, Svalbard næringsutvikling and Spacetec.

On the industrial side, Spacetec and Informasjonkontroll are in the process of setting up a new production chain for RADARSAT at TSS. The two companies have been awarded a contract in Singapore for equipment for a satellite ground station, including a SAR processor. Spacetec has also been awarded contracts in China and South Africa. In the ENVISAT-1 programme, Norsk Forsvarsteknologi and Norsk Elektro Optikk are developing important components for the spectrometer, while AME Space will supply electronics for the radar altimeter. The Meteosat Second Generation Programme has inaugurated phase B activities. AME Space, Raufoss and Det norske Veritas are strong candidates as suppliers of processors, valves and quality assurance systems.

F. Space research

In the space science sector, the Norwegian Space Centre looks after the interests of Norwegian scientists vis-a-vis ESA and other international partners. Research groups are offered technical and administrative support for their projects. The Norwegian Space Centre plays a core role in implementing major pilot projects of national interest. National financing of research is the responsibility of the Research Council of Norway, but the Norwegian Space Centre has made financial contributions to the industrial parts of the research projects when these match general industrial priorities.

Much of the efforts with respect to ESA has concerned the preparation of "Horizon 2000+", the new long-term plan for the research programme.

In 1994, the German-Norwegian cooperative programme TURBO came to a successful conclusion with the launch of two sounding rockets from Andøya Rocket Range. Preparations for RONALD, the successor to the TURBO programme, are on schedule, with launches due to start in 1996. In early 1994, the PULSAUR II payload was launched from Andøya. This programme was another scientific success. PULSAUR II is the biggest payload ever to have been built by Norwegian scientists. Norwegian scientific and industrial deliveries to the SOHO and Cluster projects were made on schedule in 1994.

A large-scale pilot project for a Norwegian research satellite has been carried out. This project is known as the Norwegian Ionospheric Small Satellite Experiment (NISSE), and its objective is to study energy exchange between the upper layers of the Earth's atmosphere and near-space. The scientific leadership of the project is in the hands of the Norwegian Defence Research Establishment (NDRE), and all space physics groups in Norway are participants. The pilot project was carried out with the support of the research groups and industry (Cap Computas, EIDEL, NFT, SINTEF and NTH), in addition to the Norwegian Space Centre and the Research Council of Norway. The results of the project have been given a very good international evaluation. NISSE can be launched in 1998 if financing is obtained in time.

Comprehensive studies of the prospects of establishing a sub-station of Andøya Rocket Range on Svalbard to launch sounding rockets have been carried out. The industrial rate of return on ESA's science programme is now about 0.95. Preparations for participation in the new ESA programmes XMM and INTEGRAL were carried out in 1994. A rate of return slightly above unity is expected on these projects. Scientific participation in INTEGRAL is possible, if the Research Council of Norway sets aside sufficient funding for the space research programme.

During 1994, it became evident that the national financing of the scientific exploitation of the ESA membership was insufficient to ensure a desirable degree of participation in new projects. Studies of the prospects of increasing the availability of resources were initiated, with the aim of clarifying the situation.

G. Andøya Rocket Range

Andøya Rocket Range (ARR) had another successful financial year as a result of the whole organization's goal-oriented efforts and cost-consciousness. ARR marketing has become more goal-oriented, and is a continuing process that aims to guarantee the future of the range. Establishment of new services are being worked out to make the range less economically vulnerable. In order to increase the clients' confidence in the services of ARR even further, a quality assurance system will be set up. Two new members of staff joined ARR in 1994, bringing the total number of employees to 26. In the course of 1994, ARR launched 19 rockets, of which seven were instrumented and 12 were for meteorological purposes. Four research balloons were also released.

The Norwegian/American rocket campaign known as PULSAUR II was successfully carried out in January and February 1994. The University of Bergen was responsible for this project. The aim of the campaign was to study auroral pulsation, and it was a follow-up of a similar campaign in 1980. A rocket campaign for the Japanese Institute of Space and Aeronautical Science (ISAS) was successfully carried out at the end of February 1994.

