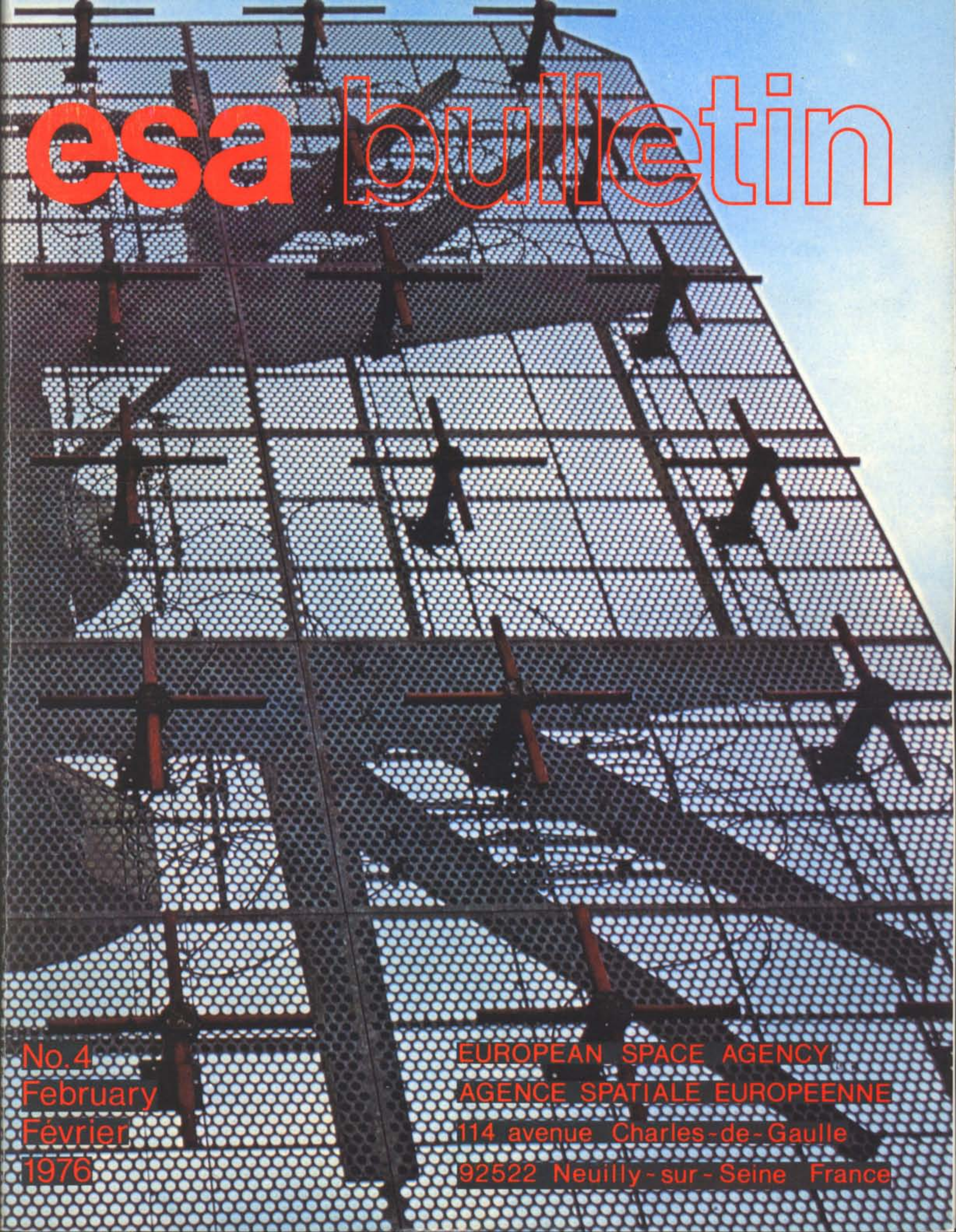
esa bulletin



No. 4
February
Février
1976

EUROPEAN SPACE AGENCY
AGENCE SPATIALE EUROPEENNE
114 avenue Charles-de-Gaulle
92522 Neuilly-sur-Seine France

The European Space Agency was formed out of, and took over the rights and obligations of, the two earlier European Space Organisations: the European Space Research Organisation (ESRO) and the European Organisation for the Development and Construction of Space Vehicle Launchers (ELDO). The Member States are Belgium, Denmark, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

In the words of the Convention: The purpose of the Agency shall be to provide for and to promote, for exclusively peaceful purposes, co-operation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems,

(a) by elaborating and implementing a long-term European space policy, by recommending space objectives to the Member States, and by concerting the policies of the Member States with respect to other national and international organisations and institutions;

(b) by elaborating and implementing activities and programmes in the space field;

(c) by co-ordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of applications satellites;

(d) by elaborating and implementing the industrial policy appropriate to its programme and by recommending a coherent industrial policy to the Member States.

The Agency is directed by a Council composed of representatives of Member States. The Director General is the chief executive of the Agency and its legal representative.

The Directorate of the Agency consists of the Director General; the Director of Planning and Future Programmes; the Director of Administration; the Director of Scientific and Meteorological Satellite Programmes; the Director of Communication Satellite Programmes; the Director of the Spacelab Programme; the Technical Inspector; the Director of ESTEC and the Director of ESOC.

The ESA HEADQUARTERS are in Paris (Neuilly-sur-Seine).

The major establishments of ESA are:

EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTRE (ESTEC), Noordwijk, Netherlands.

EUROPEAN SPACE OPERATIONS CENTRE (ESOC), Darmstadt, Germany.

EUROPEAN SPACE RESEARCH INSTITUTE (ESRIN), Frascati, Italy.

Chairman of the Council for 1976: Dr. W. Finke (Germany).

Director General: Mr. R. Gibson.

L'Agence Spatiale Européenne est issue des deux Organisations spatiales européennes qui l'ont précédée – l'Organisation européenne de recherches spatiales (CERS) et l'Organisation européenne pour la mise au point et la construction de lanceurs d'engins spatiaux (CECLES) – dont elle a repris les droits et obligations. Les Etats membres en sont: l'Allemagne, la Belgique, le Danemark, l'Espagne, la France, l'Italie, les Pays-Bas, le Royaume-Uni, la Suède et la Suisse.

Selon les termes de la Convention: L'Agence a pour mission d'assurer et de développer, à des fins exclusivement pacifiques, la coopération entre Etats européens dans les domaines de la recherche et de la technologie spatiales et de leurs applications spatiales, en vue de leur utilisation à des fins scientifiques et pour des systèmes spatiaux opérationnels d'applications:

(a) en élaborant et en mettant en oeuvre une politique spatiale européenne à long terme, en recommandant aux Etats membres des objectifs en matière spatiale et en concertant les politiques des Etats membres à l'égard d'autres organisations et institutions nationales et internationales;

(b) en élaborant et en mettant en oeuvre des activités et des programmes dans le domaine spatial;

(c) en coordonnant le programme spatial européen et les programmes nationaux, et en intégrant ces derniers progressivement et aussi complètement que possible dans le programme spatial européen, notamment en ce qui concerne le développement de satellites d'applications;

(d) en élaborant et en mettant en oeuvre la politique industrielle appropriée à son programme et en recommandant aux Etats membres une politique industrielle cohérente.

L'Agence est dirigée par un Conseil, composé de représentants des Etats membres. Le Directeur général est le fonctionnaire exécutif supérieur de l'Agence et la représente dans tous ses actes.

Le Directoire de l'Agence est composé du Directeur général, du Directeur des Programmes futurs et des Plans, du Directeur de l'Administration, du Directeur des Programmes de satellites scientifiques et météorologique, du Directeur des Programmes de satellites de communications, du Directeur du Programme Spacelab, de l'Inspecteur technique, du Directeur de l'ESTEC et du Directeur de l'ESOC.

Le SIEGE de l'ASE est à Paris (Neuilly-sur-Seine).

Les principaux Etablissements de l'ASE sont:

LE CENTRE EUROPEEN DE RECHERCHE ET DE TECHNOLOGIE SPATIALES (ESTEC), Noordwijk, Pays-Bas.

LE CENTRE EUROPEEN D'OPERATIONS SPATIALES (ESOC), Darmstadt, Allemagne.

L'INSTITUT EUROPEEN DE RECHERCHES SPATIALES (ESRIN), Frascati, Italie.

Président du Conseil pour 1976: Dr. W. Finke (Allemagne).

Directeur général: M. R. Gibson.

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For availability of ESA scientific and technical publications, see page 73.

All requests for *general* information on ESA activities (literature, photographs, films, etc.) should be addressed to the Public Relations Branch, ESA, 114, avenue Charles-de-Gaulle, 92522 Neuilly-sur-Seine, France.

Pour obtenir les publications scientifiques et techniques de l'ASE, voir page 73.

Toutes autres demandes de renseignements concernant les activités générales *de l'ASE (documentation, photographies, films etc.) doivent être adressées au Service des Relations publiques de l'ASE, 114, avenue Charles-de-Gaulle, 92522 Neuilly-sur-Seine, France.*

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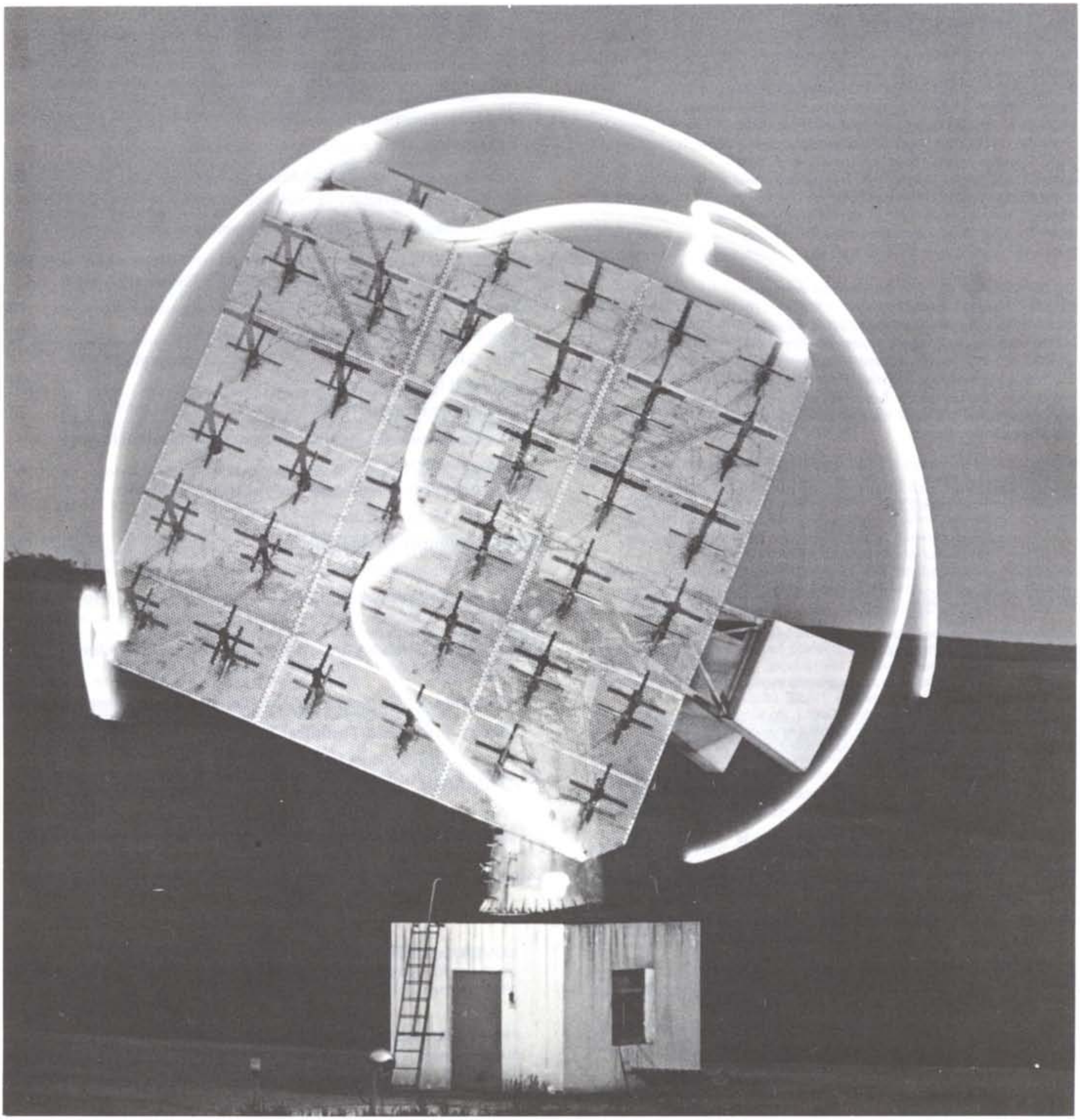


Director General's Message

Message du Directeur général

Je saisis l'occasion de ce premier bulletin de la nouvelle année pour remercier l'ensemble du personnel de l'Agence du travail qu'il a accompli en 1975. L'année écoulée a certes été pour nous une année de très gros efforts mais qui ont été couronnés par l'approbation des budgets de l'Agence pour 1976, donnée par le Conseil à sa session de la mi-décembre. A plusieurs reprises, les délégués au Conseil ont, l'an passé, rendu hommage au travail du personnel de l'Agence, notamment lors de l'approbation officielle des comptes de l'exercise 1974 où, pour la première fois, le Conseil a remercié dans une Résolution les membres du personnel de l'Agence des 'efforts qu'ils ont faits pour assurer une gestion efficace des affaires de l'Organisation'.

Au cours des conversations que j'ai eues avec le personnel dans nos divers établissements, j'ai essayé d'expliquer ce que l'année qui s'ouvre nous réserve et il n'est donc peut-être pas utile d'y revenir ici en détail. J'aimerais toutefois souligner que cette année sera, elle aussi, importante et chargée de travail. De temps à autre des 'augures maison' font circuler dans nos murs des rumeurs alarmantes. Les versions varient mais beaucoup de ces prophéties s'accompagnent de sombres descriptions du déclin et de la chute de notre Agence. Je suis pleinement conscient des dangers auxquels nous serons confrontés cette année et en particulier de la nécessité dans laquelle nous sommes de ne pas limiter uniquement notre attention à l'immense programme que nous avons en cours mais aussi d'envisager dynamiquement l'avenir. Mes collègues du Directoire et moi nous sommes déjà attelés à cette tâche et plusieurs d'entre vous sont associés aux diverses études qui ont été entreprises; en toute conscience, je pense que l'on peut difficilement ne pas se montrer optimiste devant notre avenir.

Mais, quelque important que puisse être le fait d'assurer l'avenir à moyen terme de notre Agence, il doit être clair que notre responsabilité porte au premier chef sur les programmes existants. C'est sur la façon dont nous exécuterons ces programmes que nous serons jugés. J'ai besoin pour cela de l'aide et de l'enthousiasme de chacun d'entre vous. J'espère avoir montré qu'en retour la Direction de l'Agence prend réellement à coeur les intérêts du personnel et je pense qu'à cet égard nous pouvons tous reconnaître qu'un ou deux grands résultats ont été acquis. Mon intention est de continuer en 1976 à donner au personnel la possibilité de comprendre le sens des activités de l'Agence et d'y participer, tant au cours de réunions avec le Comité central de l'Association du Personnel que d'assemblées plus nombreuses. Je me montrerai franc en ces occasions et j'en attends autant de vous. Je compte sincèrement sur votre coopération active à la réalisation des objectifs de l'Agence.

Je vous souhaite à tous une bonne et heureuse année 1976.

Let me take this opportunity of thanking all ESA staff for their efforts in 1975. It was an extremely busy year, but it ended happily at the Council meeting in mid-December when the Agency's budgets for 1976 were approved. Council delegates on several occasions during the year paid tribute to the work of the Agency's staff, and, on the occasion of the formal acceptance of the 1974 accounts, the Council Resolution for the first time included thanks to staff for 'their efforts in ensuring efficient management of the Organisation's affairs'.

During talks to staff at our various locations I have tried to explain what the year ahead holds for us, and it is perhaps not appropriate here to go into much detail. I would, however, like to emphasise that it will be another busy and important year. One from time to time hears the doom-laden predictions of our home-produced soothsayers. The versions vary, but many contain stark descriptions of the Agency's decline and fall. I am fully aware of the dangers which face us in the coming year, and particularly of the need for us not simply to restrict our attention to our immense on-going programme, but to be actively looking to the future. I and my colleagues in the Directorate are already addressing ourselves to this subject and many of you are associated with the various studies that are under way; I frankly find it difficult to be other than optimistic about our future.

But, however important it may be to assure the medium-term future of the Agency, it must be clear that our first responsibility is to the existing programmes. It is by our performance on these programmes that we will be judged. For this I need the help and enthusiasm of every single staff member. As a return for this help, I have tried to show that the management of the Agency truly has the interests of staff at heart and I believe that we can all see one or two major achievements in this field. In 1976 I intend to continue to give staff the opportunity of understanding and participating in the activities of the Agency, both through meetings with the Staff Association Committee and in larger get-togethers with staff. I shall on these occasions be frank and expect you to be the same. Your contribution to the achievement of the Agency's objectives is very much needed.

A happy and successful 1976 to you all.

R. GIBSON

The New European Space Agency
La nouvelle Agence spatiale européenne

G. Geens, Belgian Secretary of State for Science Policy
Secrétaire d'Etat à la Politique scientifique de Belgique

The following text is extracted from the speech made by Mr. Gaston Geens before the Parliamentary Assembly of the Council of Europe in Strasbourg on 2 October 1975, in his capacity as Chairman of the European Space Conference.

Le texte suivant est extrait du discours que M. Gaston Geens a prononcé devant l'Assemblée parlementaire du Conseil de l'Europe à Strasbourg le 2 octobre 1975, en sa qualité de Président de la Conférence spatiale européenne.

Mr. President, Ladies and Gentlemen,

I very much appreciate your President's invitation to talk to you today about European space activities, and in particular about the European Space Agency.

Your Assembly certainly cannot be indifferent to the creation of that organisation, since you have taken an active interest in European space problems for many years. In fact, it was in the autumn of 1960 that your Assembly for the first time adopted a recommendation for the creation of a European space organisation. At that point it would appear that the time was not yet ripe for the idea of complete integration of effort, for two organisations were set up, one to deal with launchers, and the other with scientific research.

However, since then you have never wavered in your demand for the establishment of a single European Space Agency and as integrated a policy as possible. And now your efforts are at last crowned with success on this fifteenth anniversary of your first recommendation.

The road to European unification, which is one of the Council of Europe's prime objectives, is strewn with obstacles, perhaps more so in the space field than anywhere else. The creation of the European Space Agency is actually the final phase of a long crisis which began as early as 1966 with the argument about the desirability of continuing with the Europa I launcher project. It was only very gradually that all the political, technical and even psychological misgivings were overcome. The result is nevertheless very encouraging, and Europe now has its instrument and the financial and technical means for carrying out its programmes and reaching its objectives. But a

Monsieur le Président, Mesdames, Messieurs,

Je suis très sensible à l'invitation que votre Président m'a faite de vous parler aujourd'hui des activités spatiales européennes et en particulier de l'Agence spatiale européenne.

La création de cette Agence ne peut certes pas laisser indifférente votre Assemblée qui, depuis de nombreuses années déjà, s'est activement intéressée aux problèmes spatiaux de l'Europe. Ce fut, en effet, dès l'automne 1960, que votre Assemblée adopta pour la première fois une recommandation proposant la création d'une organisation européenne de l'espace. Les idées n'étaient apparemment pas encore mûres à cette époque en faveur de l'intégration totale des efforts, car deux organisations furent créées, l'une appelée à s'occuper des lanceurs, l'autre de la recherche scientifique.

Cependant, vous êtes intervenus depuis lors avec constance en faveur de la mise en place d'une seule Agence spatiale européenne et d'une politique aussi intégrée que possible. Voilà vos efforts finalement couronnés de succès en cette année du quinzième anniversaire de votre première recommandation.

La voie de l'unification de l'Europe, qui est un des principaux objectifs poursuivis par le Conseil de l'Europe, est parsemée d'obstacles; dans le domaine des activités spatiales, ce fut peut-être davantage le cas qu'ailleurs. La création de l'Agence spatiale européenne est en réalité le dénouement d'une longue crise qui a commencé déjà en 1966 par la controverse au sujet de l'opportunité de continuer le projet de lanceur Europa I. Ce n'est que pas à pas que toutes les hésitations politiques, techniques, voire psychologiques furent vaincues. Le résultat est néanmoins très encourageant, l'Europe possède maintenant un outil, elle dispose des moyens financiers et techniques pour réaliser ses programmes et ses objectifs. Mais il reste beaucoup à faire. La volonté politique qui s'est manifestée doit être cultivée et renforcée afin de garantir l'avenir de l'Europe spatiale.

Je souhaiterais d'abord rappeler ce que la Convention qui vient d'être signée apporte de vraiment nouveau par rapport aux deux conventions existantes. Ensuite, je tâcherai de mettre en lumière brièvement les perspectives que nous offre cette Convention et je pense qu'il serait également intéressant de souligner dans quelle mesure la nouvelle Convention est un élément important dans l'ensemble de la construction de l'Europe. Je terminerai par un bref commentaire des programmes en cours qui démontre à la fois l'ampleur de l'effort déjà entrepris et la démarche qu'il faut entreprendre pour encore l'harmoniser.

great deal remains to be done. The political will which has made itself apparent must be cultivated and strengthened so as to guarantee Europe's future in space.

I want to begin by reminding you that the Convention which has just been signed really has something new to offer as compared with the two existing conventions. Then I shall try to point briefly to the prospects this new Convention opens up for us, and I think it may also be important to stress how important the Convention is to the whole construction of Europe. I shall end with a brief commentary on the programmes under way, which show both the magnitude of the effort already undertaken and the steps needed to harmonise it still further.

FRESH IDEAS MADE CONCRETE IN THE NEW CONVENTION

(a) The two existing conventions did not provide for *the institutionalisation of political discussion.* That was a real gap which was partially bridged, however, by the creation in 1967 of the European Space Conference which has, since then, provided a forum where Europe's political options have been debated. But it was essential to give the Conference real political status which would allow it to take decisions for direct action. That has been done in the ESA Convention.

The Convention concluded in this field is, in my view, of capital importance. For each country separately, and for Europe as a whole, space activities have a direct impact on science policy, on the policy for promoting advanced technology and on industrial policy. The decisions that have to be taken thus affect overall policy, which means that they are of concern to those responsible for government.

(b) Another innovation is the way in which the system whereby European and national programmes 'co-existed' alongside each other is progressively giving way to the creation of a real European space community whose only programmes will be European ones. That is the aim of the *gradual Europeanisation of the various national programmes,* an aim that certainly cannot be described as unambitious. But here again the difficulties must not be underestimated. To imagine that the integration of our national programmes into an overall European scheme will be an easy task would be to display great ignorance of our western European countries.

NOUVELLES IDEES CONCRETISEES DANS LA NOUVELLE CONVENTION

(a) Les deux conventions existantes ne prévoyaient pas l'institutionalisation de la délibération au niveau politique. *C'était une lacune réelle qui fut d'ailleurs comblée partiellement par la création en 1967 de la Conférence spatiale européenne, qui a depuis lors été le forum où les grandes options politiques de l'Europe ont été débattues. Mais il fallait doter cette Conférence d'un véritable statut juridique lui permettant de prendre des décisions directement exécutoires. C'est désormais chose faite dans la Convention de l'ASE.*

L'accord qui a été réalisé dans ce domaine est à mon avis capital. Les activités spatiales ont, en effet, pour chaque pays pris séparément et pour l'Europe considérée globalement, un impact direct sur la politique scientifique, sur la politique de promotion des technologies avancées ainsi que sur la politique industrielle. Les décisions à prendre revêtent donc un caractère de politique globale, c'est-à-dire qu'elles intéressent les responsables au niveau gouvernemental.

(b) Une autre innovation est l'acheminement progressif d'un système de coexistence de programmes européens et nationaux vers un système de véritable communauté spatiale européenne où il n'y ait plus que des programmes européens. C'est cela l'objectif de l'européanisation par étapes successives des divers programmes nationaux, *objectif qui ne manque certes pas d'ambition. Ici encore, il ne faut pas sous-estimer les difficultés auxquelles on sera confronté. Ce serait mal connaître nos pays de l'Europe occidentale que de s'imaginer que les programmes nationaux seront faciles à intégrer dans un vaste ensemble européen.*

Mais l'effort doit être tenté. Sans cette intégration, l'activité spatiale me paraît impossible à soutenir et à rentabiliser. Il s'agit en effet, d'une part, de réaliser l'économie des moyens et d'éliminer les duplications; d'autre part, de s'assurer qu'une communauté suffisamment grande s'intéresse au produit et s'applique à l'utiliser.