In spring 1994, two research balloons for France's Centre National de la Recherche Scientifique (CNRS) were released; these measured the ozone layer. This balloon campaign was a collaborative project between CNRS and ARR, in which CNRS's interests were scientific, while ARR wished to demonstrate that it possessed the expertise for this type of service. The releases were very successful in both scientific and technical terms, and they have resulted in more contracts to release balloons for CNRS and for the University of Wyoming in the United States.

In summer 1994, the Norwegian/German TURBO project launched three instrumented and 12 meteor-ological rockets. The principal partners were NDRE and the Universities of Tromsø and Bonn. The University of Stockholm also had an instrument on board. The campaign was successful, with two of the payloads being recovered and available for further rocket campaigns in the future.

Two successful rocket launches for ISAS were performed in November 1994. These had the aim of studying auroral pulsation and making ozone measurements. Five periods of measurement with lidar instruments were carried out in 1994. These measurements were made by the University of Bonn, whose personnel spent a total of 408 working days on the range.

In August 1994, for the first time, a course in space technology and space research for secondary school teachers was offered. The course was organized in collaboration with the Norwegian Space Centre's Headquarters in Oslo and the University of Oslo. A working seminar on the use of satellite data in schools was also held in August.

Technical projects of importance for the development of the range's services are:

- The task of upgrading the ALOMAR observatory started on 7 June 1993, when the foundation stone was laid by the late Foreign Minister J. Jørgen Holst. The observatory was officially opened on 16 July 1994 by Germany's Minister of Science P. Krüger and State Secretary B. Pettersen of the Ministry of Environment. ALOMAR is a collaborative project that involves a number of Norwegian and foreign research groups. The observatory, which will have five laser systems, of which three are already operational, as well as a number of ground measurement systems, is unique. It is fully financed, with the Norwegian share provided by the Norwegian Industrial and Regional Development Fund, the Ministry of Local Government and Labour, and NSC/ARR.
- The new launch pad (U3) for rocket configurations of up to 20 tons was put into operation in January 1994.
- The planning of a mobile launch facility for research rockets at Ny-Ålesund on Svalbard started in autumn 1993. The aim is to be able to offer launch services by 1996/97. This will offer research groups a unique opportunity to launch rockets both along and across magnetic field lines in the polar cleft.
- Studies of a launch facility for small polar orbiting satellites are continuing in the form of a Norwegian/Swedish collaborative project. Technical studies are being carried out, and a suitable launcher is being identified. This

project is being led by a steering group that consists of personnel from NSC and the Swedish Space Corporation.

A national network for environmental data from northern regions is being established, and ARR is heavily involved in the planning process. Among other things, the possibility of setting up a service based on drones (remote-controlled, unmanned aircraft) equipped with a range of sensors, is being evaluated.

H. Tromsø Satellite Station

Tromsø Satellite Station (TSS) had another good financial year in 1994. This was due to cost consciousness, good financial control and a highly competent and motivated staff. TSS operates on the basis of the same strategic objectives as before, and focuses on selected aspects of environmental monitoring.

The strategic areas of concentration include supply of near real-time operational services for maritime applications. The development of services is concentrated on three main areas; monitoring of oil-spills, ocean ice and waves. Monitoring maritime oil pollution is the most promising project, and this was given the highest priority in 1994. The project has now evolved from the demonstration phase to a pilot service, and it has been developed in good cooperation with the end-user, the State Pollution Control Authority. This project has also aroused considerable international interest, which is being exploited in the marketing process.

COSPAS/SARSAT LUT is run as a contract service for the Ministry of Justice and the National Search and Rescue Service and is TSS's most important single contract. The collaboration with the Rescue Coordination Centre North Norway in Bodø regarding development and operation of this service is very good.

Marketing was greatly stepped up in 1994. A Head of marketing department/Assistant Managing Director was appointed, and the marketing department was expanded to six persons. On 1 January 1994, TSS took over responsibility for the marketing and sale of TSS data from Spacetec. The marketing department thus became responsible for the marketing and sale of all products and services from TSS. The marketing efforts have already had positive results.

Preparations for the reception and processing of data from RADARSAT have been made in a number of areas. A new 10-metre antenna was installed during summer 1995. Contracts for the supply of other items of reception and processing equipment were awarded to Norwegian companies; these were due for delivery before the satellite was declared operational in December 1995. Negotiations have been held with Radarsat International, which owns the commercial rights to the data. Some of these negotiations have been difficult. The cooperation with the Swedish Space Corporation has been of great importance for the successful accomplishment of these negotiations, which continued in 1995 with the aim of reaching agreement as soon as possible.

The station's main antenna was upgraded in 1994, when mechanical and electro-mechanical parts were replaced. The replacement of wear items has now been completed, and an adequate store of spare parts has been built up. With its new antenna, TSS is now a data acquisition station with competitive abilities within reliability as well as quality.

A considerable proportion of TSS's income comes from ESA contracts for acquisition, processing and storing of SAR data from the Japanese JERS-1 satellite, ATSR data from ERS-1 and AVHRR data from the NOAA satellites. As a result of ESA's financial problems, this source of income has come under pressure, and this gives reason for worries. It is therefore of vital importance to establish alternative types of commercial activity.

One important possibility in this connection is the establishment of a satellite station on Svalbard that would be capable of providing main station services for satellite operators such as EUMETSAT and NASA. This project has been given the name of Svalsat and it has met a positive reception from both EUMETSAT and NASA. On the national level, efforts have concentrated on securing the necessary finance for the investments. Svalsat has the potential to become a cost-effective ground station, and it could be a source of long-term operating contracts for TSS.

In conjunction with positive developments of operational services, first and foremost based on SAR data, Svalsat could ensure that TSS would enjoy a good financial and scientifically interesting future.

RUSSIAN FEDERATION

[Original: Russian]

I. National space activities

The space activities of the Russian Federation in 1995 were conducted under its Federal Space Programme and also as part of international scientific-technical cooperation and commercial agreements.

One important achievement in 1995 was the continued operation within a relatively modest budget of a space network (comprising telecommunications and television, the Mir manned orbital station, space research and technological development, navigational safety, tracking of vessels in distress, topographic geodesy and cartography, and remote sensing of the Earth) designed for the purpose of implementing the Russian national space programme and aimed at achieving greater economic stability, further developing science and technology, improving the country's security and intensifying its international cooperation activities.

This space programme was conducted by the Russian Space Agency (RSA) in collaboration with the Russian Academy of Sciences, the Russian Ministries of Defence, of Communications, of Cartography, and of Hydrology and Meteorology and other clients and users of space information and products.

During 11 months in 1995, 32 space facilities of various kinds were launched, including:

- 17 artificial Earth satellites from the Cosmos series (Cosmos 2306 to Cosmos 2322);
- Two manned spacecraft from the Soyuz TM series (Soyuz TM-21 and Soyuz TM-22);
- The Spektr research module for the Mir manned station;
- The Prognoz-M2 unmanned scientific station;
- Four unmanned cargo spacecraft from the Progress-M series (Progress M-26 to Progress M-29); and
- One satellite each from the Gals, Luch-1, Molniya-3, Foton, Tsikada, Resurs-F and Sich-1 series.

The above-mentioned space facilities were placed in orbit by 28 launches from Cosmos, Molniya, Proton, Soyuz and Tsiklon carrier rockets. In the case of two launches of satellites in the Cosmos series, three satellites were placed in orbit each time by a single carrier rocket:

- 7 March - three satellites (Cosmos-2307 to Cosmos-2309); and
- 24 July - three satellites (Cosmos-2316 to Cosmos-2318).

A. Manned space flight programme

Work connected with the Mir manned scientific research station continued.

During 1995, crews from four Russian principal expeditions (the 17th, 18th, 19th and 20th) and two international crews (Russian-American and Russian-Western European) worked on the Mir station, which has been operating in the Earth's orbit since 1986.

The programme of work performed by the crew of the 17th principal expedition (cosmonauts A. Viktorenko, E. Kondakova and V. Polyakov) during the period from October 1994 to March 1995 included operations in basic areas of contemporary space science such as medicine, geophysics, astrophysics and space materials science.

On 11 January 1995, the cosmonauts carried out checks of the Kurs and radioelectronic docking system mounted on a connecting section of the station. The experiment was performed using the Soyuz TM-20 transport craft, which - with the cosmonauts on board - separated from the orbital station, travelling a distance of 160 metres from it. Subsequent operations, including the berthing and docking of the craft with the station, were performed by automatic flight control. The Soyuz TM-20 craft was in independent flight for a period of 26 minutes.