Par ailleurs, la Communauté spatiale européenne, rassemblée dans l'ASE, sera prête à accorder son assistance, en installations, en matériel et même en personnel, aux Etats membres qui le solliciteraient pour des activités spatiales à des fins pacifiques.

(c) Les deux conventions existantes mentionnaient, plutôt timidement, la possibilité d'une exploitation commerciale des équipements développés en commun. *Ces dispositions étaient*

Still the effort must be made. Without such integration the pursuit, let alone the economic pursuit, of space activity seems to me impossible. Two things are needed: firstly, to economise the means at our disposal and to eliminate duplication; secondly, to ensure that a sufficiently large-scale community will interest itself in the product of such activity and apply itself to making use of it.

Moreover, the European Space Community, in the material form of ESA, will always be ready to provide assistance, in the shape of installations, material and even personnel, to any Member States asking for it in connection with space activities for peaceful purposes.

(c) The two conventions already in existence both referred, if somewhat timidly, to the possibility of the *use on a commercial basis of material developed jointly.* These provisions, however, were worded too vaguely, although they did foreshadow the stage of practical application. Since the early 1960's, there has been a highly significant development of space activities.

The exploration of space, undertaken at first for purposes of scientific research and technological development, has been progressively directed towards more purely economic ends. I need only mention the example of telecommunications satellites, navigational aids for ships and aircraft, meteorology, and the search for underground minerals, all of which will from now on have an important role in space activities as a whole.

For these reasons we have felt it necessary to include in the statutes and objectives of the new Agency a number of specific provisions:

- the new Convention explicitly includes among the Agency's activities, alongside its scientific aims, one relating to operational applications systems
- the task of the Agency is to ensure and develop European co-operation in the space field
- the Agency is given the means to act on a relatively independent basis, by the possession *inter alia* of its own launching equipment, and it is to ensure the viability of this side of its work by a certain degree of priority for the use of its own productions
- it has the necessary powers and is responsible for arranging its relations with those who may in future make use of the systems it develops, as well as for affording them technical support and allowing them the use of its installations.

trop vagues, bien qu'annonçant déjà la phase des applications pratiques de l'espace. Depuis le début des années 1960, on a assisté à une évolution très caractéristique des activités spatiales.

La mission spatiale, initialement vouée à la recherche scientifique et à la performance technologique, s'est progressivement axée sur des finalités économiques plus directes. Je citerai simplement l'exemple des satellites de télécommunications, d'aide à la navigation maritime et aérienne, de météorologie, enfin de détection des ressources terrestres. Ces applications jouent désormais un rôle essentiel dans l'ensemble des activités spatiales.

Aussi fallait-il insérer dans les statuts et dans la mission de la nouvelle Agence des dispositions spécifiques à cet effet:

- *la Convention nouvelle assigne formellement aux activités de l'Agence, à côté des finalités scientifiques, une finalité débouchant sur des systèmes opérationnels d'application;*
- *l'Agence a pour mission d'assurer et de développer la coopération européenne dans ce domaine;*
- *elle est dotée des moyens de s'y mouvoir avec une indépendance relative, notamment par la disposition de ses propres moyens de lancement et elle devra s'assurer la rentabilité de cet effort par une priorité relative donnée à l'utilisation de ses propres développements;*
- *elle a compétence et vocation d'organiser les rapports avec les futurs usagers des systèmes qu'elle développe et de leur apporter son appui technique ainsi que l'utilisation de ses installations.*

(d) Par rapport aux conventions existantes, la Convention ASE renforce le principe de la continuité de la politique menée. *Ainsi la planification budgétaire portera désormais sur cinq années; par ailleurs, les possibilités de retrait ont été rendues plus difficiles et le financement des engagements pris, d'un commun accord, avant le retrait éventuel, devra être honoré.*

Bien entendu, aucune convention internationale ne peut donner la garantie absolue que tous les programmes seront exécutés jusqu'à leur terme sans défaillance aucune. Tout ce que je peux dire à ce sujet c'est que la volonté politique existe chez tous les partenaires indistinctement, à l'heure actuelle, et j'estime que ceci est tout à fait réconfortant, eu égard aux hésitations du passé.

(e) Un dernier domaine dans lequel la Convention ASE innove est celui de la politique industrielle. *Dans le passé, la politique*

(d) So far as the existing conventions are concerned, the ESA Convention upholds the *principle of a continuing policy.* Hence, budgetary planning will in future cover five-year periods; the possibility of withdrawal from the Agency has been rendered more difficult and any financial obligations arising out of jointly agreed projects must be carried out before any such withdrawal takes place.

Obviously, no international convention can give an absolute guarantee that all the programmes will be carried through in their entirety. All I can say is that the political will exists at present in all the participants without distinction, a fact I regard as highly encouraging, given the doubts manifested in the past.

(e) One other field in which the ESA Convention breaks new ground is that of *industrial policy.* In the past, the industrial policy of certain advanced European technological organisations, in space and other fields, has too often been restricted to the question of what it has been agreed to call the 'fair return'.

Without failing to recognise the importance of this idea, those who drafted the Convention thought it should be made part of a larger whole. It was realised that the competitiveness of European industry in the world must be safeguarded at all costs, and that increasing this competitiveness must be a basic objective of industrial policy. Another objective is the search for markets which can make the considerable financial effort undertaken by the Member States economic. Finally, our industries will have to be nationalised and specialised if we want to keep them abreast of world competition. So the Agency's industrial policy will cover a very wide field in which certain vital future requirements for our industries, sometimes deriving from contradictory interests, will have to be satisfied.

PROSPECTS OPENED UP BY THE ESTABLISHMENT AND OPERATION OF THE EUROPEAN SPACE AGENCY

(a) The task that we have undertaken is one of peaceful co-operation. Its aim is to gain a better knowledge of space and to make better use of the special opportunities which it affords us, particularly in the fields of observation and signalling. Precisely because of the peaceful nature of our work, its fruits should not be confined to Europe alone but ought to be made available to other countries in a spirit of peaceful co-operation. This seems to me to be of importance for the relations of space-age Europe with the rest of the world and I welcome the prospects which it opens up.

industrielle de certaines organisations européennes de technologie de pointe, que ce soit dans le domaine de l'espace ou dans d'autres domaines, s'est trop souvent limitée au problème de ce qu'il a été convenu d'appeler 'le juste retour'.

Sans méconnaître l'importance de cette notion, les rédacteurs de la Convention ont cependant estimé qu'il fallait l'englober dans un ensemble plus vaste. On a pris conscience du fait que la compétitivité de l'industrie européenne sur le plan mondial doit être sauvegardée à tout prix et que l'amélioration de cette compétitivité doit être un objectif fondamental de la politique industrielle. Un autre objectif est la recherche des débouchés capables de rentabiliser les efforts financiers considérables consentis par les Etats membres. Enfin, la rationalisation et la spécialisation de nos industries seront indispensables si l'on veut maintenir leur compétitivité vis-à-vis de la concurrence mondiale. Ainsi la politique industrielle de l'Agence couvrira un domaine très vaste dans lequel des exigences vitales pour l'avenir de nos industriels, mais procédant parfois d'intérêts contradictoires, devront être satisfaites.

PERSPECTIVES OFFERTES PAR LA CREATION ET LA MISE EN ROUTE DE L'AGENCE SPATIALE EUROPEENNE

(a) L'oeuvre de coopération que nous avons entreprise est une oeuvre pacifique. *Elle a pour but de mieux connaître l'espace et de mieux utiliser les possibilités particulières qu'il nous offre, notamment dans les domaines de l'observation et de la propagation des signaux. Précisément parce que notre oeuvre est pacifique, ses fruits ne doivent pas être limités à l'Europe seulement, mais devraient pouvoir être mis à la disposition d'autres pays dans un but de coopération pacifique. Cette ouverture me paraît importante pour les relations de l'Europe spatiale avec le reste du monde et je me réjouis des perspectives qu'elle offre.*

Bien entendu, il faudra dans ce domaine une approche qui réponde aux besoins réels des utilisateurs et tienne compte de leurs aspirations propres. Dans ce contexte, il est d'une importance capitale de pouvoir fournir des systèmes opérationnels complets, de prêter l'assistance nécessaire à leur entretien et leur mise en oeuvre, enfin d'assister ces utilisateurs dans l'acquisition des techniques nouvelles dans la mesure de leurs besoins.

La commercialisation reste, évidemment, au premier chef, le rôle de l'industrie elle-même. Celui de l'Organisation consiste à susciter au sein de l'industrie les activités répondant à ces exigences, à faire connaître la capacité technologique de l'Europe, à établir des contacts et à prêter son assistance tech-

In this field, of course, we must adopt an approach which will meet the real needs of users and take their own aspirations into account. In this context, it is vital for us to be able to provide complete operational systems, to give the assistance necessary for their maintenance and use, and to help the users to acquire any new techniques which they may need.

Marketing obviously remains primarily the role of the industry itself. The Agency's role is to stimulate within the industry activities which meet the above demands, to gain recognition for Europe's technological capacity, to establish contacts and to give technical assistance. To this end, information seminars are held and exchanges will be organised between trainees to enable them to perfect their knowledge of the new techniques.

(b) A further vista opened up by the creation of the European Space Agency is the *development of an original activity specific to Europe.* Up to now, Europe has too often been reduced to taking an interest in systems already developed elsewhere in the world.

Its technological time-lag, its late arrival in the market and, very frequently, its dependence on products manufactured and services provided elsewhere on commercially attractive conditions are serious handicaps for the European industry. It is therefore most important that we should find some new paths to tread. The economic changes that are beginning to be felt throughout the world with the limitation of resources must surely afford many opportunities for those with the necessary imagination, experience and enterprise.

I think that the policy of ESA should be to trigger off and back up action of this kind. To my mind, Europe is intellectually and materially capable of making this effort. If there is to be any real chance of success, however, preparatory work must be done and adequate technological independence secured; in this context, I am thinking particularly of the efforts which we are making to obtain our own launching facilities and produce high-quality components. It is necessary, too, to integrate our space activities sufficiently, with as common objectives a concentration of resources and high specialisation.

(c) As I have already mentioned, the ESA Convention puts *consultation at government level* on an official footing. Of course, this instrument of common discussion will only be as valuable and useful as the governments of Europe make

nique. Dans ce but, des séminaires d'information sont organisés et des échanges de stagiaires auront lieu pour que ceux-ci puissent se perfectionner dans les technologies nouvelles.

(b) Une deuxième perspective ouverte par la création de l'Agence spatiale européenne concerne le développement d'une activité originale propre à l'Europe. *Jusqu'à présent, l'Europe a trop souvent été réduite à s'intéresser à des systèmes déjà développés ailleurs dans le monde.*

Ce décalage technologique, cette arrivée tardive sur le marché et, très souvent, cette dépendance de produits et de services fournis ailleurs dans des conditions commercialement attrayantes, constituent un handicap sérieux pour l'industrie européenne. Il est donc d'une importance majeure d'identifier des voies originales. La mutation économique que la société mondiale commence à subir sous l'effet de la limitation des ressources doit certes offrir des opportunités à ceux qui ont l'imagination, l'expérience et l'esprit d'entreprise nécessaires.

Je crois que la politique de l'ASE doit consister à amorcer et à soutenir pareille démarche. L'Europe me semble intellectuellement et matériellement à même de tenter cet effort. Pour que celui-ci ait des chances réelles d'aboutir, il doit cependant être préparé et accompagné d'une suffisante indépendance technologique: à cet égard, je songe notamment aux efforts que nous consacrons à disposer de moyens de lancement propres et à produire des composants de haute qualification. Il faut aussi une suffisante intégration des activités spatiales tant sous l'aspect de la communauté des objectifs que sous celui de la concentration des moyens et de la haute spécialisation.

(c) La Convention de l'ASE, comme je l'ai déjà indiqué, institutionnalise la concertation au niveau gouvernemental. *Cet instrument de délibération commune aura bien entendu la valeur et l'utilité que les gouvernements européens voudront bien lui donner. Les problèmes qui seront soumis à cette délibération seront, en effet, très importants et ardus. En premier lieu, il y a l'objectif éloigné, mais réalisable, de* l'européanisation des programmes nationaux.

L'expérience nous apprend, en effet, que plutôt que de susciter une saine émulation, ces programmes n'aboutissent trop souvent qu'à la duplication et à la fragmentation des efforts ainsi qu'au cloisonnement des débouchés. Par ailleurs, il faudra progressivement tendre vers des programmes dans lesquels les activités communes, décidées et entreprises en commun par tous les Etats membres, prendront le pas sur les activités facultatives. Toujours dans le même ordre d'idées, nous devrons veiller à ce que les programmes européens soient it. The problems to be discussed will be very crucial and thorny ones. First and foremost there is the remote, but nevertheless attainable, objective of Europeanising national programmes.

Experience has taught us that, rather than stimulating healthy rivalry, such programmes all too often lead only to duplication and dissipation of effort and to compartmentalisation of outlets. In addition, we should work increasingly towards programmes in which common activities planned and put into action jointly by all the Member States will outweigh optional projects. Still in the same line of thinking, we must ensure that European programmes are marked as little as possible by what has been known in the past as 'leadership'. The story of the beginnings of European space projects has taught us that, where complex technical programmes are involved, no Member State may safely be left to lead the project, but that the organisation itself must control it, being the expression of the common will of the States. Lastly, Europe must continue its efforts at development through the use of its own products. To attain this objective in reasonable economic and commercial conditions, the community as a whole must be involved in production. In this context an effort must be made both to identify the long-term needs of the European Market and at the same time to plan how to meet these needs with the resources available in Europe.

I think that ESA, as we have organised it, has the necessary resources in terms of manpower and material to make the effort. I also think that the principles set out in the Convention and the system of consultation and decision-making provided for in it will enable the Agency to progress, provided the political will which underlies the principles and the system is sustained and grows.

Such is the important, stimulating task which lies before the new European Space Agency. It will have many missions, one of which, its ability to contribute to the political unification of Europe, I should like to dwell on.

In this context I would mention the job of harmonising legislation. The general conditions created by the two previous space organisations for public tendering acted as a catalyst for national regulations. The Agency will be able to perform this function even more effectively.

I am thinking, too, of industrial policy, of which I have just been speaking. I am also convinced that the formation of

le moins possible soumis à ce qu'on a appelé dans le passé 'le leadership'. L'histoire des débuts de l'Europe spatiale nous a appris que dans des programmes techniques complexes, le leadership ne peut être laissé sans inconvénient aux différents Etats membres mais que la maîtrise d'oeuvre doit au contraire être confiée à l'Organisation elle-même, qui est l'émanation de la volonté commune de ces Etats. Enfin, il est important que l'Europe soutienne son effort de développement par l'utilisation de ses propres produits. Pour atteindre pareil objectif dans des conditions économiques et commerciales justifiables, l'ensemble de la communauté doit être intéressé à la production. A cet égard, un double effort doit être fait pour identifier à longue échéance les besoins du marché européen et, corrélativement, pour concevoir la satisfaction de ces besoins en fonction des disponibilités propres de l'Europe.

Je crois que l'ASE, telle que nous l'avons organisée, est dotée sur les plans humain et matériel des moyens nécessaires pour entreprendre l'effort dans ces perspectives. Je crois par ailleurs que les principes déposés dans la Convention et les structures de concertation et de décision que nous y avons prévues permettront à l'Agence de progresser, pourvu que la volonté politique qui a inspiré ces principes et ces structures persiste et se développe.

Telle est la tâche importante et stimulante que la nouvelle Agence spatiale européenne aura devant elle. Elle aura de nombreuses missions, dont je voudrais souligner celle qui consiste à être un élément de l'unification politique de l'Europe.

Je citerai à cet égard le rapprochement des législations. Les conditions générales des marchés publics élaborées par les deux organisations spatiales précédentes ont joué un rôle de catalyseur pour les réglements nationaux. L'Agence pourra plus efficacement encore poursuivre cet effort.

Je pense également à la politique industrielle, dont je viens de vous entretenir. Par ailleurs, je suis persuadé que la formation d'équipes de techniciens de l'Europe entière, travaillant pour relever les mêmes défis techniques, sera un élément très actif de rapprochement de nos pays dans une ambition commune.

Enfin, à l'égard de l'extérieur, l'Agence sera le lieu où s'élaboreront des attitudes communes ou harmonisées entre nos pays. Je pense ici, notamment, à la concertation des Etats européens en vue de la préparation des débats sur les problèmes spatiaux aux Nations Unies.

Mais c'est essentiellement par ses exigences propres sur le plan teams of technologists from all over Europe to face the same technical challenges will be one very positive factor in bringing our countries closer together in a common ambition.

Lastly, as far as the outside world is concerned, the Agency will be the place where our countries can work out common or more closely harmonised attitudes. Here I am thinking in particular of the consultations between European States with a view to the discussions on space problems at the United Nations. It is, however, mainly because of the high scientific, technical, industrial and economic performance which activity in the space field demands that such activity is par excellence an incentive to co-operation and integration on a scale commensurate with the needs of our age.

ESA PROGRAMMES

Despite the difficulties of its birth, this programme forms – to take up a phrase used by the 1968 Ministerial Conference – a 'complete, balanced and coherent whole': complete in that it covers the various presently identified fields of space research; balanced in that it takes due account of scientific, technological and economic considerations; coherent in that it is based on the acquisition of the experience required by the technologies to be employed and on a policy of making the fullest use of these resources in all programmes.

However, this result has been achieved by very empirical methods. It is not so much the outcome of collective analysis of objectives and means, as of a series of proposals put forward by individual Member States and resolutely defended by each.

The fact that this approach should have produced a very satisfactory programme shows the desire of all the member countries to collaborate more closely as well as their awareness of their interdependence. As a result, however, there are marked disparities in the apportionment of expenditure, and objectives beyond the present programme have not yet been adequately defined. Careful attention will have to be given to this in the years ahead. In terms of its general shape and, more particularly, the arrangements for financing the various activities, this programme reflects the three main stages covered in the course of the European negotiations.

Mr. Geens then went on to outline the structural, historical and financial features of the Agency's scientific and applications programmes, paying particular attention to the distribution of funding between programmes and the apportionment of programme expenditures between Member States. He closed his speech with a word of encouragement for Europe's future in space:

des performances scientifiques, techniques, industrielles et économiques que l'action spatiale est par excellence l'élément moteur d'une collaboration et d'une intégration à la dimension des exigences de notre époque.

LES PROGRAMMES DE L'ASE

Ce programme, malgré les péripéties qui ont marqué sa genèse, constitue – pour reprendre une qualification de la Conférence ministérielle de 1968 – un ensemble relativement 'complet, équilibré et cohérent'. Complet, en tant qu'il doit s'adresser aux différents domaines actuellemnt identifiés de l'activité spatiale. Equilibré, en tant qu'il doit faire une juste part aux motivations scientifiques, technologiques et économiques de cette activité. Cohérent, en tant qu'il doit être axé sur l'acquisition de l'expérience nécessaire aux technologies à mettre en oeuvre et sur une politique de valorisation maximale de ces moyens dans l'ensemble des programmes.

Ce résultat n'a cependant été atteint que de façon fort empirique. Il est moins le fruit d'une analyse collective des objectifs et des moyens que d'une série de propositions émanant des différents Etats membres et défendue avec conviction par chacun de ceux-ci.

Que cette manière de procéder ait abouti à un programme très valable démontre le désir de tous les pays membres de resserrer leur collaboration et la conscience qu'ils ont de leur interdépendance. Il en résulte cependant des disparités notables dans la répartition des charges et une définition encore insuffisante des objectifs à poursuivre au-delà du programme actuel. Nous devrons y être attentifs dans les années qui viennent. Dans sa configuration générale et plus particulièrement dans les modalités de financement des différentes activités, ce programme reflète les trois principales étapes parcourues au cours des négociations européennes.

M. Geens poursuivit son discours en traitant de l'historique, de la structure et du budget des programmes scientifiques et d'applications de l'ASE, et plus particulièrement de la répartition des charges entre les Etats membres participant à différents programmes. Il termina son discours en exprimant des voeux de succès pour l'Europe spatiale.

Monsieur le Président, Mesdames, Messieurs, après des années d'hésitations et de tergiversations, L'Agence spatiale unique, que votre Assemblée a réclamée avec insistance, est maintenant devenue une réalité. Certes, seul l'avenir nous apprendra si les instruments politiques et techniques que nous avons mis au point seront meilleurs que ceux qui furent forgés il y a presque quinze ans.

Mr. President, Ladies and Gentlemen, after years of shilly-shallying, the single space agency which your Assembly has consistently advocated has now become a reality. Admittedly, only the future will show whether the political and technical instruments we have devised are better than those forged nearly fifteen years ago. But we can assure you that in devising these instruments we have made every effort to avoid past mistakes. Provided that the determination of the ten present partners is maintained, there is now reasonable hope of success.

Nous pouvons vous assurer cependant que dans l'élaboration de ces instruments, nous avons tout fait afin que les erreurs du passé ne se reproduisent pas. Dans la mesure où la détermination des dix partenaires actuels continuera à se manifester, un espoir raisonnable de succès est désormais permis.

Ireland to become 11th Member of ESA

L'Irlande deviendra le 11è membre de l'ASE

The Ambassador of the Republic of Ireland in Paris signed the Convention of the European Space Agency on 31 December 1975. The signature took place at the Quai d'Orsay and will make Ireland the eleventh member of ESA, once the Agency's Convention comes into effect after ratification by the Parliaments of the existing Member States – Belgium, Denmark, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom.

Ratification may take one or two years. In the meantime, ESA operates under the old ESRO Convention and Ireland retains its observer status in the Agency.

L'ambassadeur de la République d'Irlande à Paris a signé la Convention de l'Agence spatiale européenne le 31 décembre 1975. Par cette signature, qui a eu lieu au Quai d'Orsay, l'Irlande deviendra le onzième membre de l'ASE lorsque la Convention de l'Agence entrera en vigueur après sa ratification par les Parlements des Etats qui en font actuellement partie: Allemagne, Belgique, Danemark, Espagne, France, Italie, Pays-Bas, Royaume-Uni, Suède et Suisse.

La ratification pourra prendre un à deux ans. En attendant, l'ASE fonctionne sous le régime de l'ancienne Convention du CERS et l'Irlande conserve son statut d'observateur à l'Agence.

Launch of First NASDA Satellite

The National Space Development Agency of Japan (NASDA), with whom ESA has an information exchange agreement, successfully launched its first satellite JETS-1 (KIKU) on September 9, 1975. The spacecraft carries several technological experiments and has a design lifetime of three months.

The launch was effected by a three-stage N Launch Vehicle No. 1, also developed by NASDA. Their next launch, using the second N Launch Vehicle, is planned for early 1976. □

La structure des Comités de l'Agence spatiale européenne

H. Kaltenecker, Chef du Département des Affaires internationales et juridiques, ASE, Paris

La Résolution No. 1 attachée à l'Acte final de la Conférence des Plénipotentiaires pour l'établissement d'une Agence spatiale européenne, signé à Paris le 30 mai 1975 recommande, afin que l'Agence puisse fonctionner 'de facto' dès le jour suivant la date de signature de l'Acte final, 'que dans l'application des Conventions portant création du CERS et du CECLES, les dispositions de la Convention portant création d'une Agence spatiale européenne soient prises en considération dans toute la mesure du possible'. L'un des domaines intéressés par cette disposition était celui de la structure des Comités de l'Agence.

LA STRUCTURE DU CERS

La structure des Comités du CERS trouve son origine soit dans la Convention du CERS, soit en dehors de cette Convention, c'est-à-dire dans les Arrangements conclus entre certains Etats membres du CERS et le CERS sur la base de l'Article VIII de la Convention. Cette structure est la suivante:

(a) Dans le cadre de la Convention du CERS: le *Conseil* du CERS était assisté du *Comité administratif et financier (AFC)* dont la création était rendue obligatoire par le Protocole financier* du CERS (Art. IV) et du *Comité mixte des programmes et de la politique générale (JPPC)* (ESRO/C/LII/Rés. 3). Le Conseil avait mis fin au mandat du Comité scientifique et technique et avait établi, à l'image des Conseils directeurs de programmes fondés sur les Arrangements, un *Conseil directeur du programme scientifique* (ESRO/C/LII/Rés. 2).

Les *organes subsidiaires* pouvaient à leur tour créer des *groupes de travail* (par exemple, le Groupe des Finances créé par l'AFC; le TAG, le SCCG, le SBAG créés par le JPPC). Ces organes subsidiaires, composés de délégués de tous les Etats membres, assistaient le Conseil qui pouvait leur déléguer certains de ses pouvoirs. De même ils pouvaient être saisis par les Conseils directeurs de programmes (dans le cas d'une décision sur un programme facultatif, il était convenu que les Etats membres ne participant pas à ce programme ne faisaient pas usage de leur droit de vote).

* Par contre, l'Annexe II de la Convention ASE sur les dispositions financières ne prévoit pas l'obligation de créer un AFC. Le seul organe subsidiaire dont la création est rendue obligatoire par cette Convention est le SPC.

(b) En dehors du cadre de la Convention: les *Conseils directeurs de programmes* ont reçu compétence, sur la base d'Arrangements conclus au titre de l'Article VIII de la Convention du CERS, pour assurer la direction de programmes facultatifs (Aérosat, Météosat, Télécom, Spacelab, Ariane, Marots). Bien qu'ils soient extérieurs à la Convention du CERS, une liaison est établie avec le Conseil; pour les matières intéressant plus d'un programme, ces Conseils directeurs jouent le rôle d'organes consultatifs du Conseil. En outre ces Conseils directeurs de programmes peuvent établir des *organes consultatifs* ou *groupes de travail*, possibilité qui a été utilisée par certains d'entre eux (par exemple le STAG, le MARTAG).

LES DISPOSITIONS DE LA CONVENTION ASE

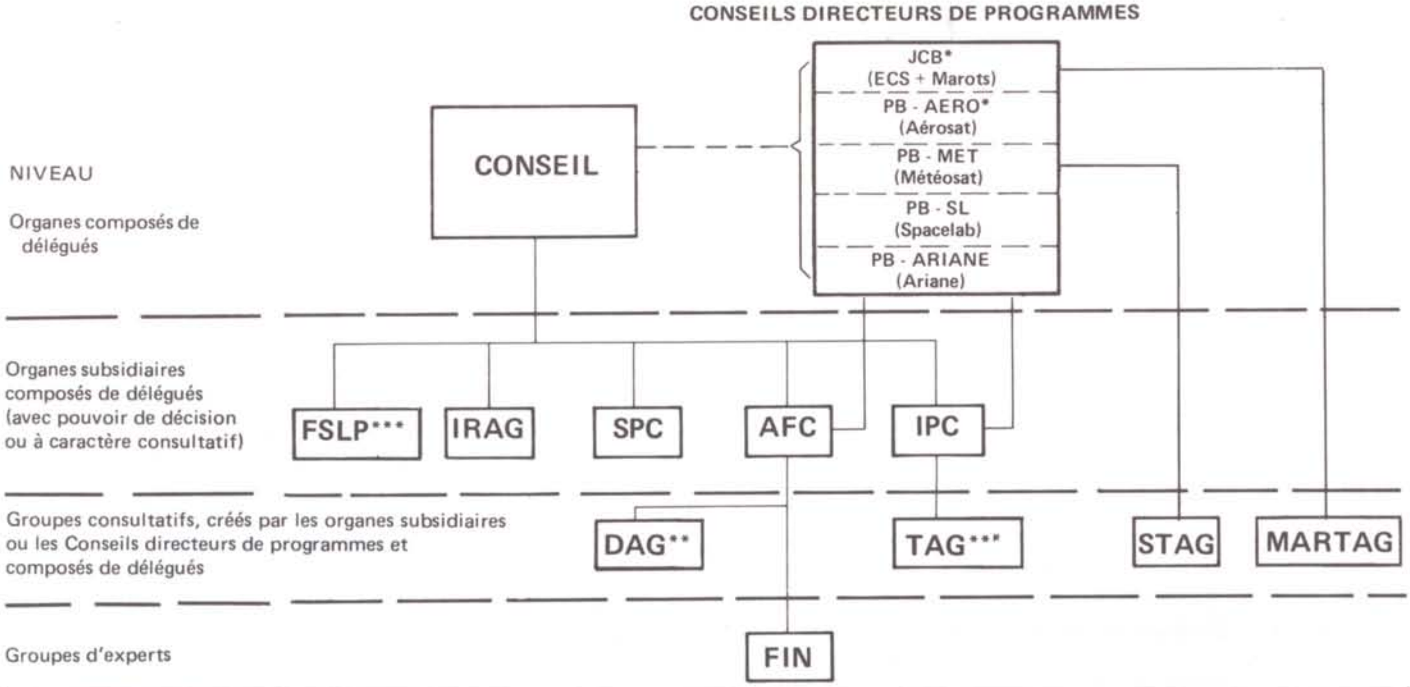
L'Article XI.8(a) de la Convention ASE prévoit que 'le Conseil crée un *Comité du programme scientifique* qu'il saisit de toute question relative au programme scientifique obligatoire . . .'. En outre selon l'alinéa (b) du même article, 'le Conseil peut créer tous autres *organes subsidiaires* nécessaires à l'accomplissement de la mission de l'Agence'.

Dans la Résolution No. 3 attachée à l'Acte final de la Conférence des Plénipotentiaires, la Conférence 'considère que l'assistance apportée au Conseil par de tels organes (subsidiaires) doit s'exercer notamment dans les domaines de l'administration et des finances, spécialement du point de vue des aspects économiques et financiers, et dans les domaines des activités de base, du programme scientifique et de la politique industrielle'. En conséquence, la Conférence 'invite le Conseil à créer les organes subsidiaires nécessaires en sus du Comité du programme scientifique mentionnée dans la Convention portant création d'une Agence spatiale européenne'.

Cette invitation à mettre en application dans toute la mesure du possible les dispositions de la Convention ASE a été suivie par le Conseil dès sa première session. Toutefois, l'action du Conseil se trouvait soumise à certaines contraintes dues à la nécessité de respecter les dispositions de la Convention du CERS qui constitue jusqu'à l'entrée en vigueur 'de jure' de la Convention ASE le support juridique du fonctionnement de l'Agence ainsi que celles des Arrangements en vigueur relatifs aux programmes facultatifs de l'Agence.

LES DISPOSITIONS TRANSITOIRES

Le Conseil de l'Agence lors de sa première session a adopté une Résolution (ESA/C/I. Rés. 2 en date du 25 juin 1975) qui tient à la fois compte des contraintes juridiques précitées et



* La réunion commune des Conseils directeurs des programmes de satellites de communications est appelée ultérieurement à traiter aussi du Programme Aérosat.

** Ce groupe a été créé par le Conseil au cours de la réunion du 16 décembre 1975. Sa place exacte dans l'organigramme des Comités reste à définir.

*** Ce rattachement, proposé par le Directeur général, a été approuvé par le Conseil lors de sa 3è session à titre d'essai pour 6 mois.

Remarque: Il existe également un Comité consultatif des Programmes pour le Projet Spécial ESRANGE qui n'entre pas dans le cadre de la structure ci-dessus.

JCB	:	Conseil directeur commun des programmes de satellites de communications.
PB-AERO	:	Conseil directeur du programme de satellite aéronautique.
PB-MET	:	Conseil directeur du programme de satellite météorologique.
PB-SL	:	Conseil directeur du programme Spacelab.
PB-ARIANE	:	Conseil directeur du programme de lanceur Ariane.
FSLP	:	Groupe de travail sur la 1ère charge utile Spacelab.
IRAG	:	Groupe consultatif des Relations internationales.
SPC	:	Comité du programme scientifique.
AFC	:	Comité administratif et financier.
IPC	:	Comité de la Politique industrielle.
DAG	:	Groupe consultatif de la Documentation.
TAG	:	Groupe consultatif pour la Technique.
MARTAG	:	Groupe consultatif technique maritime.
STAG	:	Groupe consultatif scientifique et technique.
FIN	:	Groupe des Finances.

met en application les règles de la Convention ASE. Les dispositions suivantes ont été prises:

(a) Le Conseil constate l'existence du *Comité administratif et financier,* confirme son mandat et la délégation de pouvoirs consentie antérieurement sous certaines réserves.

Le *Comité du programme scientifique (SPC)* est également maintenu et son mandat confirmé (il s'agit en effet de l'organe créé par le Conseil sous l'appellation de Conseil directeur du programme scientifique (ESRO/C/LII/Rés. 2) et visé à l'Article XI.8(a) de la Convention ASE).

Il est mis fin à l'existence du Comité mixte des programmes et de la politique générale (JPPC).

(b) Pour donner effet aux dispositions de la Convention ASE, le Conseil crée un *Comité de la Politique industrielle (IPC),* et pour tenir compte de l'élargissement de la mission de l'Agence (Art. II(a)), le Conseil a décidé de créer un *Groupe consultatif des Relations internationales (IRAG).*

La *suppression du JPPC* impliquait une redistribution des compétences qui avaient été affectées à ce Comité. Le Directeur général a proposé que certaines soient retenues par le Conseil, d'autres attribuées à l'IPC ou à l'AFC. Il s'ensuit que les groupes consultatifs qui avaient été créés par le JPPC seront rattachés soit au Conseil, soit à l'IPC, soit au Directeur général. Le Conseil a convenu d'appliquer cette proposition pendant une période de six mois à l'issue de laquelle il réexaminerait cette question. La question de la redistribution des compétences entre l'AFC et l'IPC en matière de passation des contrats est également à l'étude.

(c) L'une des contraintes juridiques était l'existence d'Arrangements créant des *Conseils directeurs de programmes.* La Convention ASE intègre dans la structure de l'Agence l'exécution des programmes optionnels; aussi ne prévoit-elle pas des Conseils directeurs de programmes, le suivi des programmes étant de la compétence générale du Conseil.

Les Conseils directeurs existants continuent à remplir leurs attributions. Toutefois à l'invitation du Conseil, les Conseils directeurs des programmes de satellites de télécommunications et de satellite maritime siègent ensemble au sein d'une *'Réunion commune des Conseils directeurs des programmes de* *satellites de communications' (JCB),* réunion à laquelle il est prévu que se joigne ultérieurement le Conseil directeur du programme de satellite aéronautique.

CONCLUSION

Lors de l'élaboration de la Convention ASE, l'accent a été mis sur le fait que le Conseil constitue l'instance suprême habilitée à connaitre de toutes les questions et le dépositaire de l'ensemble des attributions et pouvoirs. Le Conseil peut déléguer, s'il le souhaite, une partie de ses pouvoirs. Mais tout organe subsidiaire procède de lui et ne tire aucune compétence directe de la Convention ou de ses Annexes. Dans cet esprit, le nombre des organes subsidiaires doit se limiter au minimum nécessaire. Ont qualité d'organes subsidiaires les organes qui sont composés de délégués et qui peuvent, soit recevoir par délégation un pouvoir de décision, soit n'avoir qu'un caractère consultatif. Ils adoptent leur règlement intérieur sur la base de celui du Conseil, et sont autorisés à créer, selon le cas, des groupes de travail ou d'experts auxquels participent soit des délégués, soit des experts désignés pour leur compétence personnelle.
A noter enfin la place particulière du *Bureau* qui assiste le *Président du Conseil** dans la préparation matérielle des travaux du Conseil.

* Selon la Convention du CERS (Art. X.3), le Bureau est composé du Président et des deux vice-présidents. La Convention ASE (Art. XI. 3(b)) renvoie au Conseil le soin de décider de sa composition. Le Conseil, dans la Résolution précitée du 25 juin 1975, a demandé au Président d'inviter aux réunions du Bureau les Présidents de l'AFC, du SPC, de l'IPC et des Conseils directeurs de programmes.

Last Orbit for HEOS-1, ESA's Longest-Living Satellite

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ESA's longest-living satellite, HEOS-1, re-entered the Earth's atmosphere over Antarctica on 18 October 1975. Launched on 5 December 1968 (ESRO/ELDO Bulletin No. 4, January 1969) into an orbit extending almost two-thirds of the way to the Moon, the satellite carried seven experiments designed to explore the outer regions of the Earth's magnetosphere and the interplanetary medium. These experiments have made significant contributions to our understanding of the Earth's magnetic environment and its response to changes on the Sun, as well as to our knowledge of the interplanetary medium between Sun and Earth over a major part of a solar cycle.

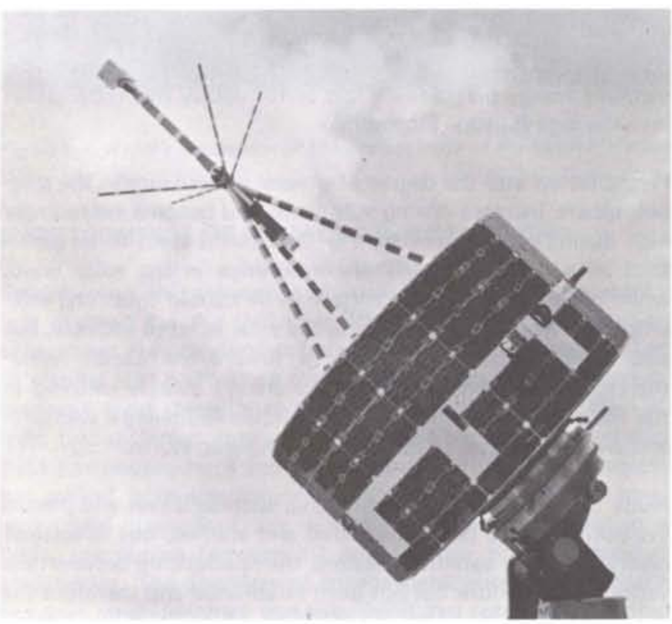
HEOS-1 was the third of ESRO/ESA's eight scientific satellites to be launched, all of which have achieved very successful missions (ESA Bulletin No. 3, October 1975). It completed 542 highly eccentric orbits in nearly seven years and was operated continuously from launch. Its full payload gave excellent scientific data for about 16 months, exceeding the design lifetime of the satellite by four months. Subsequently, a gradual failure in the satellite's attitude-measurement system supplying the trigger pulse for the operation sequence of several experiments seriously affected their operation. In 1973, two experiments were still operating, with the magnetic-field experiment continuing to work until re-entry, thus providing an unprecedented record of the interplanetary magnetic field for almost seven of the eleven years of a solar cycle.

Among the technological 'firsts' accomplished by the mission can be counted the first release of an artificial barium cloud in the distant magnetosphere, the first use of a cold-gas spin-axis re-orientation system on an interplanetary spacecraft, and the first use of a re-programmable event-detecting memory system for recording fast transient events far from Earth.

The continuing flow of scientific data for almost seven years (in spite of the very low rate of only 12 bps) has provided a rich scientific harvest. To date, more than 90 scientific publications have originated from HEOS-1 results. A particularly rewarding aspect has been the correlation with data from other ESRO/ESA, European, American and Russian spacecraft. More detailed descriptions of these results and a complete bibliography appear each year in the ESA report to COSPAR.

The 'harvest' commenced with the demonstration of the plasma properties in the outer magnetosphere provided by the spectacular barium release. (This experiment can be considered as a forerunner of the class of 'active' experiments planned for future satellites and for Spacelab.) The charged-particle detectors on HEOS-1 were able to measure the intensity and the arrival directions of the solar-flare-produced particles in interplanetary space directly. It was then possible through the combined efforts of experimenters on HEOS-1 as well as on ESRO-II and ESRO-I (these spacecraft were in near-Earth orbits at the same time) to understand the manner in which these solar particles enter the magnetosphere and find their way down into the polar-cap regions of the Earth.

The long life of HEOS-1 was ideally suited for studying the long-term behaviour of various interplanetary parameters. The solar-wind detector, in conjunction with previous American measurements, was able to establish long-term changes in the density of the solar-wind plasma over the solar cycle. It did not, however, find a significant variation in the solar-wind velocity. The magnetic-field data have revealed, together with contemporary data from HEOS-2, solar-cycle changes in the level of low-frequency turbulence in the interplanetary medium. The mean interplanetary field strength, however, was found to be independent of the level of solar activity.



HEOS-1

Cosmic-ray observations over the past three decades have shown that there is a marked variation in intensity near the Earth during the solar cycle. This variation had been interpreted in terms of changes in the interplanetary field structure and solar wind during the sunspot cycle. The interplanetary observations to which HEOS-1 contributed so significantly are, however, incapable of accounting for the observed change in cosmic-ray intensity. The cosmic-ray modulation therefore remains something of a puzzle. There are now serious doubts as to whether the measurements of the interplanetary magnetic field and the solar wind that have all been made near the plane of the ecliptic are representative of interplanetary space in general. To solve the puzzle one needs to investigate how the interplanetary structure changes with heliographic latitude. The puzzle left unanswered by HEOS is a challenge for an out-of-ecliptic mission now being studied by ESA.

The HEOS-1 magnetic-field data, in combination with contemporary measurements from HEOS-2, have provided a unique record of the structure of the near-Earth interplanetary magnetic field. These data have now been made available to a world-wide scientific community and are frequently used for correlation with ground-based, balloon, rocket or other satellite data. The measured sector polarity (the interplanetary field points towards the Earth for some days, then reverses and points towards the Sun for a further few days) confirmed the validity of a recently developed method of predicting this polarity on a day-to-day basis from ground-based data.

The magnetospheric data have also proved very valuable. The data taken inside the various regions of the magnetosphere have been used to refine and improve existing magnetospheric models. Correlations of the plasma and magnetic-field data have revealed several interesting features of the interaction between the supersonic solar wind and the geomagnetic field at the standing shock in front of the Earth's magnetosphere, the bow shock.

Conceived in the early days of ESRO and injected into orbit seven years ago, HEOS-1 has been a true European 'pioneer' in interplanetary space. Although technically it has been a 'past project' for many years and has now lost its voice from orbit, the analysis of HEOS-1's particle and field measurements will continue to provide a source of new information for many scientists for some time to come. □

The International Magnetospheric Study

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The magnetosphere is that part of space surrounding the Earth which is dominated by our planet's magnetic field. It has been studied intensively and successfully in the last two decades and scientists have begun thinking of the magnetosphere as their 'little backyard universe'. ESRO/ESA has played a major role in its exploration with the scientific satellite programme oriented primarily toward magnetospheric research. The results that have been achieved to date have provided us with a reasonably detailed picture of our immediate spatial environment. Nevertheless, we are still far from achieving even a rough explanation of some of the basic mechanisms that create and maintain the near-Earth plasma environment.

Guided by the many phenomenological descriptions and observations that now exist, we are at last able to concentrate our measurements at points of particular interest and to devise missions aimed at discovering processes thought to play a major role in the general behaviour of the magnetosphere. Fully realising these possibilities, scientists from all countries involved in the exploration of near-Earth space have joined forces in a common effort which is known as the 'International Magnetospheric Study' (IMS), to be conducted in the years 1976–78.

This article describes the objectives of and the tools available for the IMS. To put them into perspective, it is necessary first to sum up briefly and very simply what we know so far about our magnetospheric environment.

WHAT DO WE KNOW ALREADY?

Long before the scientific exploration of space with the aid of satellites began, astronomy had established many facts about the solar system. It consists of the Sun, as an ordinary star, and nine revolving planets. The Earth, the third but nearest of these planets, revolves at a distance of 1.5×10^8 km from the Sun. Our central star is generating power by nuclear fusion at a rate of 3.7×10^{26} W and, despite this immense production rate, still has an expected lifetime of 10^7 years. It emits most of its power in a radiative manner, but it also releases ionised gas which expands radially into the solar system.

It is at this point that measurements conducted from satellites have taken over and such parameters as flow speed, temperature, density and composition of the expanding solar plasma, or 'solar wind', have been recorded directly. The planet Earth, with its dipolar magnetic field, represents a tiny obstacle in the stream of the solar wind. The planet's magnetic field acts as a screen, preventing the solar wind from coming nearer than 10 Earth radii (average) to the Earth's surface. The plasma stream is deflected, causing deformation of the dipolar configuration and creating the famous teardrop-shaped 'bottle' which we call the magnetosphere (Fig. 1). In as far as the approaching solar wind cannot *a priori* enter the magnetosphere, by the same token plasma cannot escape from within this cavity.

The Sun is not burning steadily at its surface, and strong variations occur in the intensity of the solar wind, leading in turn to variations in the magnetosphere's shape. Under 'quiet' solar-wind conditions, the magnetosphere expands; when the solar wind blows harder, it is compressed.

The magnetosphere contains three distinctly different types of particle population: the near-Earth environment is dominated by cool dense plasma of the ionospheric type; further out (but only to regions where the dipolar configuration of the magnetic field is roughly preserved), we find very energetic particles, trapped magnetically in the well-known Van Allen belts; further out still, and particularly within the tail of the magnetosphere, a large reservoir of medium to low-energy particles is stored. By and large, magnetospheric particles have a much higher energy than solar-wind particles.

The overall particle content of the magnetosphere is remarkably constant for long periods of time, although high and medium energy particles are lost continuously by precipitation into the high-latitude atmosphere.

Precipitation and the degree of general disturbance in the magnetosphere increase during substorms and become exceedingly high during geomagnetic storms. Substorms seem to be generated as a result of small discontinuities in the solar wind, while geomagnetic storms appear to be caused by strong solar eruptions which not only cause the solar wind to increase, but also release high-energy particles toward the Earth. Nevertheless, steady-state conditions are always quickly restored in the magnetosphere, in a matter of hours following a substorm and within a matter of days after a magnetic storm.

Many other small-scale phenomena, such as waves and plasma instabilities, have been discovered and studied, but in spite of several hundred satellite missions the relationship between the various observations has not been established and therefore the dynamics, in terms of cause and effect, of our immediate space environment are not yet wholly understood.

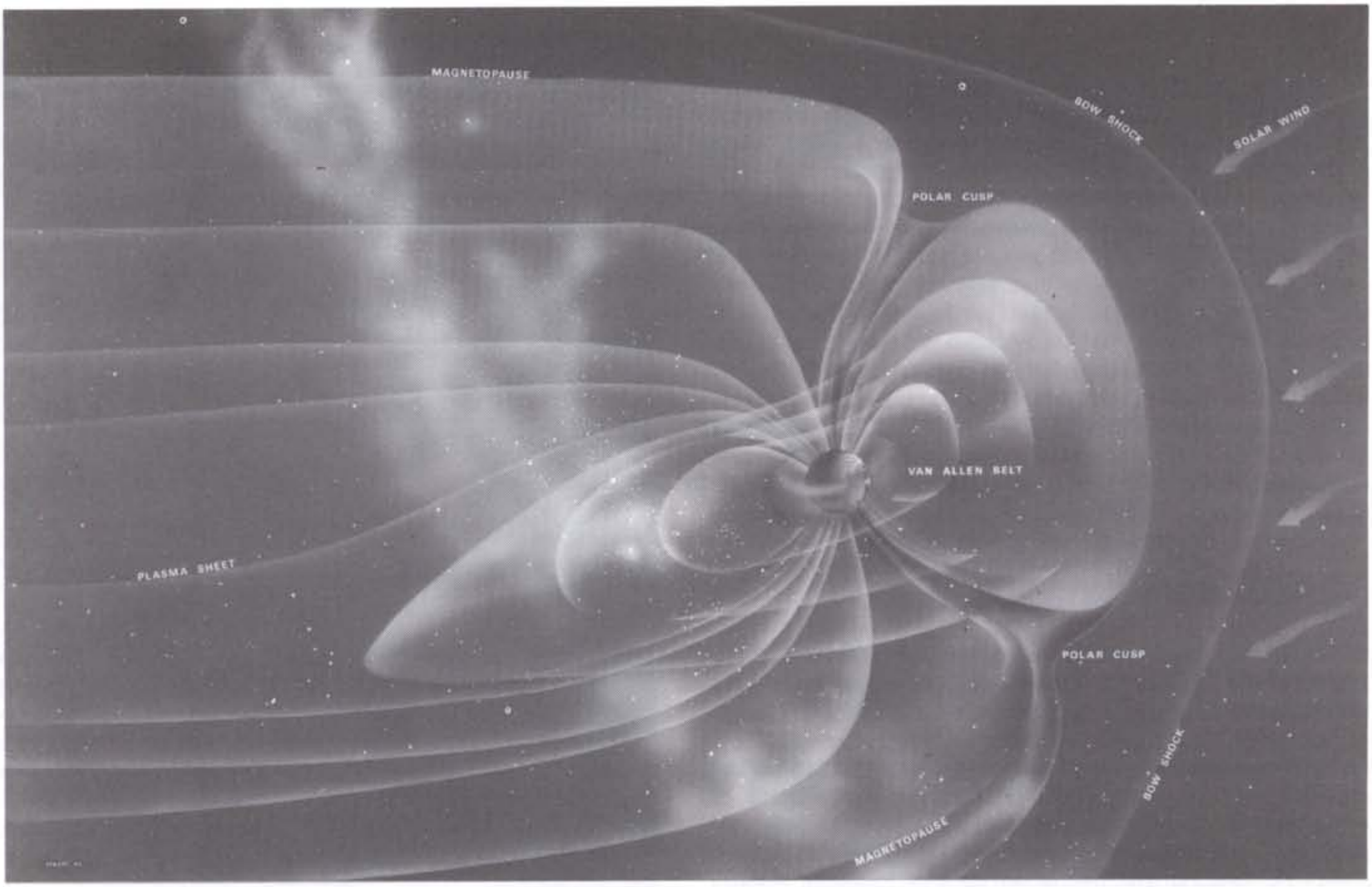


Figure 1 — Artist's impression of the average state of the terrestrial magnetosphere which will be the subject of co-ordinated exploration during the IMS.