On 6 February 1995, the cosmonauts assisted in completing the main phase of the flight programme of the American craft Discovery, during which it was brought closer to the Mir orbital station. The purpose of this operation was to test the technical mechanisms and apparatus to be used in docking the Shuttle multi-mission craft with the Mir station.

In the final phase of this work the cosmonauts collaborated with the Russian-American crew (cosmonauts V. Dezhurov and G. Strekalov and the American astronaut N. Thagard), who arrived at the Mir station on board the Soyuz-TM 20. The joint flight programme of the five Russian cosmonauts and the American astronaut included biomedical research under the Mir-Shuttle programme, experiments to determine the properties of structural materials exposed to open-space conditions and also the assembly at the Mir station of a number of scientific instruments intended for various experiments and studies under the continuing joint flight programme.

On 22 March 1995, upon completion of the 17th principal expedition, which lasted 169 days, the cosmonauts A. Viktorenko, E. Kondakova and V. Polyakov returned to Earth on the Soyuz TM-20. The cosmonaut, research scientist and medical doctor, V. Polyakov, who had begun his sojourn in space on 8 January 1994 as a member of what was then the 15th principal expedition, completed a record flight lasting 437 days, 18 hours.

The work of the 18th principal expedition (cosmonauts V. Dezhurov and G. Strekalov and the American astronaut Norman Thagard), which lasted 115 days, included experiments in extra-atmospheric astronomy and biomedical and geophysical research foreseen under the Russian-American Mir-Shuttle programme.

During the flight, V. Dezhurov and G. Strekalov made five space walks under open-space conditions. During the first three walks they performed operations aimed at disassembling and transferring the reusable solar-cell array from the Kristall module to the Kvant module, and connecting it to the orbital station's main power system. During the last two walks operations were performed in preparation for redocking the Kristall module so that new space facilities could be docked with the Mir station, namely the Spektr research module and the Atlantis, an American reusable spacecraft. The total duration of the operations performed in open space was 19 hours, 9 minutes.

During the final phase of its mission, the 18th principal expedition collaborated with the international American-Russian crew (American astronauts R. Gibson, C. Precourt, E. Baker, G. Harbaugh and B. Dunbar and the Russian cosmonauts A. Solovyov and N. Budarin), who arrived at the Mir station on board the Atlantis on 29 June 1995.

As a result of the docking of the Atlantis with the Russian Mir research station it was possible for the first time ever to place a large-scale space system of around 210 tons' mass in the Earth's orbit. The docking and joint flight of the Mir station and the Atlantis demonstrated the potential scientific and technical benefits to be gained from setting up an international manned station. This docking operation by completion of the tracking, approach and guidance of the flight of the Discovery and the Mir station was preceded in February 1995.

The rendezvous between the spacecraft in orbit took place in several stages. First of all, the Discovery's approach to the Mir station was conducted by remote control, after which the manoeuvring of the craft was transferred to the command of the Discovery. In subsequent operations the Discovery carried out manoeuvres including an approach of ten metres to the docking unit mounted on the Kristall module, a flight around the manned station and departure from the station. At all stages of the joint flight the crews of both spacecraft maintained two-way radio communication, gave television reports, took photographs and made video recordings. Specialists at the Houston and Kaliningrad (near Moscow) mission control centres were responsible for directing the dynamic operations performed in orbit.

The flight programme of the four Russian cosmonauts and six American astronauts included joint scientific and technical research and experiments under the Mir-Shuttle programme. In particular, as part of the scientific wing of the flight programme, the Russian cosmonauts collaborated with the American astronauts in conducting a cycle of biomedical experiments aimed at studying the effect of weightlessness on the human organism. This research was

carried out both on board the Mir station and in the Spacelab laboratory on board Atlantis. Using propulsion units belonging to the Mir and the Atlantis, experiments were performed to determine the dynamic properties of the large-scale system.

On 4 July 1995, after the international crew had completed its joint research in orbit, the Atlantis reusable spacecraft separated from the Mir orbital station. Together with the American astronauts Robert Gibson, Charles Precourt, Ellen Baker, Gregory Harbaugh, Bonnie Dunbar and Norman Thagard, there were two Russian cosmonauts, V. Dezhurov and G. Strekalov, who returned to the Earth on board the Atlantis on 7 July 1995.

Fifteen minutes before the Atlantis separated from the Mir orbital station, the Soyuz-TM transport craft undocked from the station carrying on board the crew of the 19th principal expedition, A. Solovyov and N. Budarin, and made a flight around the station. The purpose of this operation was to enable the cosmonauts to take photographs and make video recordings of the docking of the Russian and American spacecraft. The Soyuz-TM craft flew independently for a total of 43 minutes, after which it once again docked with the Mir research station.

Over a period of 75 days the crew of the 19th principal expedition completed its scheduled assignments in the areas of geophysics, astrophysics, space materials science, medicine and biology, including a cycle of experiments under the Mir-Shuttle programme; they also made three open-space walks with a total duration of 13 hours, 46 minutes. During the first space walk the cosmonauts carried out checks of the external components of the Mir station and assessed the condition of the side docking unit. Using a specially designed instrument, they opened the supplementary solar-cell array on the Spektr module.

During the second walk in open space a Trek instrument panel was removed from the external wall of the Kvant-2 module, this panel having been used over a period of four years in joint Russian-American experiments to study the generation and distribution in the galaxy of superheavy cosmic ray nuclei. Also taken from the outside surface of the module were cassettes containing samples of structural materials which had been exposed for long periods of time to open-space conditions; these were replaced with new ones.

During the third walk the cosmonauts mounted a Miras large-scale spectrometer, with a mass of some 200 kg, on the external surface of the Mir station. The spectrometer, designed by Belgian and Russian specialists, is intended for geophysical research. It was delivered to the manned station by the Spektr module.

During this last week the crew of the 19th principal expedition has been collaborating with the international crew (cosmonauts Y. Gidzenko and S. Avdeev and an astronaut from the European Space Agency (ESA), Thomas Reiter). Their programme, scheduled to last 135 days, covers a wide range of experiments and research, using the various equipment installed in the Mir station as well as work in open space.

On 20 October 1995, cosmonaut S. Avdeev and astronaut T. Reiter made a walk in open space lasting 5 hours, 16 minutes. Its purpose was to mount scientific instruments on the external surface of the Spektr research module in preparation for experiments to be performed in connection with the EUROMIR-95 project.

Under an agreement concluded in October 1995 between the RSA and the ESA, T. Reiter's flight on board the Mir station was extended by 44 days to a total of 179 days. This will set a new half-year record for the length of time spent in space by a Western astronaut.

The Spektr module, with a mass of some 20 tons, was launched on 20 May 1995 and docked with the Mir station on 1 June 1995 for the purpose of enabling scientific and technical research and experiments to be performed on the Mir orbital station, partly within the framework of the multi-year manned flight cooperation programme, and also in order to supply the manned station with additional solar-cell arrays and equipment.

The scientific equipment comprises Russian, American and European makes. It is intended for biomedical research, study of the Earth's natural resources and its environment and of physical processes in the upper

atmosphere and circumterrestrial space, and also experiments in the fields of applied science. The total mass of the Mir-Kvant-Kvant-2-Kristall-Spektr-Soyuz TM-21 complex was over 120 tons.

The work operation of the Mir orbital station in 1995 was permitted by four unmanned cargo spacecraft from the Progress M series (Progress M-26 to Progress M-29), which docked with it on 17 February, 12 April, 22 July and 10 October respectively.

In addition, under the flight programme, operations were performed during the period from 27 May to 10 June and also on 17 July 1995 to redock the Kristall and Spektr modules. All the operations involving the undocking of spacecraft from the Mir station, their shifting and emplacement at their standard working locations were performed by automatic flight control using manipulators present on the modules.

B. Applied space technology programmes

In 1995 the operation of the long-range telephone and telegraph communication system was maintained, as was the relaying of radio and television programmes and the transmission of data on behalf of various sectors and official authorities of the Russian Federation and international communications by means of the Gorizont, Ekspress, Gals and Ekran-N spacecraft.

In order to ensure operation of the long-range telephone and telegraph communication system and transmission of television programmes to points on the Orbita network, in the interests of international cooperation and also for other economic purposes, satellites from the Molniya-3, Cosmos-2319, Luch-1 and Gals series were orbited on 9 August, 30 August, 11 October and 17 November 1995 respectively.