SHORTCOMINGS OF PREVIOUS OBSERVATIONS

Before going on to describe what remains to be done and is in fact planned for the IMS, the limitations of a single-satellite experiment may be demonstrated with a simple example. Let us assume that a satellite's magnetometer shows a reduction in magnetic field strength at a certain moment in time, then at least two different conclusions are possible: (i) the magnetic field has undergone a temporal change, or (ii) the spacecraft has moved from a region of higher to a region of lower magnetic field strength. Using a single-satellite experiment as a basis, the choice between (i) and (ii) can only be decided statistically. The discovery of the magnetopause, the boundary between magnetosphere and solar wind, has come about in this way and a great number of individual satellite crossings of the magnetopause were needed before its characteristics and approximate location could be established. An observation during a single satellite crossing is shown in Figure 2.

If we now want to go on to study the behaviour of the magnetopause, we need to know the speed of motion of that boundary when subjected to an increasing solar-wind strength. It should be clear immediately that this parameter, although of fundamental importance for the understanding of magnetospheric dynamics, cannot be derived from a single-satellite pass. Only two satellites orbiting together with a suitable distance between will be able to determine the magnetopause's motion. This simple example should serve to demonstrate that multisatellite missions will give us access to entirely new magnetospheric parameters. Many other more complicated

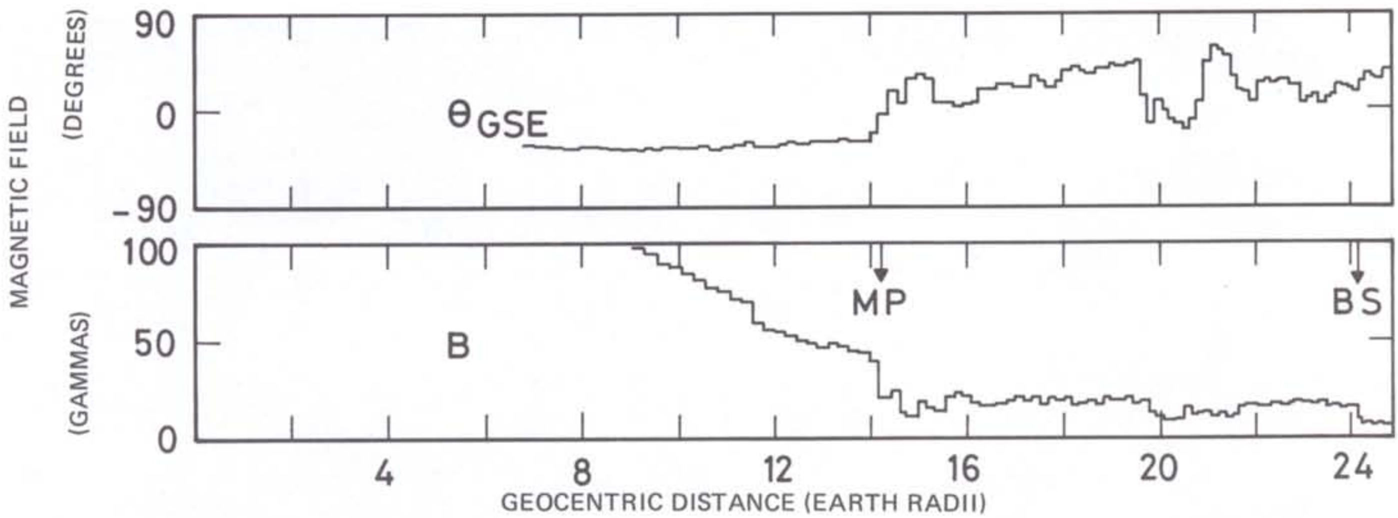


Figure 2 — Magnetometer data from the HEOS-2 satellite showing an outbound crossing of the magnetopause (MP). Both the intensity and direction of the magnetic field change during the crossing. Data from a single satellite crossing do not allow one to decide whether a spatial or temporal variation has occurred.

examples can be cited: each requires simultaneous observations at two or more points inside (mainly) or outside the magnetosphere.

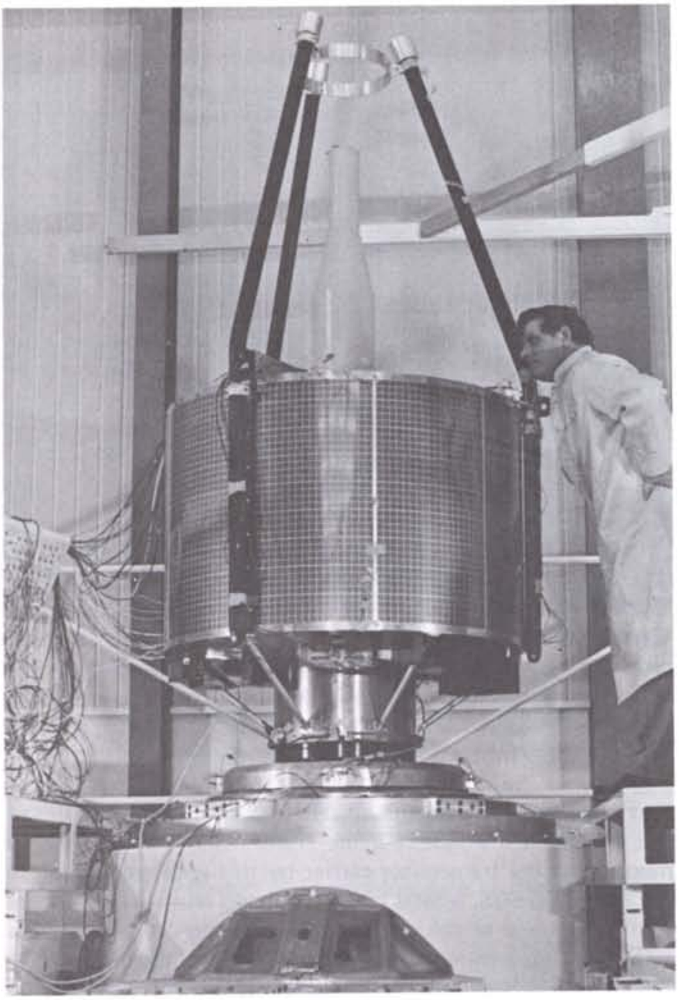
It is intended during the IMS to make optimum use of all available tools, not only satellites but also rocket-borne or ground-based observational platforms, in a single co-ordinated and concerted attack on the outstanding problems. Only a combined effort of this nature will help us to obtain answers to such questions as: How does the solar-wind plasma gain entry to the magnetosphere? How is it accelerated to the energies observed in the Van Allen belts? What are the necessary conditions for a quiet magnetosphere and under what circumstances do instabilities develop?

MEASUREMENTS DURING AND PLANNING FOR THE IMS

The International Magnetospheric Study is built around two major satellite missions, GEOS and ISEE. GEOS, a purely ESA mission, will be the world's first scientific geostationary satellite and has been adopted as the reference spacecraft for the IMS. The ISEE mission is a combined NASA/ESA venture comprising three satellites: ISEE-A and B will be launched by one vehicle and will acquire identical orbits (perigee 400 km; apogee 20 R_E), with a variable spacing between the A and B craft; ISEE-C will be positioned far outside the magnetosphere, 235 Earth radii upstream in the solar wind, at a point where the gravitational forces of Sun and Earth cancel one another. Further satellites, such as the HELIOS solar fly-by mission, EXOS, a Japanese magnetospheric satellite, and a Russian near-Earth satellite, will complement the *in situ* measuring network. All of these satellites will be equipped with sophisticated instrumentation for the measurement of particles, fields and waves.

It is planned to complement the satellite programme with extensive rocket and balloon launching programmes. Such launches will be carried out primarily at higher latitudes, within the auroral zones where the particle precipitation from the magnetosphere takes place. Rocket-borne particle detectors will measure this precipitation just before it strikes the Earth's atmosphere. Balloon payloads will mainly measure X-rays generated by the interaction of the energetic particles with the atmosphere.

Last, but by no means least, there will be the contribution of geophysical observations from the ground. These will consist, for example, of magnetometer recordings and auroral recordings by scanning photometers tuned to different characteristic emission frequencies. Magnetospheric disturbances are reflected by strong currents in the lower ionosphere and these in turn cause a magnetic field which can be recorded on the ground. Scanning photometers will reconstitute the patterns of



Mass model of ISEE-B prior to vibration tests.

auroral displays, and both magnetometers and photometers will be used in extended networks to derive the morphology of precipitation patterns.

In summarising the tools available to us for the IMS, we note that plasma disturbances transmitted from the Sun can be detected by interplanetary probes such as HELIOS and ISEE-C. The interaction of such disturbances with the magnetosphere will be studied by the ISEE-A and B satellite pair. In its equatorial orbit, at a distance of 6.6 Earth radii, GEOS will study a region of the magnetosphere which is of particular interest because it is linked by magnetic field lines to both the northern and southern auroral zones. The ultimate effect of solar-originated disturbances on our atmosphere will be recorded by rocket- and balloon-borne instrumentation and will be monitored continuously from the ground.

To make the IMS a success and to repay the effort that is being invested, planning and co-ordination on a worldwide scale is mandatory. Spacecraft orbits and payloads must be carefully matched and the most suitable operating modes for complementary experiments must be worked out in order to seek the expected phenomena at the correct time and at the correct location. Satellite and ground-based experimenters must be fully aware of the possibilities and limitations of their respective measuring capabilities. Nor can the data handling and distribution aspects be neglected. A satellite like GEOS generates data at a rate of 100 000 bps, which is equivalent to an output of one full computer tape every 30 min. Needless to say, such a wealth of data can only be analysed efficiently if high-quality summaries are produced from which periods of geophysical significance can be identified for further study.

IMS OBJECTIVES AND EXPECTED SCIENTIFIC RETURN

In summarising the objectives and possible benefits of an extensive undertaking like the IMS, it must be postulated that the exploration and understanding of the near-Earth part of the Universe is a fully justified venture in itself. Wider knowledge of regions outside the solar system will only be achieved by combining collective information from these regions, such as their radiation at various wavelengths, with detailed information on fundamental processes observed *in situ* in the solar system. Another stimulus stems from the possibility of using the magnetosphere as a 'laboratory' for studying fundamental plasma physics, an approach that may promote discoveries related to high-density plasma physics and controlled nuclear fusion. Study of instabilities and wave-particle interactions would seem to be of major importance in this context.

It has been discovered that magnetospheric processes have direct influence on our immediate environment. Short-wave radio communication and electrical power distribution networks can be seriously affected by strong geomagnetic storms. The amount of energy injected into our atmosphere by precipitating magnetospheric particles is such that they may play a role in establishing its heat balance and hence may well influence its dynamics. Striking relationships between solar processes and climatic conditions such as temperature and rainfall, and thence food production, famines and even economic wealth, still await an explanation, an explanation that could well prove to be of untold benefit to all the inhabitants of our 'magnetically bottled' planet Earth. □

The GEOS Data Stream - How is it generated and how will it be handled?

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All seven of the scientific experiments that make up the GEOS payload are dedicated to magnetospheric research, four to the measurement of particles and three to the measurement of electric and/or magnetic fields. Here, our interest in the seven experiments is to be focused on their data output, an output such that when all transmission requirements are totalled, the data rate from the satellite amounts to 107 160 bps.

The following example may demonstrate what this means in terms of information flow. A normal book carries about 2000 letters per page; in binary coding each letter can be represented by a 5-bit code (32 different characters). Consequently, a full typewritten page is equivalent to 10 000 bits. An average book has something like 600 pages, which brings its total information content to 6 000 000 bits. Thus, turning on GEOS's telemetry for only 1 min is equivalent to filling a complete 600 page book. If, finally, we realise that GEOS is designed to operate and transmit more or less continuously for two years, it takes but a little multiplication to conclude that during GEOS's lifetime we may fill 1 million books. There are few libraries in the world which have this number of books on their shelves.

This article is intended to explain why such a high data rate is required from GEOS, how it will be generated, and how ESA is dealing with the somewhat daunting prospect of handling this formidable data stream — perhaps 'torrent' would be a more fitting descriptor.

SCIENTIFIC REQUIREMENTS

GEOS will be launched at a time when progress in the field of magnetospheric research will only be possible if several so far unexplained dynamic phenomena can be studied in detail. Such studies require particle experiments with both wide spatial coverage and high temporal and spatial resolution. There is also a need for wave measurements that provide complete vector information in both the electric and magnetic domains and cover a wide frequency range.

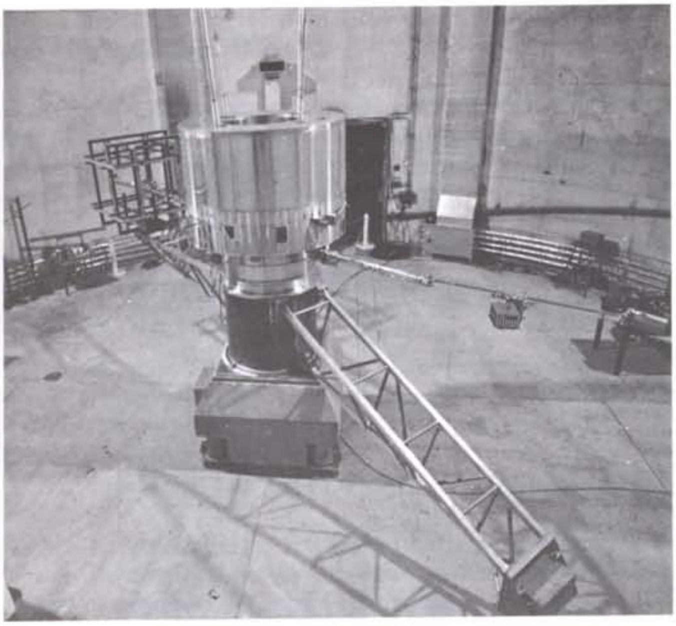
For the particle experiments, large spatial coverage and resolution can only be achieved by employing a number of detectors, each viewing in a different direction and with a narrow field of view. Each detector requires a separate data channel. High temporal resolution is achieved by reading these channels at a very high sampling rate into the spacecraft telemetry. Table 1 summarises the transmission requirements of the various GEOS experiments. The average data rate from the four particle experiments (S-302, S-303, S-310, S-321) is of the order of 1 kbps. Considering the sophistication of these experiments, such a data rate is by no means abnormally high and quite comparable with the output of particle experiments on other satellites currently under development, such as ISEE-A and B. Experiment S-329 must be seen as a special case; it attempts to measure the electric field in space by monitoring the deflection of an electron beam by this field. Identification of the beam within the natural electron background can only be assured by a very high sampling rate in the electron sensor of this experiment. The magnetometer (S-331) again has a very moderate bit rate, one which is dictated by its measuring accuracy (9 bits) and its time resolution, which extends to 5 Hz.

Table 1 clearly shows that it is the wave/field experiment (S-300), the most comprehensive satellite wave experiment that has so far been built, which consumes more than 90% of GEOS's bit rate. S-300 performs a 6-component measurement (3 orthogonal magnetic and 3 orthogonal electric) and provides frequency coverage to 80 kHz in the electric domain and to 30 kHz in the magnetic domain. It therefore requires the transmission of three 80 kHz (bandwidth) analogue channels and three others with a 30 kHz bandwidth.

Previous wave experiments on satellites have mainly employed one wideband analogue channel. Transmission was achieved by modulating the transmitter carrier by this wideband signal. In the case of GEOS, a total of six wideband channels were to be transmitted and as the relative phase between all six channels was to be maintained, direct analogue transmission invoking such techniques as FM/FM multiplexing was very soon found to be impractical.

The only solution that appeared feasible was digitisation of the analogue signals and transmission at a very high bit rate. Straight 8-bit digitisation of the six S-300 channels, at a rate of say three times the upper frequency limit, results in a total bit rate to be transmitted of 8 Mbps. It was clear from the beginning that such a bit rate — although technically feasible — was too demanding in terms of satellite transmission power. It was, however, realised that a bit rate of the order of 0.1 Mbps could be allocated to the wave experiment without stretching the satellite's power budget.

After considerable study, the experimenters proposed to circumvent their data transmission problem by employing sophisticated onboard processors to compress their data flow



Development model of GEOS undergoing electromagnetic-cleanliness tests.

into a manageable bit rate. It was decided to use six swept-frequency analysers and a digital correlator for that purpose.

A swept-frequency analyser is a device that transposes frequencies from a higher to a lower frequency band; e.g. from the band between 60 000 and 60 450 Hz into that from 0 to 450 Hz. The information contained in this band is then transmitted at a reasonable bit rate. The six S-300 swept-frequency analysers can be commanded into 256 different, but partly overlapping bands between 300 Hz and 80 Hz. The disadvantage, compared to direct transmission, stems from the fact that the total frequency interval (0-80 kHz) cannot be looked at simultaneously, but must be explored in steps.

A correlator is a device that effectively averages an analogue wave form signal over a given period of time. It preserves the wave information to the extent that the frequency spectrum of the wave over the averaging interval can be reconstituted from the correlogram. In other words, using a correlator as a preprocessor means maintaining broadband frequency coverage at a limited bit rate, but at the expense of high time resolution.

TABLE 1 - *Scientific data generation by GEOS*

Experiment	Main data output	Output generated by	Format*	Number of channels**		Bit rate (kbps)
S-302	Electron/proton data	Direct sampling of 2 detectors	LS	4D	7A	1.02
S-303	Proton and heavy-ion data	Internal multiplexer	LS	2D	1A	0.40
S-310	Electron/proton data	Direct sampling of 10 detectors	LS	9D	1A	1.62
S-321	Electron/proton data	Internal multiplexer	LS	2D	4A	1.27
S-329	Electron beam data	High-rate sampling of beam detector	LS	2D	10A	1.66
S-300	DC electric-field data	Waveform sampling	LS	1D	4A	0.63
	ULF magnetic-field data	Waveform sampling	LS	1D	6A	1.23
	Filter-array output	Sampling of wave power detector	LS	16D	16A	0.81
	Wideband data	Six swept-frequency analysers	HS		6A	71.52
	Averaged wideband information	Auto-and cross-correlation	HS	1D		17.70

* LS = low speed; HS = high speed. ** A = analogue; D = digital.

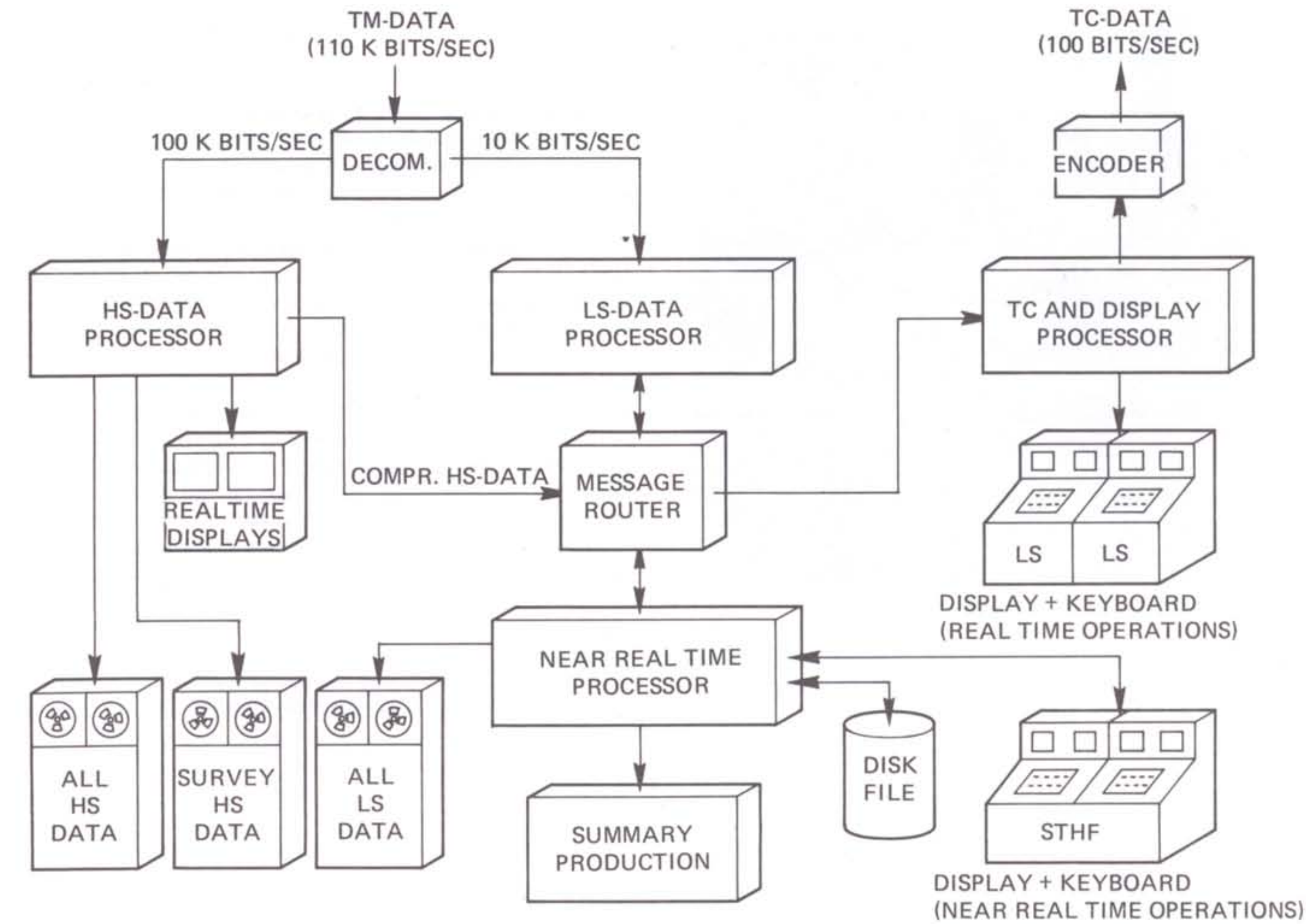


Figure 1 — Schematic of GEOS spacecraft-control and data-handling facilities available at ESOC, Darmstadt.

The outputs of the six swept-frequency analysers and the output of the correlator are transmitted in a separate 'high speed' telemetry format (95.25 kbps). All other GEOS data, the output from the particle experiments, the beam experiment, the magnetometer data, some low-frequency channels from the wave experiment, and the necessary spacecraft housekeeping data, are transmitted in 'low-speed' telemetry format (11.91 kbps).

It must be emphasised at this point that the data from all experiments could be further compressed by suitable onboard processors. In fact this compression could be such that no scientific information is lost. This solution was, however, ruled out during the GEOS feasibility-study stage. There was a clear policy decision not to implement complicated onboard processors, but to use online computer control on the ground, a solution that appeared more promising because of the constant visibility of a geostationary spacecraft from its ground station.

PROBLEMS OF DATA PROCESSING AND DISTRIBUTION

At the time when the GEOS design was finalised and the stringent data-handling requirements emerged, preparations were started at the European Space Operations Centre (ESOC), Darmstadt, for the handling and distribution of the data. The hardware, handling and distribution needs have since been established and installation of the necessary facilities is now in progress (Fig. 1).

Upon receipt at the ground station and transmission to ESOC, the satellite's data stream will be divided into its low- and high-speed components. The processing tasks to be conducted in the high-speed branch are listed below.

1. Continuous recording on magnetic tape of the high-speed data in full, but without any data preprocessing. A total of some 26 000 tapes is forecast for the two-year mission.

2. Recording on magnetic tape of 'survey data', a task similar to (1), but recording takes place only for 3 min in every hour, on the hour.

3. Real-time display of some of the high-speed data channels.

4. Real-time compression of high-speed data. This compression consists of averaging several successive correlograms and computing the average power contained in the outputs of the swept-frequency analysers. The compressed data are routed to a very large disk file for temporary storage.

The low-speed data are to be treated in the second branch, where key channels are to be displayed in real time. They are also to be analysed in real time and can be used for the automatic generation of telecommands. The low-speed data will be stored temporarily on disk but, in contrast to the high-speed data, without prior compression.

The main disk file has a capacity of 24 h and will be emptied with this frequency. Three different 'products' are to be drawn from it:

(i) A tape with all low-speed data in raw form and the compressed high-speed data.
(ii) Daily summaries consisting of plots of key experiment channels on a 24 h time scale (1 cm/h).
(iii) Experiment summaries consisting of plots of key experiment and housekeeping channels, but on a time scale that allows better time resolution.

Product (i) is to be transferred to an offline computer where further decommutation of the data will take place and where the tapes for individual experimenters will be prepared. Product (ii) appears as hard copy and will be made available either in this form, on microfilm, or on magnetic tape, to other data centres for worldwide distribution during the IMS. A limited number of hard copies can also be distributed directly. Product (iii) will go only to the experimenters concerned.

TABLE 2 - *Tape production rate during GEOS's lifetime*

Experiment	Tape content	Number of days to fill 1 tape	Number of tapes in 2 yr
S-302	Raw data	2.4	304
S-303	Raw data	5.9	124
S-310	Raw data	2.0	365
S-321	Raw data	2.1	348
S-329	Raw data	1.8	406
S-331	Raw data	4.4	166
S-300	DC electric-field raw data	3.9	187
	ULF magnetic-field raw data	2.1	348
	Filter-array raw data	3.0	243
	Compressed HS data	2.0	365
	Survey data	1.0	730
	Status for HS data	10.0	73
	Raw HS data	0.028	2628*
		Total to experimenter	± 6500

* Only 10% of the HS data are archived and forwarded to experimenters.

Table 2 summarises the distribution of GEOS data. Except for the high-speed data, the data flow to the various scientific institutes will average one tape per three days, which can be digested by the recipient with reasonably adequate data-handling facilities. Nevertheless, there has been some apprehension from the outset about whether processing will keep abreast of input and it was therefore decided to emphasise data summary production within the overall concept of GEOS data handling.

The need for such summaries is especially acute in the case of the high-speed data, which will fill one computer tape every 40 min. Here, it was decided several years ago, for various reasons, that it would not be practicable to archive and distribute all the high-speed data tapes produced during GEOS's lifetime. The experimenters concerned will have to make a selection from these data based on the summaries provided. It has been agreed that the raw high-speed data are to be stored in a temporary buffer with a three-month capacity. Overflow from this buffer must be avoided by the experimenters deciding which data to keep for further analysis. Ultimately, not more than 10% of the high-speed data will be kept and distributed.

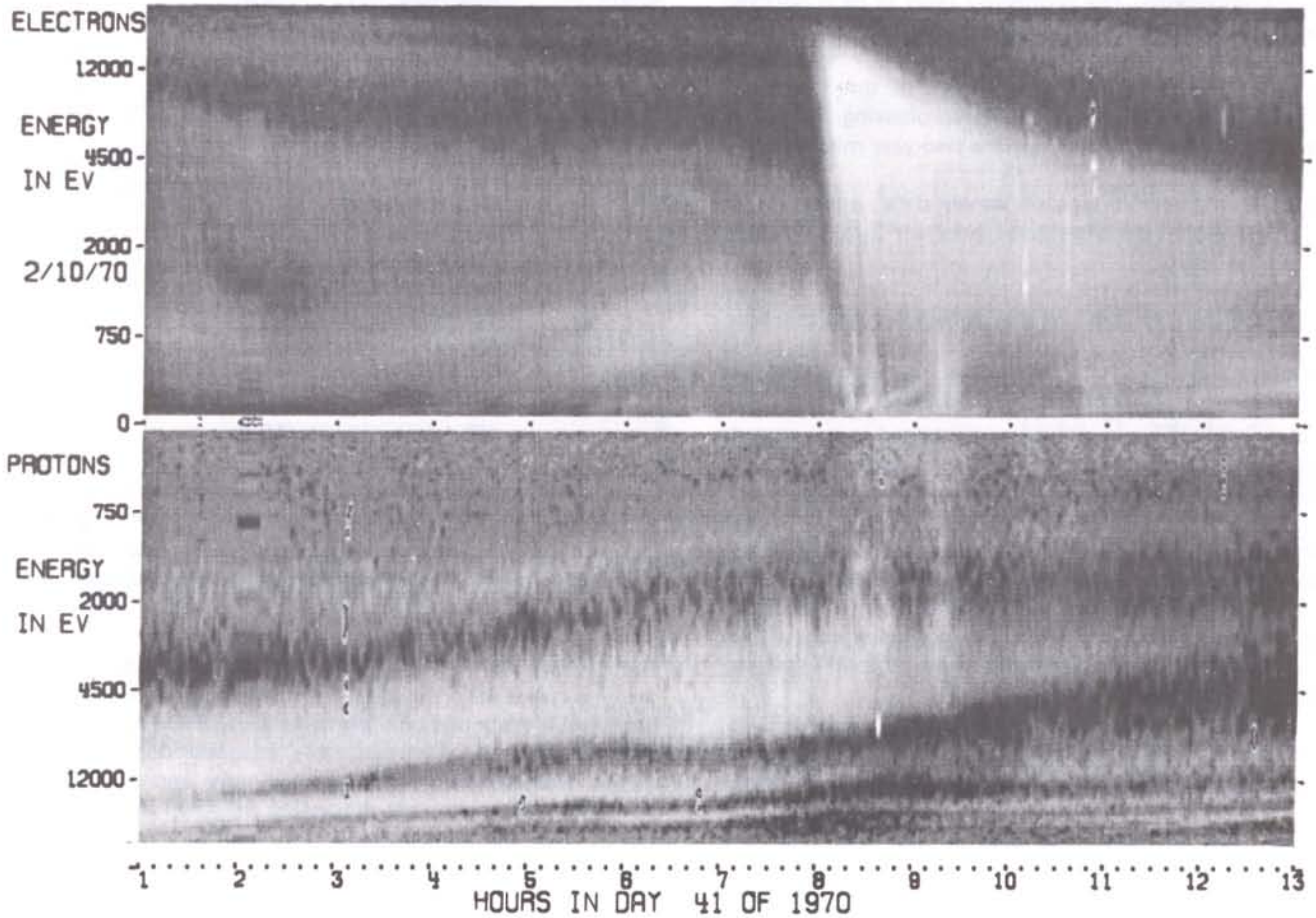


Figure 2 — Example of a spectrogram representing particle data. Particle energy is plotted on the vertical axis, and time on the horizontal. The flux at a particular energy and time is presented in grey scaling (low fluxes dark, high fluxes white). (Example taken from De Forest et al.)

ESA is committed to generate, and to forward to its customers, approximately 6500 computer tapes during the lifetime of GEOS (see Table 2). Bearing in mind: (i) that the purchase price per tape is about 10 AU, and (ii) that the handling and distribution charges are of the same order, the data distribution costs compare favourably with the total cost of the mission.

In addition to these tapes, various summaries must be produced and distributed. The latter task is of negligible magnitude compared to the raw-data distribution. The summary generation is, however, a step beyond the normal ESOC practice of forwarding raw experiment data, but it had to be undertaken as a direct and mandatory consequence of GEOS's high data production rate.

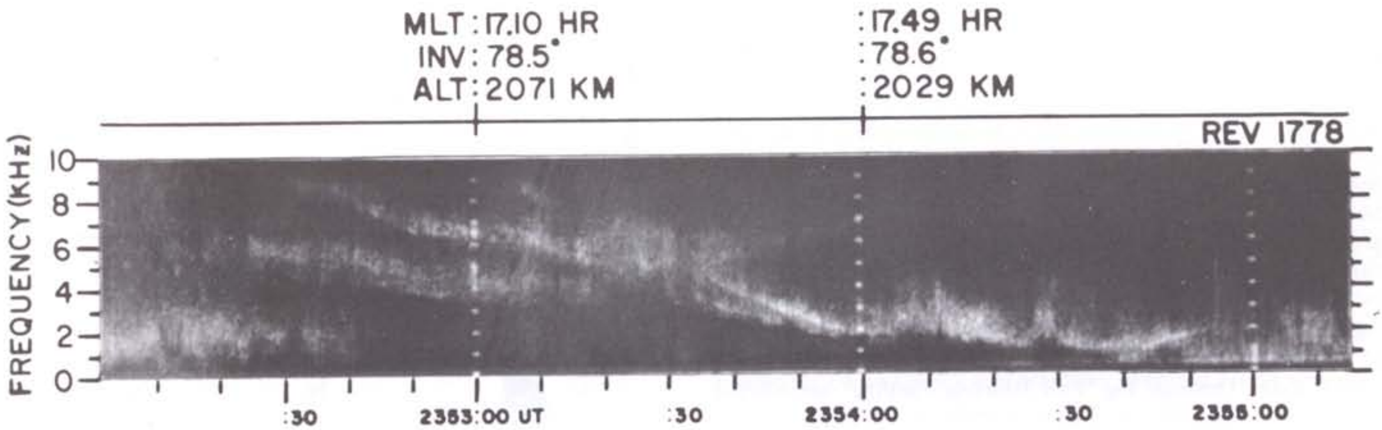


Figure 3 — Presentation of wave data in highly compressed form. Frequency is plotted on the vertical axis, and time on the horizontal. The wave's energy flux at a particular moment is indicated by an 'intensity code' (red or green). The two colours allow discrimination between waves propagating in different directions.
(Example taken from Gurnett et al.).

A WORD OF REASSURANCE

In the introduction, we painted a disturbing picture of what a bit stream of 100 000 bps can produce in terms of transmitted information, a picture that must have been in the minds of those who have in the past expressed strong doubts as to the manageability of the GEOS data, in particular the digestibility of the high-speed data. Manageability, the prime obligation of ESA with respect to the GEOS data, has been achieved by limiting the final distribution of high-speed data to only 10% of the total received.

Digestibility of the data is a question of suitable presentation. The basic content of the GEOS data stream is particle flux in different energy ranges and wave intensity in different frequency intervals, both dependencies as a function of time. Such relationships are presented most meaningfully in a three-dimensional display. In the case of a particle experiment, this means generating a diagram with energy plotted along the vertical scale and time along the horizontal. The particle flux at a particular energy at a particular time is then presented by a point of varying grey scaling in such a diagram. Figure 2 shows an example, called a 'spectrogram', in which particle data are presented in a highly compressed but easily digestible form.

Wave data can be presented in similar fashion by plotting frequency along the vertical axis, time along the horizontal axis and the wave intensity at a particular time and at a particular frequency as a point of varying intensity. An example of a 'sonogram' is given in Figure 3. It should be clearly understood that both the spectrogram and the sonogram give only a rough indication of particle and wave behaviour as a function of time. Nevertheless, displays are of great value for 'digesting' the data and selecting interesting periods for further study using higher time resolution.

In order to realise how many bits a human brain can digest when they are presented in such a highly compressed form, we can consider the example of a television picture, which also involves grey scaling to present information. Very roughly, a TV screen consists of 625 lines and similar number of resolvable features per line, or in total 625 × 625 points. Each point may assume 16 different levels of grey shading. Per second 25 such pictures are presented, which leads to a bit flow of 40 Mbps. Looking at the GEOS data in such perspective, we realise that it can, in principle, be digested within a few days of receipt.

□

COS-B Operational

G. Lichti, B.G. Taylor and R.D. Wills, for the COS-B Caravane Collaboration

COS-B, ESA's first satellite (ESRO's eighth) was launched on 9 August 1975 from Western Test Range, USA by a Thor Delta vehicle into a nominal eccentric orbit with a 37 h period and an apogee of nearly 100 000 km. In orbit, all satellite sub-systems were found to be functioning satisfactorily. Experiment switch-on started on 11 August and by 17 August the experiment units had been thoroughly checked out, the satellite directed to observe its first target, the Crab Nebula, and the first observation period begun. Thus ended the long and arduous task of the COS-B 'Caravane' Collaboration in building the COS-B experiment for gamma-ray astronomy and getting it operational. In parallel with the production of the hardware, the collaboration completed extensive calibrations, including tests at the accelerators of DESY and CERN, a high-altitude balloon flight and prepared and tested the suite of computer programs needed to analyse and interpret the orbital data. Through the 'Fast Routine Facility', established at the Space Operations Centre (ESOC) in Darmstadt, some 20% of the data from each observation period have been analysed in a manner sufficient to demonstrate that the experiment is working according to specification (or rather to expectations generated via the calibrations). The preliminary results presented here on the basis of this small data sample indicate that COS-B, given its planned two-year operational lifetime, will produce an unprecedented picture of the gamma-ray sky.

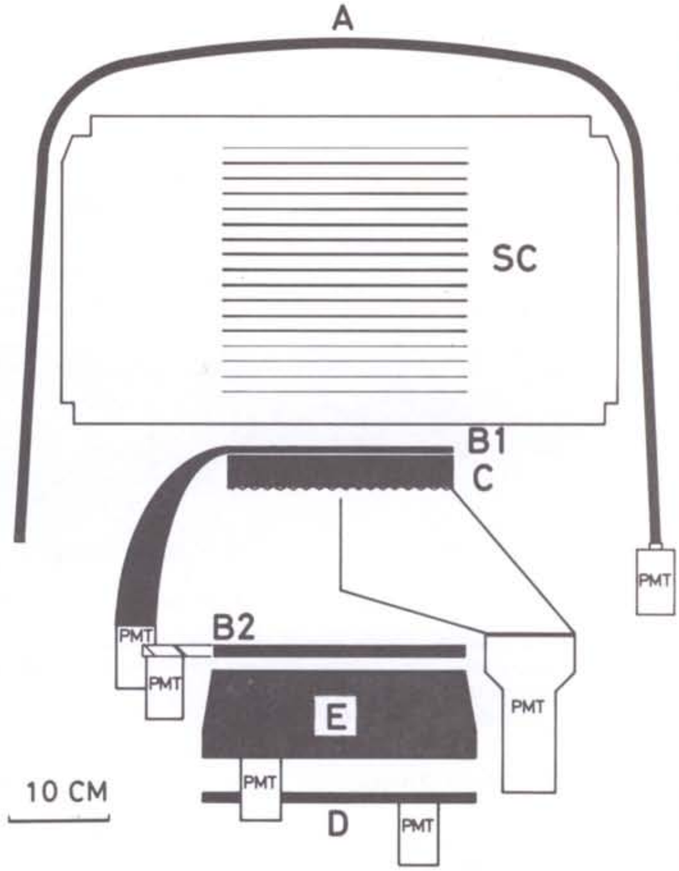


Figure 1 — Schematic of the central experiment package.

MISSION OBJECTIVES

The principal objective of the COS-B mission is the study of the fluxes, energy spectra, spatial distribution and temporal characteristics of extraterrestrial gamma radiation in the 20 MeV to several GeV energy range. Of particular interest are the emission from the plane of the Galaxy, the diffuse radiation from high galactic latitudes and known or postulated point sources. Secondary objectives include study of the long-term variability of X-ray sources and cosmic gamma-ray bursts.

The central experiment package described extensively by Bignami *et al.*, and shown in Figure 1, features a 0.5 radiation length, 16-gap spark chamber (SC) for the identification and determination of the arrival direction of the gamma quanta, a caesium-iodide energy calorimeter (E) of 4.7 radiation lengths thickness for energy determination, a three-level telescope (B1/C/B2) defining the field of view of the instrument and a plastic-scintillator anticoincidence counter for the rejection of charged particles. A proportional counter with an effective area of 80 cm^2 and sensitive in the range 2-12 keV, collimated to a 1° flat top and an extinction half angle of 10°, records the arrival time of X-ray photons. The instrumentation was provided by the groups of the COS-B Caravane Collaboration listed in Table 1.

The scientific instrumentation makes up 120 kg of the satellite's 280 kg total. The craft is spin-stabilised at 10 rpm with the experiment's 'optical axis' co-linear with the spin axis. It is equipped with a nitrogen-gas attitude-control system, permitting the experiment to be pointed in any desired direction, with the proviso that the solar cells remain illuminated and the attitude-measurement sensors still view the Sun and the Earth. The attitude of the satellite at any instant can be determined to better than 0.5°. The telemetry link margin

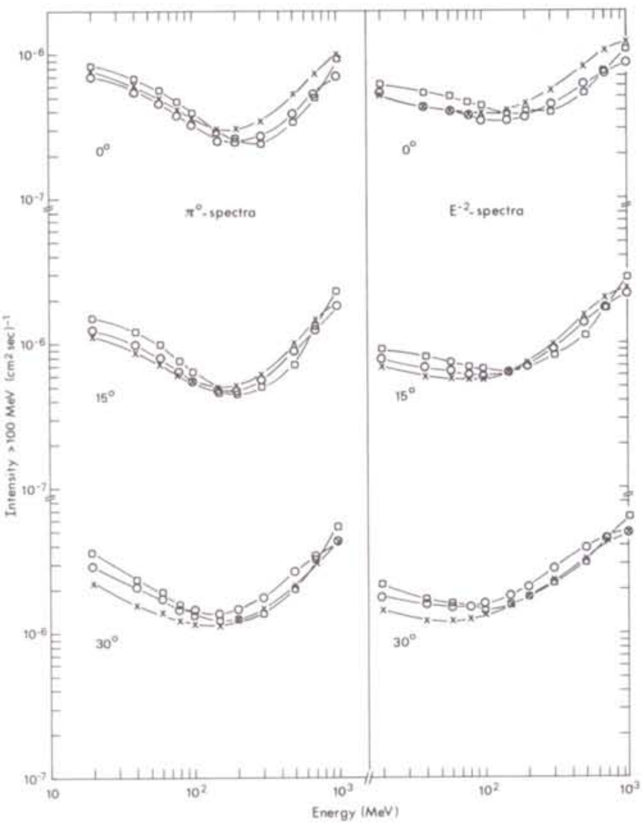


Figure 2 — Lower limit of detectable point sources of gamma radiation.

TABLE 1

The research groups of the COS-B Caravane Collaboration

Spark Chamber	SC*	Max Planck Institut für Extraterrestrische Physik, Garching-bei-München
Triggering Telescope	B1/C/B2	Space Science Department, ESTEC
Anticoincidence Counter	A	Service d'Electronique Physique, Centre d'Etudes Nucléaires de Saclay
Energy Calorimeter	E/D	Cosmic Ray Working Group, Huygens Laboratory, University of Leiden
Pulsar Synchroniser and Experiment Electronics		Istituto di Scienze Fisiche dell Università di Milano and Istituto di Fisica, Università di Palermo

* These abbreviations relate to Figure 1.

is such that the satellite can be operated at 320 bps throughout the orbit. Sufficient consumables, namely attitude-control and spark-chamber gases, are carried to support an operational lifetime in orbit in excess of two years, the spark chamber being evacuated and refilled with gas every six weeks.

INSTRUMENT CALIBRATION

The overall response of the gamma-ray experiment to photons and to charged particles was determined empirically by exposing the engineering and flight models to beams at particle accelerators. A tagged photon beam facility with energies between 20 MeV and 6 GeV was established in 1972 jointly by the COS-B Collaboration and the group at DESY in Hamburg and has been described in detail by Christ *et al.* This beam has been used subsequently by other experimenters for calibrating gamma-ray instruments. The effect of the charged-particle environment in orbit was investigated by means of proton beams set up at CERN and electron beams at DESY. Analysis of the engineering model has been completed in great detail and presently the 'calibration curves' for this model are 'folded' with the orbital data to yield the preliminary results presented below. Analysis of the flight-model calibration data is not yet complete, but the data are essentially the same as for the engineering model and these will, of course, be used for the ultimate analysis of the orbital data. The physical characteristics of the COS-B experiment have been discussed at length by Bennett *et al.* and, as an example of the results, Figure 2 gives the lower limits of point-source intensities, detectable at a 5 σ level, as a function of the energy threshold. Results are given for point sources emitting an E^{-2} spectrum and for π^{0}-decay sources in the isotropic background given by Fichtel *et al.* (derived from measurements by the pioneering SAS-II satellite) observed at 0°, 15° and 30° to the optical axis, assuming a 2×10^{6} s effective observation time.

In-orbit tests have demonstrated that the triggering rate, for the telescope mode selected, is typically 0.24 triggers per second, which is very close to that predicted by the beam calibrations. With operation throughout the orbit at 320 bps, the typical dead-time figure is 10% and, with the experiment operated for some 31 h of the 37 h orbital period, the sensitivity indicated by Figure 2 is realised with one calendar month observation of each source, as was the intention.

QUICK-LOOK DATA ANALYSIS

The orbital parameters, mainly the apogee, enable some 95% of the data transmitted when the experiment is switched on (above the radiation belts) to be recovered in real time by the

ESTRACK stations at Redu (Belgium) and Fairbanks (Alaska). Data recovered at Redu can be transmitted to ESOC in real time or 'post pass' and some 40% of this Redu data, i.e. 20% of the total, can be processed in the Fast Routine Facility (FRF) to give preliminary scientific results. The facility incorporates computer programs contributed by the COS-B Collaboration to perform:

- detector calibration from measurements on cosmic-ray protons
- spark-chamber picture analysis
- gamma-ray energy estimation
- derivation of arrival-direction distributions
- statistical summaries of scientific housekeeping data.

The end product of the FRF analysis chain is a 'sky map' giving the gamma-ray flux per unit area within the experiment field of view in selectable energy ranges. Predicted orbit and attitude data are used in the FRF. Preliminary results are thus available within a day or so of receiving the data from the ground station.

THE OBSERVATION PROGRAMME

The dates of the attitude manoeuvres and the target directions observed so far are given in Table 2, together with the intended short-term future programme. In a little more than the first year of operation, it is anticipated that COS-B will complete a survey of the galactic plane and observe one or two extragalactic objects, at the same time determining the 'isotropic' background.

Target directions in the galactic plane are chosen firstly on the basis that there is a known or potential gamma-ray emitter in that direction, and secondly on the basis of providing a uniform survey of the plane after one year of operation. The satellite will be directed to view a particular X-ray source only if compatible with these two constraints. COS-B was directed to observe known gamma sources early in its orbital life to provide better statistical information, spectra and to detect temporal variability.

PRELIMINARY RESULTS FROM THE FAST ROUTINE FACILITY

Due to 'teething' problems with the FRF system and some program 'bugs' when subjected for the first time to real orbital data, a sky-map of the Crab region was not produced in the FRF before the data were purged to make way for those of the second observation period. However, an example of results from the small X-ray detector is indicated in Figure 3, which

TABLE 2 – *The COS-B observation programme*

Start of Observation	Target	Right Ascension h m	Declination ° ′	l^{II} °	b^{II} °
17 August 1975	Crab NP-0532	05 31	+21 58	184.5	−5.8
17 September	GX5-1	17 58	−25 4	5.1	−1.0
20 October	Vela X	08 33	−45 0	263.6	−2.8
8 November	Vela X-1	09 00	−40 21	263.1	3.9
28 November	Cygnus region	20 18	+36	74	0
24 December*	Cen X-3	11 19	−60 19	292.1	0.4
23 January 1976	Cen A (NGC-5128)	13 22	−42 47	309.5	19.4
23 February	Cir X-1	15 16	−56 59	322.1	0.1
24 March**				∿16	∿0
12 April				∿26	∿0
1 May				∿45	∿0

* Foreseen continuation
** Possible extension

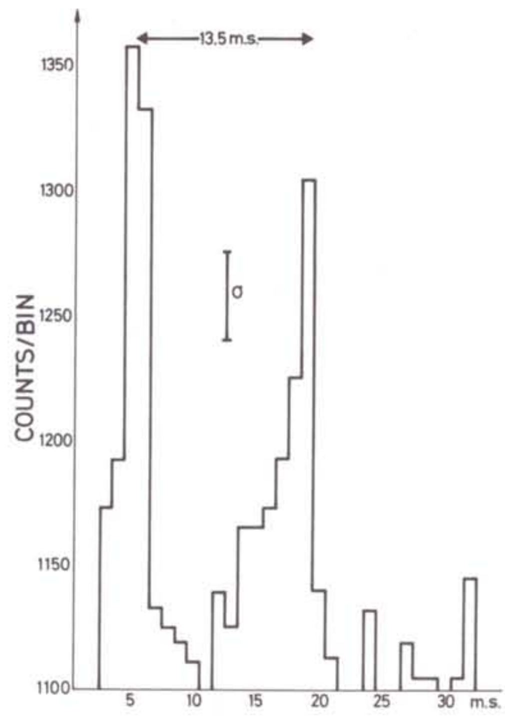


Figure 3 – Light curve of the Crab pulsar NP-0532.

shows the 'light curve' of the Crab pulsar NP-0532 at the well-known pulsar frequency. The main pulse and interpulse are clearly resolved in this particular 4×10^3 s data sample. The bin width chosen is 1 ms. X-ray arrival times are determined to an accuracy of better than 0.25 ms, and given the total observation time of 2×10^6 s the light curve and its possible long-term variation will be determined to very high precision. The result shown here is intended to demonstrate the correct operation of the instrument and the software.