To ensure operation of the Global Navigation Satellite System (GLONASS) used for navigation by civil aircraft, and naval and fishing vessels, as well as in other areas of the economy, six artificial satellites from the Cosmos series were launched on 7 March and 24 July 1995.

A total of 22 space facilities from the Cosmos series are now in orbit as part of the GLONASS system. In the course of 1995, their number was increased to the standard quota of 24 satellites.

24 January 1995 saw the launch of an artificial Earth satellite from the Tsikada series. This satellite will operate as part of the space navigation system of the same name, the purpose of which is to track naval and fishing vessels throughout the Pacific Ocean. The Nadezhda satellite continued operating within the COSPAS-SARSAT international system for tracking and rescuing sea vessels and aircraft in distress.

For the purposes of observing the Earth's surface within the Russian and Ukrainian national and international programmes, including environmental monitoring of the natural environment, and in order to obtain up-to-date information on the state of the icecap in the Arctic region and the condition of shelf areas of the Pacific Ocean, a Sich-1 satellite (Ukraine) was launched on 31 August 1995.

As part of continued research in the area of space materials science, a regular artificial Earth satellite from the Foton series was launched on 16 February 1995. Over a 15-day period experiments were performed on board the satellite to obtain, under microgravity conditions, semiconductor materials with improved properties and optical glass with a variable reflective index, and to carry out biological research. In addition, the "Biobox" equipment designed by ESA specialists and the IBIS equipment developed by specialists from the French National Centre for Space Studies (CNES) were tested.

With a view to continuing research on the Earth's natural resources for the benefit of various sectors of the economy and for the purposes of environmental monitoring and international cooperation, a satellite from the Resurs-F series was launched into orbit on 26 September 1995, its particular purpose being to take multizonal and spectrozonal photographs of various scales.

In 1995 the satellites Meteor-3, Resurs-01, Okean-01 and Electro continued to operate for the benefit of hydrometeorology, oceanography and investigation of the Earth's natural resources.

C. Space research programmes

The programme of flight experiments at the Granate orbital observatory was continued successfully. Over the six years of its operation a detailed study has been made of several dozen galactic and extragalactic sources presumed to be black holes, neutron stars (X-ray bursters and X-ray pulsars), X-ray novae, and accumulations of galaxies and quasars; several extremely interesting and hitherto unknown objects have been discovered. New sources emitting radiation in the annihilation gamma line of positrons have also been discovered. At the present time, following the observation in September 1995 of the galactic centre, the observatory is operating in scanning mode.

An extensive programme of scientific, technical, technological and other research and experimentation was conducted in the course of manned flights by Russian cosmonauts on board the Mir station. The Roentgen international observatory has been operating successfully in orbit for eight years as part of the Mir station. A series of observations and photographs of the central part of the galaxy was taken using its telescopes in 1995.

In order to study physical processes in the Universe, measurements were performed to determine cosmic ray spectra in various wavelengths and bandwidths. Using the Maria magnetic spectrometer and the "Buket" telescope-spectrometer, experiments were performed to measure sources of high-energy charged particles in circumterrestrial space, including the Earth's radiation belts, and to register galactic and extragalactic sources of X-ray radiation.

As part of the programme for exploring the Earth's natural resources and studying the environment, including environmental monitoring visual observations, photography and spectrometric measurements were made of the land and water areas of the Pacific Ocean, partly by means of the Priroda-5 instruments installed on the Spektr module.

Further experiments were performed to assess the effects of the space environment on structural materials and radio-electronic components exposed for long periods under open-space conditions. A set of experiments was performed at various technical facilities in the field of space materials science. In particular, fusing was carried out at the Gallar facility to obtain a semiconductor material with improved properties. At the ALISSA facility an experiment was conducted to obtain information on particular aspects of thermal mass transfer in gas-liquid systems under microgravity conditions.

With a view to further investigation of radiation conditions in orbit and to improving the resources available for space dosimetry, the micrometeorite situation along the flight track of the Mir station was monitored and the Spin-6000 experiment measuring gamma-ray spectra in various parts of the orbital station was performed.