The second observation target was the galactic centre region, in particular the strong X-ray emitter GX5-1. Figure 4 shows the profile of the gamma-ray emission above 100 MeV as a function of galactic latitude, summed over the longitude interval from 339° to 21° (42° total). A total of 270 gamma rays make up this histogram, the rays being positively identified by the very clear signature of the resolved positron-negatron pair in both projections of the spark chamber (class 22 events). The number of gamma-rays per bin is indicated. Statistical errors are shown for each latitude bin: it must be remembered that the data shown represent less than 20% of the total available. The vertical scale represents the gamma-ray flux in arbitrary units. The dotted histogram represents the results obtained by SAS-II, as published by Fichtel *et al.*, this being the target direction studied in the greatest depth by that instrument. The COS-B and SAS-II histograms are 'almost normalised' at the peak to show the general agreement, yet to avoid confusion by overlapping of the lines.

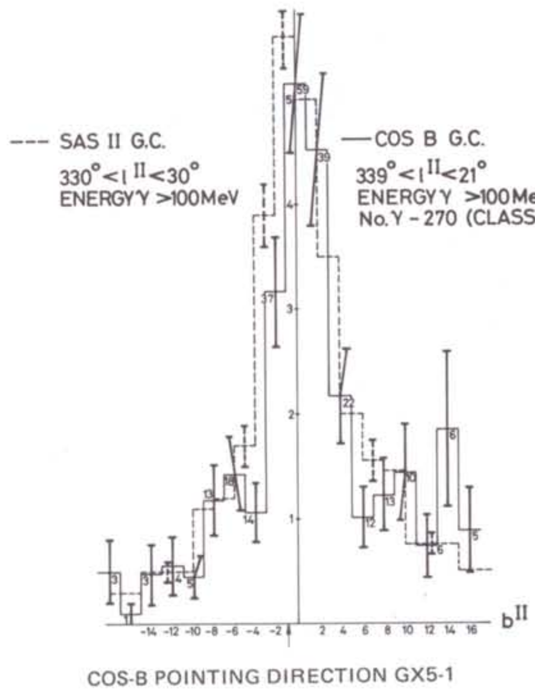
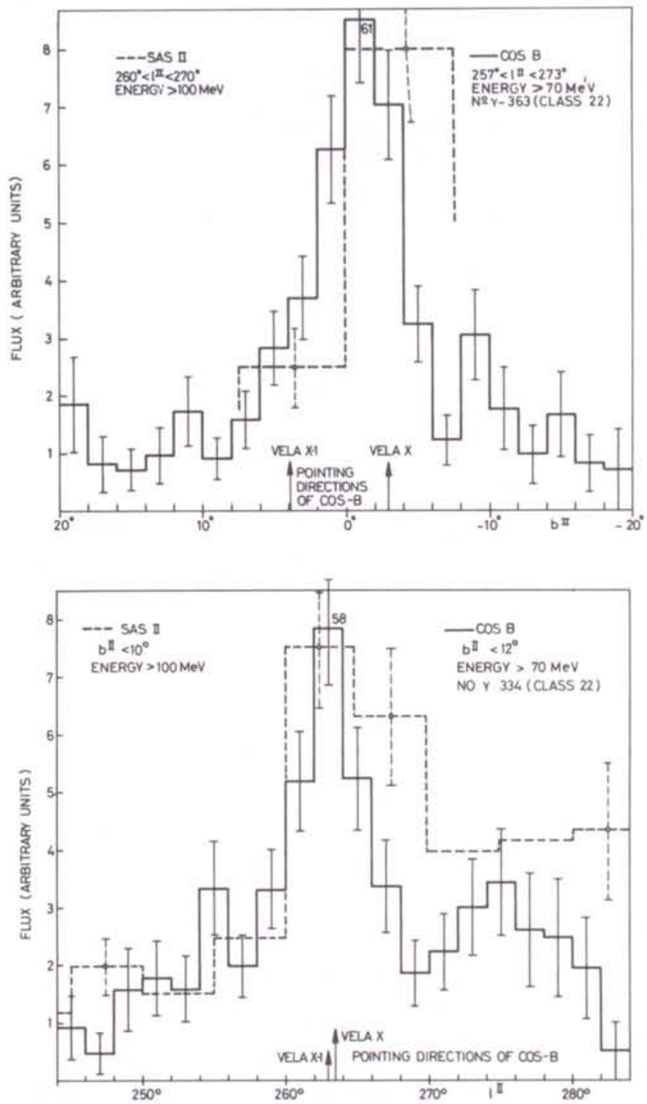


Figure 4 – Profile of gamma-ray emission from the galactic centre region.



Figures 5/6 – Profiles of gamma-ray emission from the Vela region.

The third observation period was devoted to the Vela region of the galactic plane. The payload was pointed to the Vela pulsar PSR 0833-45 for the first part of the period and to Vela X-1, an eclipsing binary, for the second. Figures 5 and 6 show the profile of gamma emission, this time for gamma energy in excess of 70 MeV, requiring a clear pair in both projections. It should be noted that these histograms for Vela result from the integration of gamma rays over the two parts of the observation period. In fact the separate histograms for the two pointing directions are identical within the statistics, showing there is no bias to the actual pointing direction and that no distortions are introduced, even though the engineering-model calibration results were used on flight-model data.

The vertical scale represents the flux in arbitrary units and the SAS-II results from Thompson *et al.* are indicated, again almost normalised at the peaks. Clearly, these preliminary COS-B data outline the structural features of this area to a significant degree even though only some 20% of the data have been utilised. No attempt was made in the FRF to extract temporal information from the Vela pulsar.

Figure 7 shows essentially the same plot as Figure 5, but in terms of counts per second for each bin, i.e. not corrected for exposure. The exposure is, however, reasonably uniform within 10° of the pointing direction. The count rate for three integral energy intervals, approximately > 100, > 200, > 1000 MeV, are shown, indicating clear evidence for the existence of gamma-ray emission from this region in excess of 1000 MeV. These data are too rudimentary to deduce a meaningful energy spectrum at this stage. The preliminary data are to be submitted for publication in Nature in the near future.

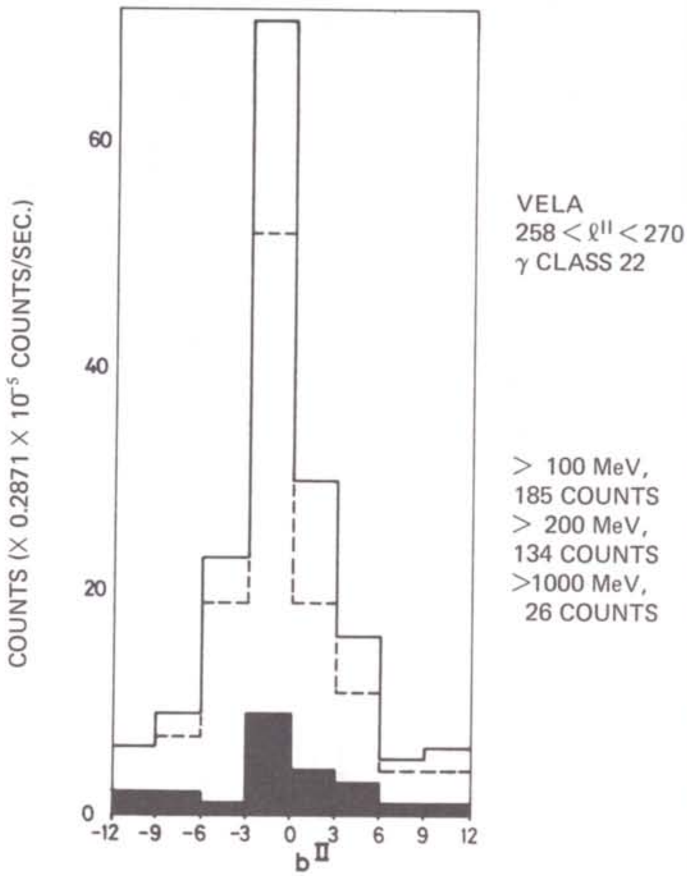


Figure 7 — Profile of emission from the Vela region in three energy intervals.

POSTSCRIPT

Data tapes containing all data from the first observation period (Crab) with actual attitude and orbit information were supplied to the collaboration by ESOC by the end of December. It is anticipated that tapes for subsequent periods will be supplied at monthly intervals.

A symposium entitled 'Recent Advances in Gamma-Ray Astronomy' is being organised, on behalf of the COS-B Caravane Collaboration, by the Space Science Department of ESA, and will be held at ESTEC, Noordwijk, in the week 25 – 29 October 1976. Results of the analysis of the COS-B data will be available from the first year of operation, at least in preliminary form. Further information can be obtained from one of the authors, Dr. B.G. Taylor, the symposium organiser.

Information concerning the COS-B observation programme has been circulated to many experimenters and astronomers in gamma-ray astronomy and related disciplines to enable correlated measurements to be undertaken. Anyone interested in further information should contact Dr. R.D. Wills, the COS-B Project Scientist.

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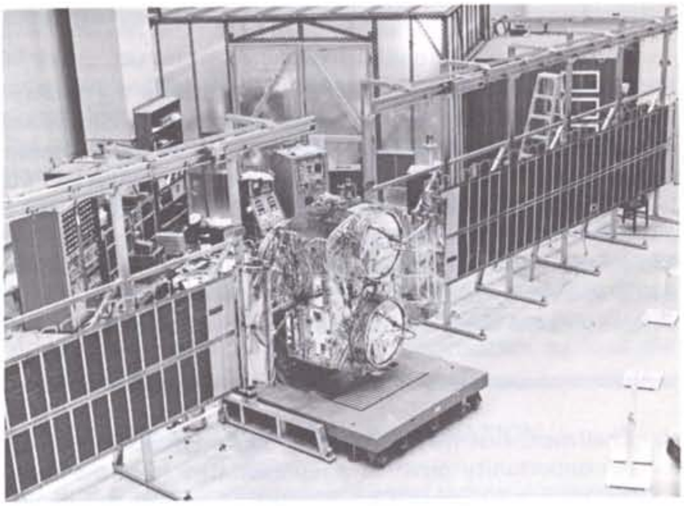
New European Technology aboard Canadian/US Communications Satellite

The Communications Technology Satellite (CTS), developed jointly by Canada and the United States, was launched into a near-nominal transfer orbit from Cape Canaveral on 17 January. It carries a number of novel hardware items developed by European industry which represent major advances in space technology.

Under a technical co-operation agreement with the Canadian Department of Communications, ESA has supplied two 20 W travelling-wave-tube amplifiers (from Thomson-CSF, France) with power supplies (from FIAR, Italy) and a special low-noise parametric amplifier (from GTE, Italy) to the CTS project, free of charge. In addition, large, lightweight solar-array blankets developed by ESA and providing a power output in excess of 1 kW have been purchased from European industry (AEG, Germany) by the Canadians.

CTS is a high-power, three-axis stabilised satellite, intended to provide experimental colour television transmissions and



sound broadcasts to small, low-cost ground terminals. It represents the first significant space application of the 12/14 GHz frequency band. ESA's interest in participating in this project is to test on-board equipment for possible use in satellites to be developed within the European Communications Satellites programme. The Agency's own experimental and pre-operational communications satellite, OTS, is due to be launched next year.

Obituary Dr. A. W. Lines

Dr. A.W. Lines, generally referred to – though not generally to his face – as 'Freddie', was one of the pioneer figures in ESRO's history. He came to ESRO in 1961 from the Royal Aircraft Establishment in Farnborough, and became the Organisation's first Technical Director. He was simultaneously Director of ESTEC and was personally involved in creating the Establishment. Dr. Lines left ESRO on 31 March 1968 and took up a senior post in the Science Research Council in London.

His death at the age of 61 will be deeply felt by the many staff members who worked with him in those formative years. They are well placed to know how great a debt the European space effort owes to Dr. Lines and to his determination and perseverance. Although many suffered the sharpness of his tongue, none will remember with anything but pride the years of common effort under his rugged direction. RG

The European Space Effort in the Light of Global European Policy

C. Layton, Directorate for Industrial and Technological Affairs, Commission of the European Communities

Mr. Christopher Layton is Director responsible for the development of policies for the data-processing, telecommunications and aerospace industries in the Commission of the European Communities. The address that follows was delivered at ESTEC last year on the occasion of the 'European Space Days', a meeting/exhibition organised by ESA with a view to providing an opportunity for representatives of the industrial and developing nations to form an accurate impression of the overall competence and capabilities of the European space effort.

Mr. Chairman, first may I thank the European Space Agency for the opportunity given to a representative from the Commission of the European Communities to address this distinguished audience; in particular Mr. Spinelli, the Commissioner responsible for Industrial and Technological Affairs, has asked me to send his best wishes and those of the Commission to the new Agency for its future work.

EEC INTEREST IN ESA'S APPLICATIONS PROGRAMMES

I believe the Commission feels very confident in the ability of the Agency, an equal partner of other world organisations, to work in sharing the benefits of space exploration and exploitation and to put its capabilities at the disposal of other regions of the world. This confidence is inspired both by the creation of the Agency, and by the realistic and wise way in which the long debate about the objectives of the European space effort has been resolved in the present programme. In the past, the interest of the European Communities in space affairs and of the Commission in particular has been modest. Since there already existed specialised European agencies implementing space programmes, there seemed no need to develop a competence within the European Community to implement space activities. The European Economic Community is, however, a major potential user of operational space systems. Our concern with space grows as space becomes a way to solve practical problems of economic importance. The fact that the European Space Agency's programme gives high priority to applications enhances its interest to the Community, as well as the need to develop a close partnership between our two organisations.

First may I say a little about the development of the Community today. In its first 15 years the Community's major achievements were the development of a customs union and an agricultural policy. But since 1972, indeed since the enlargement of the Community, more and wider themes have become a major preoccupation. We have seen the initiation of a first, and now a second, environmental programme, the introduction of a regional policy, with a budget now fixed at 1300 million Units of Account over three years; at the beginning of 1975 the Community signed the Lomé agreements with 48 countries from African, Caribbean and Pacific areas, marking a major new development in the Community's relationships with the developing world. Today the Commission and the EEC Member States are working on the preparation of further joint European policies, particularly in the fields of raw materials policy and energy. All these new dimensions mark the awareness of the Community's Member States that collaboration with a common accent is necessary in a widening range of areas in which the modern state is involved, as they work their way with pain and difficulty, but still steadily, towards the goal of economic union, indeed a 'European union' as it is called. These new dimensions due to the awareness of common need lead the Community to see a new potential as a user of the tool of space applications.

REMOTE SENSING AND DATA PROCESSING

I want to say a few words about the particular fields in which we see the Community having a real user interest in some of the areas where work is developing in the Agency here and in space activities in the world as a whole. The first area where the Community may and could become a significant user is that of remote sensing. The services of the Commission are currently exploring how best remote sensing may serve the Community. There are possible areas of application interest in agriculture, regional policy, environmental policy, resources and raw materials policy, and certainly in our whole relationship with the developing world, always provided in this last respect that the key principle of the Lomé Convention, equality between the Community and the developing countries, is respected. At present most of the information on space-borne remote sensing comes from NASA. Here the Community's interest, which is also in the interest of our data processing policy, is in the systematic collection and archiving of this information at a Community level, prior to dissemination to the different European users. In the future, if the European Space Agency were to develop a remote-sensing capability, then of course the Community might also be interested as a user.

TELECOMMUNICATIONS

A second area where the Community's larger economic interests are relevant to your activities is that of telecommunications. The Community is following with great attention the OTS, Marots and Aerosat programmes to speak only of the

Space Agency projects, which we believe pave the way for operational telecommunication systems needed in the next decade. In telecommunications, the basic forum for European collaboration hitherto has been the CEPT. And, of course, OTS is designed as an experiment which can lead on to operational satellites satisfying future CEPT requirements. The Community, however, is now taking the first steps towards a larger development of a European telecommunications policy. Our first interest is in the opening up of markets for telecommunications equipment, but we've also encouraged the telecommunications administrations to embark on a major programme of harmonisation in the field of future services and technical standards, which was decided at the April conference of the CEPT, and this could clearly lead on to a greater degree of European planning of the future electronic trunk network of telecommunications in Europe over the next 20 years, with a greater coherence and definition of European telecommunication requirements, all highly relevant to the future use and development of the European Telecommunications Satellite. In rather more detailed practical terms, we also see some interest in perhaps performing satellite data transmission tests making use of OTS in the framework of our data processing programme and in connection with the European Informatics Network. Another subject worth exploring is a network of oceanographic and meteorological measurements in European waters which could conceivably use Meteosat as a data relay system. The Commission's services are also looking carefully at the opportunities Spacelab may provide in the future to perform man-supported scientific activities in space, possibly including the development of space-borne manufacturing capabilities, like large single crystals, new alloys, pure vaccines, and so on; that is for the future but it is nonetheless relevant to the long-term capabilities of the European advanced technology industries.

INDUSTRIAL POLICY

In the area of industrial policy the European space agencies have been pioneers and Professor Lévy has elaborated widely on this theme. In the Community, following the work of the Coal and Steel Communities and Euratom, certain new beginnings have been made on policy for advanced technology industry. In July 1974 the Council of Ministers passed a resolution on data processing with two main objectives; developing collaboration within, and the development of, the European-based industry, and also developing collaboration in the field of applications of Community interest. Here ESRO has become a faithful customer of the European data processing industry, and data processing is clearly a key part of all space systems, a clear area of common interest where our two organisations can work together. In March 1975 the Council of Ministers passed a resolution calling for co-ordination of policy, indeed the development of a strategy for the European aircraft industry. Once again a clear area of common interest. The development of a powerful space industry in Europe is closely linked with the development of a strong aircraft industry, and the policies toward the structure of the industry which the Commission is considering to promote for the aircraft industry in Europe. May I say that here also you provide us with interesting models; you are creating a European Space Agency today; perhaps one day in the future we may find it necessary to create a comparable organisation to lead the European aircraft industry and its programme.

SCIENTIFIC AND TECHNICAL INFORMATION

One final theme concerns scientific and technical information, which again your Agency has pioneered in Europe. Here I'd like to say that Mr. Appleyard, our Director General responsible in this field, much regrets his inability to be here and has asked me to say a few words. In the Commission we attach great importance to the dissemination, protection and exploitation of the results of research and development, especially in the public sector and especially in those areas where the Community, Space Agency and other international organisations have a responsibility. We believe that here, at a European level, we must co-operate as closely between ourselves (that is to say between our different European organisations) as we must with the Member States. We believe in the Community that one of the first obligations on us as an international organisation, and perhaps on you here in the Agency, is to set an example, to put our own house in order. I believe that we have a lot to learn in the Commission from your Agency and ESRO in the past. We are therefore very happy in the Commission that it's been possible to prepare a concrete and mutually profitable scheme of co-operation between the European Space Agency and the European Community, in connection with our respective plans for scientific and technical information services. We in the Commission hope that all our Member States will accept this idea as enthusiastically as we do ourselves, and that our joint projects will go far to facilitate the work of many in Europe who care for science and technology in general and for space in particular.

A final word. The Community in the coming years, we hope, will make steady progress towards a European union, which means that it will develop a widening range of policies for a widening range of industries. You have been pioneers in this, and we look forward to a close partnership in our future work. □

The Accounting Unit and its Problems
L'unité de compte et ses problèmes

H. Frank, Administrative Directorate, ESA, Paris

European organisations such as ESA, which accept and disburse their funds in the many currencies of their Member States, require a pre-defined monetary or accounting unit by which to relate these different working currencies and so ensure the fast accounting in a single transaction of, for example, German Marks, French Francs and Pounds Sterling, as a matter of daily routine.

Les Organisations internationales comme l'ASE (et avant elle le CERS et le CECLES), dont les dépenses se font dans les multiples monnaies de leurs Etats membres, ont besoin d'une unité monétaire commune qui permette de rattacher ces différentes monnaies à un même étalon de valeur et d'additionner, par exemple, des francs français, des livres sterling et des marks allemands.

At the time of signature of the ESRO Convention on 14 June 1962, this monetary unit or Accounting Unit was defined in Article VI.1 of the Financial Protocol annexed to the Convention as follows:

> 'The budget of the Organisation shall be expressed in accounting units defined by 0.88867088 grams of fine gold'.

Although the Organisation, like the United Nations, OECD or CERN, could have chosen a hard currency, such as the US Dollar, as its fundamental unit, it followed the example of the European Communities in adopting an accounting unit based on gold, in order to minimise the risk of complications in the event of revaluation or devaluation of national currencies. Definition of the Accounting Unit in terms of gold had the further advantage that Accounting Units could be converted into national currencies, or vice versa, on the basis of the official par values of currencies notified by Member States to the International Monetary Fund. The financial transactions of the Organisation would therefore be unaffected by the daily fluctuations of exchange markets.

This system worked reasonably well until the end of 1971, as long as the international monetary system based on the Bretton Woods agreement of 1944 remained stable. Official changes of par value of Member State currencies were rather the exception, and between 1962 and 1971 such changes occurred only three times; in 1967 (devaluation of £, DKr and Peseta), in 1969 (devaluation of FF, revaluation of DM), and in 1971 (revaluation of SF).

Lors de la signature de la Convention du CERS, le 14 juin 1962, le Protocole financier annexé à celle-ci définissait ainsi, en son Article VI, 1, cette unité monétaire commune ou unité de compte:

> *'Le budget de l'Organisation est exprimé en unités de compte définies par un poids de 0,88867088 gramme d'or fin'.*

L'Organisation aurait pu, comme les Nations Unies, l'OCDE ou le CERN, prendre pour unité de compte une monnaie réelle, par exemple le dollar des Etats-Unis; mais elle préféra suivre l'exemple des Communautés européennes, qui avaient adopté une unité de compte basée sur l'or, afin de réduire au minimum les risques de perturbations en cas de dévaluation ou de réévaluation de monnaies nationales.

La définition de l'unité de compte par rapport à l'or présentait un autre avantage: elle permettait d'opérer la conversion des unités de compte en monnaies nationales ou vice versa sur la base des parités officielles de ces monnaies notifiées par les Etats membres au Fonds monétaire international, de sorte que les opérations financières de l'Organisation n'étaient pas affectées par les fluctuations quotidiennes des marchés des changes.

Ce système a fonctionné de façon assez satisfaisante jusqu'à la fin de 1971, c'est-à-dire aussi longtemps que le système monétaire international fondé sur les accords de Bretton Woods (1944) est demeuré stable. Les modifications officielles des parités monétaires des Etats membres ont en effet été peu fréquentes puisque, entre 1962 et 1971, trois années seulement en ont connu: 1967 (dévaluation de la livre sterling, de la couronne danoise et de la peseta), 1969 (dévaluation du franc français, réévaluation du deutsche mark) et 1971 (réévaluation du franc suisse).

UNE NOUVELLE DEFINITION PROVISOIRE

Le système des parités officielles ayant été suspendu de facto par l'accord signé en décembre 1971 au Smithsonian Institute, qui permettait à certains Etats membres d'adopter des taux centraux différents de leurs parités officielles et à d'autres Etats membres de laisser flotter leurs monnaies, il a fallu redéfinir l'unité de compte utilisée par l'Organisation. Celle-ci, après des discussions qui se déroulèrent en 1972 et 1973, adopta en 1974 une nouvelle formule dans laquelle la valeur de l'unité de compte était déterminée par rapport à une monnaie de référence, la conversion des monnaies flottantes en unités de compte s'effectuant aux taux de change moyens pratiqués sur les marchés des changes officiels pendant un mois donné.

TEMPORARY NEW DEFINITION

The *de facto* suspension of the system of official par values by the Smithsonian Agreement in December 1971 allowing some Member States to adopt central rates different from their official parities and others to let their currencies float, required a new definition of the Accounting Unit used by the Organisation. After discussions during 1972 and 1973, the Organisation finally adopted a new concept as from 1974, in which the value of the Accounting Unit was determined by its relation to one reference currency and conversion of floating currencies into Accounting Units was effected at the average exchange rate of official exchange markets during a given month. Currencies based on central rates were valued at these rates.

THE NEW EUROPEAN ACCOUNTING UNIT

The temporary ESRO-devised system was finally refined and formalised with the decision of the Agency's Council on 30 July 1975 to adopt the European Accounting Unit, established by the European Communities, as the new Accounting Unit for the Agency, from 1 January 1976. Article VI.1 of the Financial Protocol was amended as follows:

> 'The budget of the Organisation shall be expressed in Accounting Units. The value of the Accounting Unit shall be equivalent to that of the standard basket unit of account created by the decisions taken by the Council of the European Communities on 21 April 1975, unless otherwise decided in an arrangement concluded, or to be concluded, by the Organisation'.

The 'standard basket', which forms the basis of the new European Accounting Unit, includes the nine currencies of the Communities in the following 'percentage weights':

German Mark	27.3%	Belgian Franc	7.9%
French Franc	19.5%	Danish Crown	3.0%
Pound Sterling	17.5%	Irish Pound	1.5%
Italian Lira	14.0%	Luxemburg Franc	0.3%
Dutch Florin	9.0%		

The value of the basket is considered equal to the sum of the values of the nine currencies. The basket is first calculated in Belgian Francs using the Brussels exchange rates between Belgian Francs and the other basket currencies at their proportional weights. Once the relation between the Accounting Unit and the Belgian Franc has been established, the relation between the Accounting Unit and all other currencies can be determined on the basis of the exchange rates between the Belgian Franc and other currencies as quoted on their national markets.

Quant aux monnaies basées sur des taux centraux, la valeur retenue était celle correspondant à ces taux.

LA NOUVELLE UNITE DE COMPTE EUROPEENNE

Le système provisoire ainsi établi par le CERS devait être perfectionné et institutionnalisé par la décision prise le 30 juillet 1975 par le Conseil de l'Agence d'adopter à partir du 1er janvier 1976 l'unité de compte européenne créée par les Communautés européennes. L'Article VI, 1 du Protocole financier a été modifié comme suit:

> *'Le budget de l'Organisation est exprimé en unités de compte. La valeur de l'unité de compte est équivalente à celle de l'unité de compte panier-type instituée par la décision du Conseil des Communautés européennes du 21 avril 1975, sauf s'il en est autrement disposé dans un arrangement conclu ou à conclure par l'Organisation'.*

Le panier-type qui constitue la base de la nouvelle unité de compte européenne comprend les neuf monnaies des Communautés avec les pondérations suivantes:

Deutsche mark	*27,3%*
Franc français	*19,5%*
Livre sterling	*17,5%*
Lire italienne	*14,0%*
Florin néerlandais	*9,0%*
Franc belge	*7,9%*
Couronne danoise	*3,0%*
Livre irlandaise	*1,5%*
Franc luxembourgeois	*0,3%*

La valeur du panier est considérée comme égale à la somme des valeurs des neuf monnaies. On calcule d'abord le panier en francs belges en utilisant les taux de change de Bruxelles entre le franc belge et les autres monnaies du panier selon leurs pondérations respectives. Une fois établie la relation entre l'unité de compte et le franc belge, la relation entre l'unité de compte et toutes les autres monnaies peut être déterminée sur la base des taux de change entre le franc belge et les autres monnaies tels qu'ils sont cotés sur les marchés des pays considérés.

Conformément au principe adopté par l'Organisation en 1974 de fixer d'avance pour une année des taux de change stables, les taux de change entre l'unité de compte et les monnaies nationales qui seront utilisés par l'Agence en 1976 ont été calculés sur la base des taux pratiqués en juin 1975, ce qui donne le tableau suivant:

Following the principle adopted by the Organisation in 1974 of fixing stable exchange rates in advance for each coming year, the exchange rates between the Accounting Unit and the currencies to be used by the Agency for 1976 have already been calculated on the basis of national exchange rates in June 1975, as follows:

1 ESA Accounting Unit =	Belgian Francs	45.50638
	Danish Crowns	7.08200
	French Francs	5.21657
	German Marks	3.04823
	Irish Pounds	0.57122
	Italian Lire	814.75285
	Dutch Florins	3.13769
	Spanish Pesetas	72.60213
	Swedish Crowns	5.09688
	Swiss Francs	3.24651
	Pounds Sterling	0.57084
	Norwegian Crowns	6.37908
	Austrian Schillings	21.53649
	US Dollars	1.30241
	Canadian Dollars	1.33604

PROBLEMS

There are no major problems associated with the use of the European Accounting Unit in ESA, but a number of technical aspects of its implementation will require further thought and perhaps different solutions in the future. There are, for instance, the statistics on geographical distribution of contracts expressed in Accounting Units at the time contracts are awarded, which do not take into account depreciation of floating currencies over the years until the contracts have been paid off.

Another problem lies in the use of fixed exchange rates for up to 18 months after they have been determined for the comparison of bids from industry, although the relations between certain currencies may have changed considerably in the meantime. Some Member States have also raised the point that the external value of a currency as expressed by exchange rates does not necessarily reflect the currency's real purchasing power in its own country, and a system should therefore be devised to allow different valuation of a currency in terms of Accounting Units depending on whether the money is spent in the country concerned or used outside to buy other currencies. These problems are to be studied by the Agency in the course of 1976 and will possibly lead to modification of the present system, without changing the basic concept of the European Accounting Unit. □

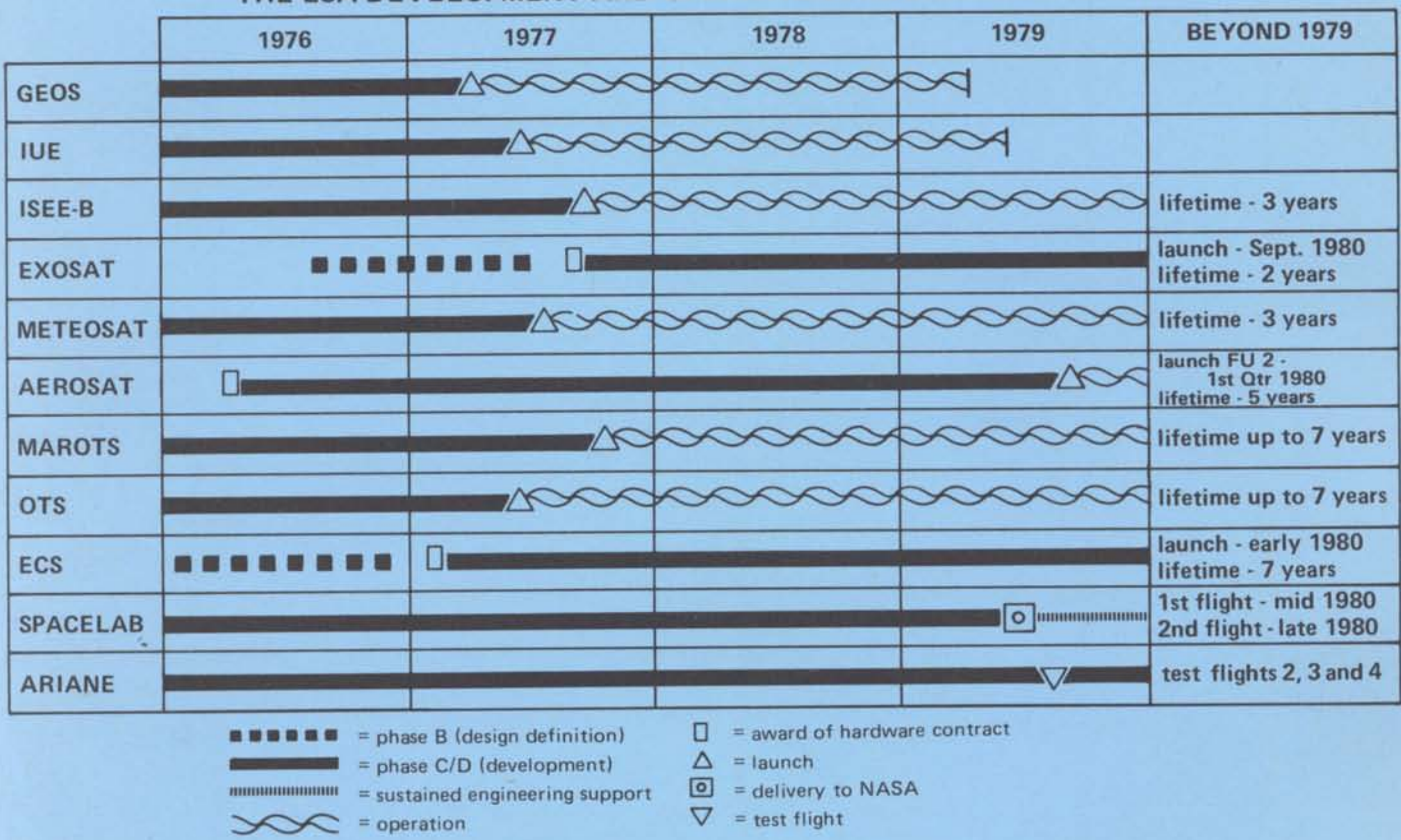
1 unité de compte =	*Franc belge*	*45,50638*
	Couronne danoise	*7,08200*
	Franc français	*5,21657*
	Deutsche mark	*3,04823*
	Livre irlandaise	*0,57122*
	Lire	*814,75285*
	Florin néerlandais	*3,13769*
	Peseta	*72,60213*
	Couronne suédoise	*5,09688*
	Franc suisse	*3,24651*
	Livre sterling	*0,57084*
	Couronne norvégienne	*6,37908*
	Schilling autrichien	*21,53649*
	Dollar des Etats-Unis	*1,30241*
	Dollar canadien	*1,33604*

PROBLEMES

L'utilisation de l'unité de compte européenne à l'ASE ne pose pas de problèmes importants, mais un certain nombre de modalités techniques d'application devront être examinées plus à fond et peut-être donner lieu, dans l'avenir, à des solutions différentes. Par exemple, les statistiques sur la répartition géographique des contrats, établies en unités de compte au moment où ceux-ci sont attribués, ne tiennent pas compte de la dépréciation que les monnaies flottantes ont subie au cours des années jusqu'au règlement final des contrats. Autre problème: pour la comparaison des soumissions présentées par les entreprises, on utilise des taux de change fixes jusqu'à 18 mois après leur détermination, alors que les relations entre certaines monnaies ont pu changer considérablement entretemps. Certains Etats membres ont également fait observer que la valeur externe d'une monnaie, telle qu'elle est exprimée par les taux de change, ne reflète pas nécessairement le pouvoir d'achat réel de cette monnaie à l'intérieur du pays, et qu'il faudrait donc concevoir un système permettant de calculer différemment la valeur d'une monnaie en unités de compte selon que les fonds sont dépensés dans le pays considéré ou utilisés à l'extérieur pour acheter d'autres monnaies. L'Agence étudiera ces problèmes en 1976, ce qui pourra conduire à modifier l'application actuelle de la formule de l'unité de compte européenne sans toucher, bien entendu, à son principe. □

Projects under Development
Projets en cours de réalisation

THE ESA DEVELOPMENT AND OPERATION PROGRAMME (as at December 1975)



GEOS

Important progress has been made and all prototype experiment units have now been qualified and integrated, the European thrusters have successfully completed a mission simulation test, and the European apogee motor has been qualified.

Scientific payload

The complete prototype payload of seven experiments has been qualified, while electromagnetic-cleanliness and some environmental-exposure tests are being performed at IABG, Ottobrunn, and at ESTEC. All seven experiments were delivered to BAC for installation and testing in the qualification model. Because of delays in delivery of the prototype electronic subsystems, correct operation of the experiments was verified by utilising hardware from the development model. Preliminary EMC tests on the ensemble have shown low noise performance. Acceptance testing of flight experiments has also been commenced.

Spacecraft

Technical progress on the spacecraft's equipment continues. The AEG solar array has been successfully qualified over a wide temperature range (−85 to +110°C) and the Fokker interconnection technique for grounding the optical solar reflectors has passed qualification tests. Antenna-pattern tests conducted at ESTEC have shown that no problems with command operation should be encountered during the critical transfer-orbit phase.

Propulsion system

The hydrazine auxiliary propulsion system has successfully completed the 'hot-fire' test in Hawker Siddeley's vacuum facility at Stevenage. The thrusters were subjected to simulated life-testing with the appropriate duty cycles, including the critical case of a hot restart. Thruster and system behaviour was excellent and it was possible to conduct operations equivalent to more than the two-year mission in only four weeks of intensive testing.

Furthermore, the first flight-standard thrusters delivered have proved to be of higher quality than the qualification model, and have very good reproducibility, indicating that a significant improvement over the earlier models has been achieved. These SEP thrusters are the first completely European hydrazine thrusters capable of developing a 14N impulse.

Apogee motor

The SNIAS-SEP apogee motor was formally qualified during the Qualification Test Review in October, when eight full-scale motors were fired (in addition to the small-scale firings used for plume heating and outgassing research). The GEOS motor is the first European solid-propellant design to achieve this status; it is not only magnetically clean, but is also the first to operate reproducibly at subzero temperatures (−10°C). Following qualification, a special trial was carried out at Colleferro, by a combined team from SNIA, Dornier and ESA, where a motor firing was initiated by commanding a spacecraft pyrotechnic control unit; this demonstrated compatibility of the on-board electronics. The firing trials have shown thrust levels consistently higher than the minimum specified, and as a result it will be possible to reduce the effective mass of the motor.

Programme management

The main development contract has been signed and agreement reached on improved acceptance conditions for low-noise electromagnetic cleanliness. After a review of subsystem schedules, following the arrival of hi-rel components, and the verification of quality, the spacecraft programme has been revised, leading to an April 1977 launch date.

Compatibility of the GEOS telecommunications and data-handling system with the NASA-STADAN stations has been confirmed by tests at Goddard Space Flight Center, with the special transportable simulator, or 'suitcase'. The simulator will now be used for spectrum checks at NASA's Madrid station, to determine whether the S-band transmission could have an impact upon the deep-space network.

At the ESA ground station in Odenwald, equipment integration is proceeding according to plan. At ESOC, the supporting computer system is operational. Good progress continues to be made with data-processing activities — the content and format of experimenter summary displays have been defined, and work is progressing on the layout and content of real-time data displays and the definition of automatic command software.

A design review for the Control Centre equipment has been held, and this is now being manufactured. When the ANS spacecraft operations come to an end in December, space will available at ESOC for the GEOS-dedicated control room.

GEOS

D'importance progrès ont été accomplis dans la réalisation du programme: tous les prototypes d'expériences ont été qualifiés et intégrés, les propulseurs européens ont subi avec succès un essai de simulation de mission et le moteur d'apogée européen a été qualifié.

Charge utile scientifique

L'ensemble du prototype de la charge utile, soit 7 expériences, a été qualifié, les essais de propreté électromagnétique (EMC) et quelques essais d'ambiance ayant été exécutés dans les installations de l'IABG, à Ottobrunn et à l'ESTEC. Toutes ces expériences ont été livrées à la BAC pour être installées et essayées dans le modèle de qualification à Filton. En raison des retards intervenus dans la livraison de sous-systèmes électroniques prototypes, le bon fonctionnement des expériences a été vérifié au moyen de matériels provenant du modèle de développement. Les essais EMC préliminaires effectués sur l'ensemble ont montré qu'il fonctionnait avec un faible bruit. Les essais de recette des modèles de vol des expériences ont débuté.

Véhicule spatial

Les travaux techniques concernant les équipments du véhicule spatial continuent de progresser. Le réseau solaire AEG a pu être qualifié sur une large plage de température allant de −85 à +110°C, et la technique d'interconnexion Fokker pour la mise à la masse des réflecteurs solaires optiques (OSR) a subi avec succès les essais de qualification. Les essais de diagramme des antennes effectués à l'ESTEC ont montré que la phase critique de l'orbite de transfert ne devrait pas présenter de problème de télécommande.

ESA ground station at Odenwald (Germany)/Station sol de l'ASE à Odenwald (Allemagne).

Système de propulsion

Le système de propulsion auxiliaire à hydrazine a passé avec succès l'essai de mise à feu dans l'enceinte sous vide de Hawker Siddeley à Stevenage. Les propulseurs ont été soumis à des essais de longévité en service simulé avec cycles de fonctionnement appropriés, et notamment le cas critique d'un redémarrage à chaud. Le comportement des propulseurs et du système a été excellent, et il a été possible, en quatre semaines d'essais intensifs, de simuler des opérations équivalant à une mission de plus de deux ans.

En outre, les premiers propulseurs aux normes de vol qui ont été livrés se sont révélés d'une qualité supérieure à celle du modèle de qualification et présentent d'excellentes propriétés de reproductibilité, ce qui montre qu'une amélioration notable a été obtenue par rapport aux modèles antérieurs. Ces propulseurs SEP sont les premiers propulseurs à hydrazine de réalisation entièrement européenne, capables de fournir une poussée de 14N.

Moteur d'apogée

La qualification officielle du moteur d'apogée SNIAS-SEP a été obtenue à la réunion d'examen des essais de qualification du mois d'octobre, huit moteurs grandeur nature ayant été mis à feu (en plus des mises à feu sur modèles réduits utilisés pour les recherches de chaleur du jet et de dégazage). Le moteur de GEOS est le premier modèle européen à ergols solides qui ait atteint ce stade; non seulement il est magnétiquement propre, mais en plus il est le premier à fonctionner de façon reproductible à des températures inférieures à 0 (−10°C). A la suite de la qualification, des essais spéciaux ont été effectués à Colleferro par une équipe mixte de la SNIA, de Dornier et de l'ASE; au cours de ces essais, une mise à feu du moteur a été déclenchée par commande d'un dispositif pyrotechnique du véhicule spatial et a permis de démontrer la compatibilité de l'électronique de bord. Les essais de mise à feu ont fait apparaître un niveau de poussée notablement supérieur au minimum spécifié, si bien qu'il sera possible de diminuer la masse totale du moteur.

Gestion du programme

Le contrat principal de développement a été signé dans sa version définitive et un accord conclu sur une amélioration des conditions de recette en matière de propreté électromagnétique à faible niveau de bruit. A la suite d'un réexamen des calendriers des sous-systèmes résultant de l'arrivée effective des composants haute fiabilité et de la vérification de la qualité, le programme du véhicule spatial a été révisé, la date de lancement étant désormais fixée à avril 1977.

La compatibilité des télécommunications et du système de gestion des données de GEOS avec les stations STADAN de la NASA a pu être démontrée au cours d'essais menés au Goddard Space Flight Center, utilisant le simulateur transportable spécial dit 'simulateur valise'. La prochaine utilisation de ce simulateur portera sur des vérifications du spectre à la station NASA de Madrid afin de déterminer si les transmissions en bande S auraient des incidences éventuelles sur le Réseau pour l'espace lointain.

A la station au sol de l'ASE de l'Odenwald, l'intégration du matériel se poursuit conformément aux prévisions. Le système calcul de soutien de l'ESOC est opérationnel. Les activités de traitement des données se poursuivent dans de bonnes conditions — contenu et format des affichages simplifiés pour expérimentateurs sont définis — et le travail se poursuit sur l'agencement et le contenu des affichages en temps réel ainsi que sur la définition du logiciel de commande automatique.

L'équipement du Centre de contrôle a fait l'objet d'une réunion d'examen de conception et est désormais en cours de fabrication. Après achèvement des opérations ANS en décembre, on disposera à l'ESOC de la place nécessaire pour réaliser la salle de contrôle spécialisée de GEOS.

IUE

Solar array

The series of tests on the prototype solar array has continued successfully. After completing 50 thermal-cycling tests under Sun-simulation conditions at ESTEC's facilities, one of the array paddles has been returned to Goddard Space Slight Center, where it will be subjected to the final series of vibration and deployment tests, together with the engineering model of the spacecraft.

The Final Design Review for the solar array has been carried out at SNIAS. The review team, which included representatives from NASA, the UK Science Research Council and ESA, accepted the design concept presented and praised the contractor (SNIAS) for the high quality of their work.

Manufacture of the flight-unit array and spares is almost complete and the array will now undergo testing at SNIAS prior to its delivery to ESTEC, planned for February 1976.

Ground system

Construction work on the IUE building at Villafranca is continuing on schedule. The outer structure has now been completed and work is proceeding on the building's interior. The acceptance date for the building has been set for March 1976.

The S-band antenna has been completely assembled at the Villafranca site and antenna radiation measurements are now in progress.

In October, the AFC authorised the placing of a contract for ground-station integration with Plessey Radar (UK). The Agency and Plessey are now in the final stages of technical discussions and the contract is expected to be signed soon. The contractor will be responsible for supplying a large quantity of equipment, for telemetry command, monitor and control, timing etc., and for integrating it with other equipment supplied under separate ESA contracts (e.g. computer, S-band antenna). This work will continue throughout 1976 and early 1977.

IUE

Réseau solaire

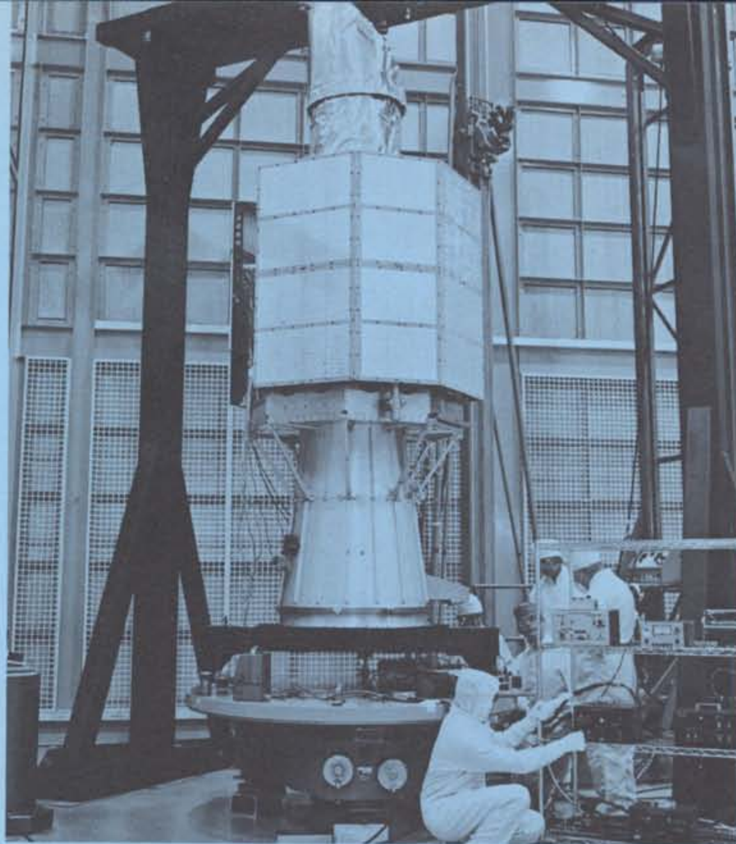
La série d'essais effectués sur le prototype de réseau solaire s'est poursuivie avec succès. Après avoir subi à l'ESTEC 50 essais de cycle thermique dans des conditions simulant le rayonnement solaire, l'un des panneaux du réseau a été retourné au Goddard Space Flight Center où il sera soumis à la série finale d'essais de vibrations et de déploiement en même temps que le modèle d'identification du véhicule spatial.

L'examen final de la conception du réseau solaire a été effectué avec succès à la SNIAS. L'équipe d'examen, qui comptait des représentants de la NASA, du SRC (Conseil de la Recherche Scientifique britannique) et de l'ASE, a approuvé la conception présentée et a félicité la SNIAS pour la qualité de son travail.

La fabrication du réseau de l'unité de vol et des rechanges est pratiquement terminée. Le réseau de l'unité de vol va maintenent être soumis à des essais à la SNIAS avant d'être livré à l'ESTEC, en principe en février 1976.

Système de vol

La construction du bâtiment de l'IUE à Villafranca se poursuit dans les délais. La structure est maintenant terminée et les travaux intérieurs progressent. La recette du bâtiment est prévue pour mars 1976.



Engineering model of IUE spacecraft with solar array in position during optical alignment check/Modèle l'identification d'IUE équipé du réseau solaire au cours d'une vérification d'alignement optique.

L'assemblage complet de l'antenne en bande S a été effectué sur le site de Villafranca et l'on procède actuellement aux mesures du rayonnement de l'antenne.

En octobre, l'AFC a autorisé la passation avec Plessey Radar (R-U) d'un contrat pour l'intégration de la station sol. L'Agence achève actuellement de mettre au point les questions techniques avec Plessey et le contrat doit en principe être signé prochainement. Le contractant sera chargé de fournir un important volume d'équipements, tels que les moyens de commande, de surveillance et de contrôle de la télémesure, de synchronisation, etc. et de les intégrer avec d'autres équipements fournis par l'Agence au titre de contrats distincts (par exemple: calculateur, antenne en bande S). Ces travaux se poursuivront pendant toute l'année 1976 et les premiers mois de 1977.

ISEE

During the last few weeks, the ISEE-B programme has moved from a mainly design phase into a hardware phase. In particular, the structural model of the spacecraft, upon which the major part of the mechanical qualification of the satellite is to be carried out, has been completely integrated with mass models of the various electrical subsystems. It is in the process of being qualified and has already successfully concluded its acceleration tests and some of the vibration tests.