A series of scientific space studies prepared jointly by Russian and American specialists was carried out under the Mir-Shuttle programme. Experiments were conducted to investigate how the human organism adjusts to weightlessness, to determine radiation conditions in orbit and to measure the spectra of ionising cosmic radiation. This work was chiefly aimed at obtaining basic scientific data in various areas of space medicine and biology.

In the interests of medical control and in order to obtain additional information on the condition of the human organism at various stages of space flight, the cosmonauts underwent cardiovascular examinations involving simulation of the Earth's gravity in a Chibis pneumatic vacuum costume and physical exercises on a veloergometer.

Biological experiments were performed to study the growth of higher plants under conditions of weightlessness, together with the so-called "Incubator" experiment aimed at investigating the influence of weightlessness and other aspects of cosmic flight on the development of bird embryos.

A series of "Resonance" technical experiments was carried out in order to determine the parameters of the acoustic and electromagnetic effects of the instruments and apparatus installed in various sections of the manned

station, along with experiments on the Volna facility designed to investigate the performance of the capillary suction units of the fuel tanks of future spacecraft.

D. International cooperation

A solar research programme is being continued under the international Coronas-I project (research on dynamic, active solar processes, the properties of solar cosmic radiation and electromagnetic radiation in the radio, visible, ultraviolet, X-ray and gamma bands).

Work is being continued in connection with the international APEX project started with the launch in 1991 of the Intercosmos-25 satellite and the Magion-3 subsatellite, the aim of the project being to study the effects of artificially generated modulated electron streams and plasma beams on the Earth's ionosphere and magnetosphere.

On 3 August 1995, within the framework of the Interbol project, the Prognoz-M2 unmanned station was launched for the purpose of long-term basic research on processes in the geomagnetic tail of the Earth's magnetosphere. This research forms an integral part of the international programme for investigating the nature and mechanisms of Sun-Earth interaction by means of space facilities and Earth-based observatories in various countries.

The station has been fitted with scientific instruments designed by scientists and specialists from Austria, Bulgaria, Canada, Cuba, Czech Republic, Finland, France, Germany, Greece, Hungary, Italy, Kyrgyzstan, Poland, Romania, Russian Federation, Slovakia, Sweden, Ukraine, United Kingdom of Great Britain and Northern Ireland and Uzbekistan, and also by member countries of the ESA.

The Magion-4 subsatellite, manufactured in the Czech Republic, was launched into orbit at the same time to permit research, in coordination with the main satellite, of the properties of circumterrestrial plasma and the magnetic field.

Under the Agreement of 17 June 1992 between the Russian Federation and the United States of America on cooperation in the exploration and use of outer space for peaceful purposes and the Executive Agreement of 5 October 1992 between the RSA and NASA on collaboration in manned flights, the Russian cosmonaut V. Titov took part in a programme of scientific research and experiments on board the American space shuttle Discovery, while the American astronaut Norman Thagard participated in a programme of scientific and technical research and experimentation on board the Mir station.

In the course of an eight-day expedition (3-11 February 1995), an international crew composed of the American astronauts J. Wetherbee, E. Collins, M. Foale, B. Harris and J. Voss-Ford and the Russian cosmonaut V. Titov completed an important phase of the joint Russian-American manned space flight programme, namely the approach of the orbital craft to the Mir research station and the flight around it. Scientific and technical and biomedical research and experiments were conducted during this expedition.

Under a commercial agreement, the German citizen and ESA astronaut T. Reiter is conducting a programme lasting several months and consisting of medical, technological and technical experiments devised by ESA specialists. These experiments are being performed on board the Mir station within the framework of the EUROMIR-95 project.

On 24 January, the Cosmos carrier rocket was used to launch the Tsikada spacecraft together with the American experimental communication satellite FAISAT and the Swedish scientific satellite Astrid, designed for plasma research in circumterrestrial space. The satellites were separated from Tsikada on its seventh revolution around the Earth.

On 19 April 1995, the crew of the 18th principal expedition succeeded in launching the German microsatellite GFZ-1 through the air-lock of the Mir station's core unit. This microsatellite is intended for research of the Earth's gravitational field.

In August 1995, the Second International Air-Space Salon (MAKS-95) was held in the Russian Federation, attracting the participation of around 400 organizations from that country and over 100 foreign firms and companies from 23 countries.

SLOVENIA

[Original: English]

At present, Slovenia reports that it does not have a national space programme.