A mechanical problem has been encountered and solved in the last two months. A buckling of the hinge booms was observed when they were prestressed sufficiently for the predicted launch environment. The solution, which has been introduced without slippage of the overall programme, has been to incorporate stiffening webs into the interior of the booms in the area affected. These changes are included in the structural model currently under test.

Development and production of the various subsystems for the integration model continues generally on schedule, although two (power and telecommunications) are still showing some delay with respect to their target dates. Active co-operative measures are being evolved at technical and managerial level to correct the situation.

On the ISEE-A spacecraft and on the experiment side, progress is also generally satisfactory. A visit has been made to NASA's Goddard Space Flight Center and to the US experimenters during which schedules and interfaces were thoroughly reviewed. The only potentially serious problem is the reliability and delivery of CMOS components. These items, which are widely used in space experiments because of their low power consumption, have been found to have a low resistance to radiation such as will be encountered during the ISEE mission and, additionally, there are some production problems with corrosion of leads. Both of these problems are under active study and it is hoped that the possible inherent delivery delays can be avoided.

With the exception of the last point, the project is continuing on schedule for a launch in October 1977, as planned.

ISEE

Au cours des dernières semaines, le programme ISEE-B est passé d'une phase essentiellement conceptuelle à une phase de réalisation des matériels. En particulier, le modèle structurel du véhicule spatial, sur lequel s'effectuera la majeure partie de la qualification mécanique du satellite, a été complètement intégré avec les modèles de masse des différents sous-systèmes électriques. Ce modèle structurel est en cours de qualification et a déjà subi avec succès ses essais d'accélération ainsi qu'une partie des essais de vibration.

Un problème mécanique s'est posé et a été résolu au cours des deux derniers mois. On a observé un flambage des bras articulés au cours de l'essai de compression, lorsque l'effort a atteint la valeur correspondant aux conditions de lancement prévues. La solution retenue, qui n'a pas entraîné de retard pour l'ensemble du programme, a consisté à introduire des raidisseurs à l'intérieur des bras dans la région intéressée. Ces modifications sont incluses dans le modèle structurel en cours d'essais.

Le développement et la production des divers sous-systèmes destinés au modèle d'intégration se poursuivent dans l'ensemble comme prévu, sauf pour deux d'entre eux (puissance et télécommunications) qui ont encore du retard par rapport aux dates voulues. Des mesures énergiques sont actuellement mises au point en coopération entre les services techniques et la Direction pour redresser la situation.

En ce qui concerne le véhicule spatial ISEE-A et les expériences, les travaux *progressent dans l'ensemble de façon satisfaisante. Une visite faite au GSFC de la NASA et chez les expérimentateurs américains a permis d'examiner soigneusement les calendriers et les interfaces. Les seuls problèmes sérieux qui puissent éventuellement se poser sont celui de la fiabilité des composants C-MOS et celui de leur livraison. Il s'est révélé que ces composants, qui sont largement utilisés dans les expériences spatiales du fait de leur faible consommation d'énergie, résistent mal aux rayonnements tels que ceux que rencontrera la mission ISEE; leur production pose d'autre part des problèmes de corrosion des conducteurs. Ces difficultés sont activement étudiées et l'on espère pouvoir rattraper les éventuels retards de livraison.*

A l'exception de ce dernier point, le projet continue à se dérouler dans de bonnes conditions et le lancement reste prévu pour octobre 1977.

EXOSAT

Study work so far co-ordinated and supervised by the System Studies Division has been compiled in the form of a preliminary technical baseline description, comprising requirement specifications, preferred baseline solutions, and draft work statements. Following appointment of a Project Manager, working groups have been set up with the aim of reviewing and analysing the current state of preparation, and organising the documentation required for the invitation to tender for satellite development. Bearing in mind that the contract for Phase C/D is to be finalised at the end of the project definition phase (Phase B), the utmost care must be taken in defining requirements in all areas of project implementation. Provided preparatory work continues as planned, the invitation to tender will be issued to industry by the end of February 1976.

Scientific experiment

Definition and development of the Exosat payload has continued satisfactorily, both in industry and at the institutes of the experimenters.

Industry's task includes provision of the scientific model of the low-energy image telescope, including development of the X-ray optics, in beryllium and in replication technologies, the position-sensitive detector and its associated electronics. The contract for the detectors for the medium-energy experiment will be placed in January 1976. Work on the electronics is proceeding.

At the experimenters' institutes and at ESTEC, studies on other payload elements, including the channel-multiplier array, the gas-supply system for the proportional counters, and the transmission gratings and filters, are continuing.

Mission implementation

ESOC participated in the review of current technical baseline documentation and has assisted with definition of the system configuration (ground network) and with mission analysis work. The present concept for the satellite and its mission is fully compatible with the constraints imposed by the use of the Delta 2914 launcher.

EXOSAT

Les études coordonnées et supervisées jusqu'ici par la Division Etudes de systèmes ont été regroupées sous forme d'une description technique préliminaire de référence comprenant les spécifications des besoins, les solutions de référence préférées et des projets de descriptifs des travaux. La nomination du Chef de projet a été suivie par la création de groupes de travail chargés d'examiner et d'analyser en commun l'état de préparation actuel et de décider comment sera organisée la documentation nécessaire pour l'invitation à soumissionner pour le développement du satellite. Etant donné que le contrat de la phase C/D doit être mis au point à la fin de la phase de définition du projet (phase B), on apporte le plus grand soin à la définition des besoins à satisfaire dans tous les domaines au cours de l'exécution du projet. Si les travaux préparatoires continuent à progresser comme prévu, l'invitation à soumissionner sera envoyée aux firmes industrielles pour la fin de février 1976.

Expérience scientifique

Les activités concernant la définition et la réalisation de la charge utile d'Exosat se sont poursuivies de façon satisfaisante dans l'industrie comme dans les instituts des expérimentateurs.

Les travaux effectués dans l'industrie comprennent la fourniture du modèle scientifique du télescope de prise d'images à faible énergie, ainsi que la mise au point du système optique à rayons X, en technologie 'béryllium' et en technologie 'réplication', du détecteur de position et de l'électronique associée à celui-ci. Le contrat pour la fourniture des détecteurs de l'expérience à moyenne énergie sera passé en janvier 1976. Les travaux concernant l'électronique se poursuivent.

Les instituts des expérimentateurs et l'ESTEC continuent à étudier les autres éléments de la charge utile, notamment le réseau de multiplicateurs de canaux, le système d'alimentation en gaz des compteurs proportionnels, et les réseaux et filtres du système de transmission.

Exécution de la mission

L'ESOC a participé à l'examen de la documentation technique de référence *sous sa forme actuelle et prêté son concours pour la définition de la configuration du système (réseau terrestre) et pour l'analyse de la mission. La conception actuellement retenue en ce qui concerne le satellite et sa mission est entièrement compatible avec les contraintes imposées par le lanceur Delta 2914.*

METEOSAT

Space segment

Owing to late delivery of some subsystems, integration of the satellite engineering model (P1) had to be slowed down somewhat, and this will result in a delay in the Development Results Review (DRR), to be held at the end of the essential P1 tests and required as input for prototype (P2) integration. If the nominal dates for delivery of the flight hardware (F1) are met, which is still feasible at present, the above P1/P2 slippage could be absorbed by a greater overlap between P2 and F1 activities.

Development of the radiometer channel-3 package is continuing on schedule and engineering-model tests conducted to date have been very satisfactory.

Ground segment

The Data Acquisition Telecommand and Tracking Station (DATTS) antenna has been installed at Odenwald and is now undergoing acceptance testing. In spite of some delays in the delivery of the receivers, it is expected that station integration will be completed in July 1976, in time for the space/ground compatibility tests which are scheduled to start during the second half of 1976. The Data Collection Platform (DCP) breadboard tests have been successfully completed. The specifications for the Primary and Secondary Users' Stations (PDUS/SDUS) are being revised and it is planned to issue the call for tender in December 1975.

One of the two ICL computers has been installed and is presently being tested. The ICL operating software is still causing some concern, particularly with respect to its interface with the SESA software development, which is a critical-path aspect of the ground-segment planning.

Operations

Work has started on setting up the Meteosat Operations Division at ESOC, reporting to the Meteorological Programme Office in Toulouse. A per interim Project Manager for Meteosat Operations has been nominated by the Director General.

Subject to expected progress in the finalisation and signing of the Meteosat Protocol, it is planned to start recruitment for Meteosat Operations Division in mid-1976.

METEOSAT

Secteur spatial

En raison de la livraison tardive de certains sous-systèmes, l'intégration du modèle d'identification du satellite (P1) a dû être quelque peu ralentie, ce qui entraînera un retard de l'examen des résultats du développement (DRR) qui aura lieu à la fin des principaux essais du modèle P1 et dont les conclusions doivent être utilisées pour l'intégration du prototype (P2). Si les dates nominales de livraison du matériel de vol (F1) sont respectées — ce que l'analyse actuelle permet d'espérer —, il serait possible de résorber le glissement des modèles P1/P2 mentionné ci-dessus grâce à un chevauchement plus marqué des activités P2 et F1.

Le développement du bloc du troisième canal du radiomètre se poursuit comme prévu et les essais effectués jusqu'ici sur le modèle d'identification ont été très satisfaisants.

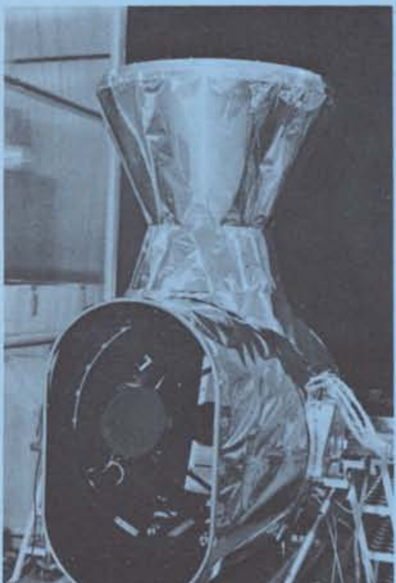
Secteur terrien

L'antenne de la DATTS (Station d'acquisition des données, de télécommande et de poursuite) a été installée dans l'Odenwald et est actuellement soumise à des essais de recette. En dépit de certains retards dans la livraison des récepteurs, en espère que l'intégration de la DATTS sera achevée en juillet 1976, c'est-à-dire en temps voulu pour les essais de compatibilité des secteurs spatial et terrien qui doivent commencer dans la seconde moitié de 1976. Les essais du modèle sur table de la DCP (Plate-forme de collecte de données) se sont achevés avec succès. Les spécifications des PDUS/SDUS (Stations primaire et secondaire d'utilisation des données) sont en cours de révision. On prévoit que l'appel d'offres sera lancé en décembre 1975.

L'un des deux calculateurs ICL a été installé et est actuellement en cours d'essai. Le logiciel d'exploitation ICL pose encore quelques problèmes, notamment en ce qui concerne son interface avec le développement du logiciel SESA qui est sur le chemin critique du planning du secteur terrien.

Opérations

On a commencé à constituer, à l'ESOC, la Division 'Opérations Météosat' (MOD) qui relèvera du Bureau du Programme météorologique (MPO) à Toulouse. Le Directeur général a désigné, à titre intérimaire, un Chef du Projet pour les Opérations Météosat. Si la mise au point définitive et la signature du protocole Météosat se déroulent conformément aux plans, on prévoit de commencer à recruter du personnel pour la MOD à la mi-1976.



Engineering model of Meteosat radiometer/Modèle d'identification du radiomètre Météosat.

SPACELAB

Industrial work

The main development contract for Spacelab was signed on 30 September 1975 by Mr. B. Deloffre, ESA Director of the Spacelab Programme and Mr. Klapwijk, President of VFW-Fokker. The contract covers the industrial work up to the second launch in 1980 of the Spacelab flight unit, which is scheduled to be delivered to NASA in 1979. Work under the contract will be done partly on a fixed-price basis (approximately 35% of the work), partly on a cost-reimbursement basis with an award-fee provision (65% of the work). The Agency's limit of liability has been established as approximately 191 MAU, at April 1974 price levels. A cost/profit-sharing arrangement has been agreed between the Agency and the contractor.

The contractor team charged with the development of Spacelab is comprised of the following industrial companies:

VFW - Fokker/ERNO (Germany)	: prime contractor, overall project direction
AEG (Germany)	: electrical power distribution
Aeritalia (Italy)	: module structure and thermal control
Bell Telephone Manufacturing (Belgium)	: electrical ground-support equipment
INTA (Spain)	: mechanical ground-support equipment
Fokker (Netherlands)	: airlock design
Hawker Siddeley Dynamics (United Kingdom)	: pallet structure
Dornier System (Germany)	: environmental control
Matra (France)	: command and data management
SABCA (Belgium)	: film vault, utility bridge
Kampsax (Denmark)	: computer software

Management

In preparation for European participation in the joint ESA/NASA payload on the first Spacelab flight, ESA's Spacelab payload activities have been divided into two distinct phases. Planning activities are the responsibility of the Director of Future Programmes and Planning. The second, 'realisation' phase, which will start after the payload elements have been chosen, falls under the responsibility of the Director of the Spacelab Programme.

A group with the acronym SPICE (Spacelab Payload Integration and Co-ordination in Europe) has been established. Its responsibilities are to co-ordinate payload development and payload integration activities in Europe, to prepare interface specifications, to approve integration-related test-compatibility and safety aspects of European payloads, to monitor schedules, to maintain a technical competence for problem solving, and to co-ordinate European payload-specialist training programmes.

Pending a final decision by Council, the SPICE group will be located at DFVLR's Porz-Wahn facility, from where it will establish interfaces with all Spacelab and payload-related organisations within Europe, and with NASA, at management level, through a joint NASA/ESA payload accommodation team.

Design review

The next major milestone in the Spacelab development programme will be the Preliminary Design Review, presently foreseen for May 1976, during which the space laboratory's design will be frozen to a large extent. In preparation for this review, the Agency is currently conducting design reviews for each subsystem with the prime and co-contractors, reviews in which NASA personnel are also participating.

SPACELAB

Travaux industriels

Signé le 30 septembre 1975 par M. Klapwijk, Président de la société VFW-Fokker, et par M.B. Deloffre, Directeur du Programme Spacelab à l'Agence spatiale européenne, le contrat principal de développement du Spacelab couvre les travaux industriels à exécuter jusqu'au second lancement de l'unité de vol du Spacelab, qui aura lieu en 1980. La livraison de l'unité de vol à la NASA est prévue pour 1979. Les travaux exécutés au titre du contrat seront rémunérés en partie sur une base forfaitaire (environ 35% des travaux) et en partie sur la base des dépenses contrôlées avec intéressement (65% des travaux). La limite de responsabilité de l'Agence a été fixée à environ 191 MUC au niveau des prix d'avril 1974. Un arrangement sur le partage des dépenses et des profits est intervenu entre l'Agence et le contractant. Le groupe chargé du développement du Spacelab comprend les sociétés suivantes:

VFW-Fokker/ERNO (Allemagne)	:	*contractant principal, direction de l'ensemble du projet*
AEG (Allemagne)	:	*distribution électrique*
Aeritalia (Italie)	:	*structure des modules et régulation thermique*
Bell Telephone Manufacturing (Belgique)	:	*equipement électrique de soutien au sol*
INTA (Espagne)	:	*equipment mécanique de soutien au sol*
Fokker (Pays-Bas)	:	*conception du sas pneumatique*
Hawker Siddeley Dynamics (Royaume-Uni)	:	*structure de la plate-forme porte-instruments*
Dornier System (Allemagne)	:	*régulation d'ambiance*
Matra (France)	:	*télécommande et gestion des données*
SABCA (Belgique)	:	*chambre à films, sous-ensemble de servitudes*
Kampsax (Danemark)	:	*logiciel de calculateur*

Gestion

Pour préparer la participation de l'Europe à la charge utile ASE/NASA que le Spacelab emportera à son premier vol, l'Agence a pris certaines décisions en matière de gestion. Les activités concernant la charge utile du Spacelab ont été réparties en deux phases distinctes: le planning *et la* réalisation. *Les activités de planning sont placées sous la responsabilité du Directeur des Programmes futurs et des Plans. La seconde phase, qui débute après la sélection des éléments de la charge utile, relève du Directeur du Programme Spacelab.*

Un groupe désigné sous le nom de SPICE (Intégration et coordination en Europe des charges utiles du Spacelab) a été créé en vue des tâches d'exécution. Ce groupe est chargé de coordonner les activités de développement et d'intégration des charges utiles qui ont lieu en Europe, de préparer les spécifications d'interface, de s'assurer que les expériences européennes sont compatibles avec les procédures d'essais et satisfont aux conditions de sécurité requises pour leur intégration dans les charges utiles, de surveiller l'observation des calendriers, de maintenir la compétence technique nécessaire pour la solution des problèmes et de coordonner les programmes de formation des spécialistes européens des charges utiles.

En attendant la décision finale du Conseil, le groupe SPICE sera installé au Centre de la DFVLR à Porz-Wahn. Il établira des liaisons avec tous les organismes européens participant à la réalisation du Spacelab et des charges utiles, ainsi qu'avec la NASA, au niveau de la gestion, par l'intermédiaire de l'équipe NASA/ASE responsable de l'agencement des charges utiles.

Examen de la conception

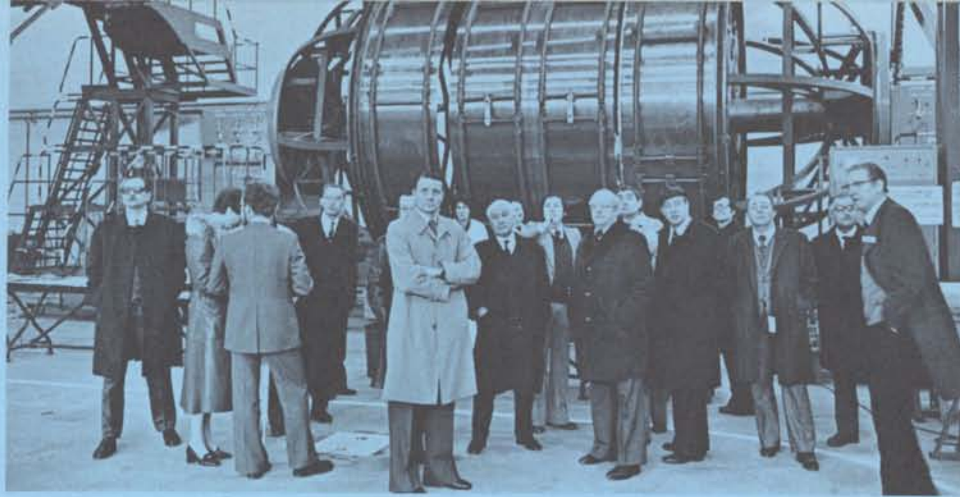
La prochaine grande étape du développement du Spacelab sera l'examen préliminaire de la conception, actuellement prévu pour mai 1976, où la conception du Spacelab sera, dans une large mesure, définitivement arrêtée. Pour préparer cet exercice, l'Agence procède actuellement, avec le contractant principal et les co-contractants, à des examens de la conception de chacun des sous-systèmes. Des membres du personnel de la NASA y participent également.

ARIANE

VISIT TO THE ARIANE FACILITIES AT LES MUREAUX AND VERNON BY DELEGATIONS TO THE ARIANE LAUNCHER PROGRAMME BOARD

On 9 December 1975, the delegations to the Ariane Launcher Programme Board visited the main facilities set up at Les Mureaux and Vernon under the Ariane programme.

SNIAS (Les Mureaux) is responsible both for launcher integration (as industrial architect) and for developing the structures of the three stages and the fairing and integrating them. To this end, SNIAS is setting up the Launcher Integration Site (Site d'Intégration Lanceur – SIL), the buildings of which are complete and which is being fitted out according to schedule. The first operation to be carried out at the site will be the integration of the various stages intended for the dynamic mock-up of the launcher, on which tests will start in mid-1976.



Visitors to Les Mureaux, with the L140 first-stage tank in the background/Les visiteurs aux Mureaux, devant le réservoir du premier étage L140.

The visitors were also able to see the construction of the first-stage tank; three tanks have now been completed and two others are being manufactured.

SEP (Vernon) is responsible for developing and manufacturing the propulsion systems for the three stages. At Vernon, the visitors witnessed an 80 s firing of a Viking-II engine on test-stand PF2. In addition, they were able to note progress on the cryogenic test-stands PF41, 42 and 43, intended for the development and qualification of the third-stage propulsion system. Test-stand PF41 (intended for turbo-pump and engine tests) and the control room are practically complete, PF41 being due to enter service in March 1976. The visitors also saw test-stand PF20, which is primarily intended for firing the complete first stage. After the installation and qualification of the control and measurement facilities, scheduled for Spring 1976, the first cluster firing (thrust frame equipped with four Viking-II engines) will take place there early in September 1976. It should be recalled that the tests on the propulsion system of the second stage L33 (engines and stage) will be carried out by DFVLR at Lampoldshausen in Germany. They will start in April 1976.

APEX PROGRAMME

Proposals received up to 2 December 1975 for the APEX Programme (Ariane Passenger EXperiments) cover 71 experiments, the breakdown of which is shown in the table below. The number may be increased by proposals from Delegations for extending current programmes (e.g. Meteosat or OTS), in response to suggestions by ESA.

On the other hand, a reduction in the initial number of suggested experiments must be expected, mainly for financial reasons. It is not proposed to discuss the proposals in detail, but simply to make the following general remarks.

Germany

The basic concept is to fly an MBB structure equipped with subsystems (developed or under development) prefiguring the heavy platforms — such as might be launched by Ariane — of the future three-axis stabilised geostationary satellites. Germany would like to add a propulsion system for orbital circularisation.

France

CNES: Several objectives, both scientific and technological. With regard to the platform, CNES envisages a satellite derived from OTS in order to demonstrate Ariane's capacity for launching a three-axis stabilised geostationary satellite.

SNIAS: Main objective: promotion of its geosynchronous platform structure suitable in size for Ariane, which is still to be equipped with its subsystems.

SEP: Propulsion.

Aim common to Germany and France

Low-power propulsion systems (electric propulsion) and the liquid or dry propellant systems required for circularising the transfer orbit, which are generally associated with the payload. Such systems can be supplied by European industry. The choice of the system to be flown will depend on ESA policy in this matter, due to be defined during the first half of 1976.

APEX experiment proposals as at 2 December 1975

State		Applications	Technological		Scientific		*Total per State*
		Self-contained	Self-contained	Non-self-contained	Self-contained	Non-self-contained	
Germany		–	1*	21	–	4	26
France	CNES	–	2	17	1	12	39
	SEP	–	–	3	–	–	
	SNIAS	–	1*	3	–	–	
Switzerland (Bern University)		–	–	–	1**	–	1
Austria		–	–	–	–	1	1
India		1	–	1	–	1	3
Radio amateurs		1	–	–	–	–	1
Total		2	4	45	2	18	71

* Ariane-type platform. These experiments are listed as selfcontained on the assumption that they will be equipped with the necessary subassemblies, which is yet to be confirmed.

** Suggestion of flying the GEOS prototype.

India

Aim: telecommunications for national use. The proposed selfcontained satellite system (150 kg) is compatible with the INSAT project (Indian National Satellite system for TV and Telecommunication). A scientific experiment is also foreseen.

Radio amateurs

The proposed selfcontained satellite (68 kg) is the eighth in the 'OSCAR' series, of which seven have already been launched. Aim: public service for amateurs plus a scientific aspect: introduction of multiple access to the repeater (which would increase the capacity fourfold). Ideal final orbit: polar elliptical, with 8 to 12 h periodicity.

ARIANE

VISITE DES INSTALLATIONS ARIANE AUX MUREAUX ET A VERNON PAR LES DELEGATIONS DU CONSEIL DIRECTEUR DU PROGRAMME ARIANE

Le 9 décembre 1975, les délégations du Conseil directeur du programme Ariane ont visité les principales installations réalisées aux Mureaux et à Vernon au titre du programme Ariane.

La SNIAS (Les Mureaux) est responsable d'une part de l'intégration du lanceur (Architecte industriel) et d'autre part de la réalisation des structures et de l'intégration des trois étages et de la coiffe. A ces fins, la SNIAS fait réaliser le site d'intégration du lanceur (SIL), dont le gros oeuvre est terminé et l'équipement en voie d'installation suivant le calendrier prévu. La première opération qui sera effectuée au SIL concerne l'intégration des différents étages destinés à la maquette dynamique du lanceur dont l'essai commencera à la mi-76.

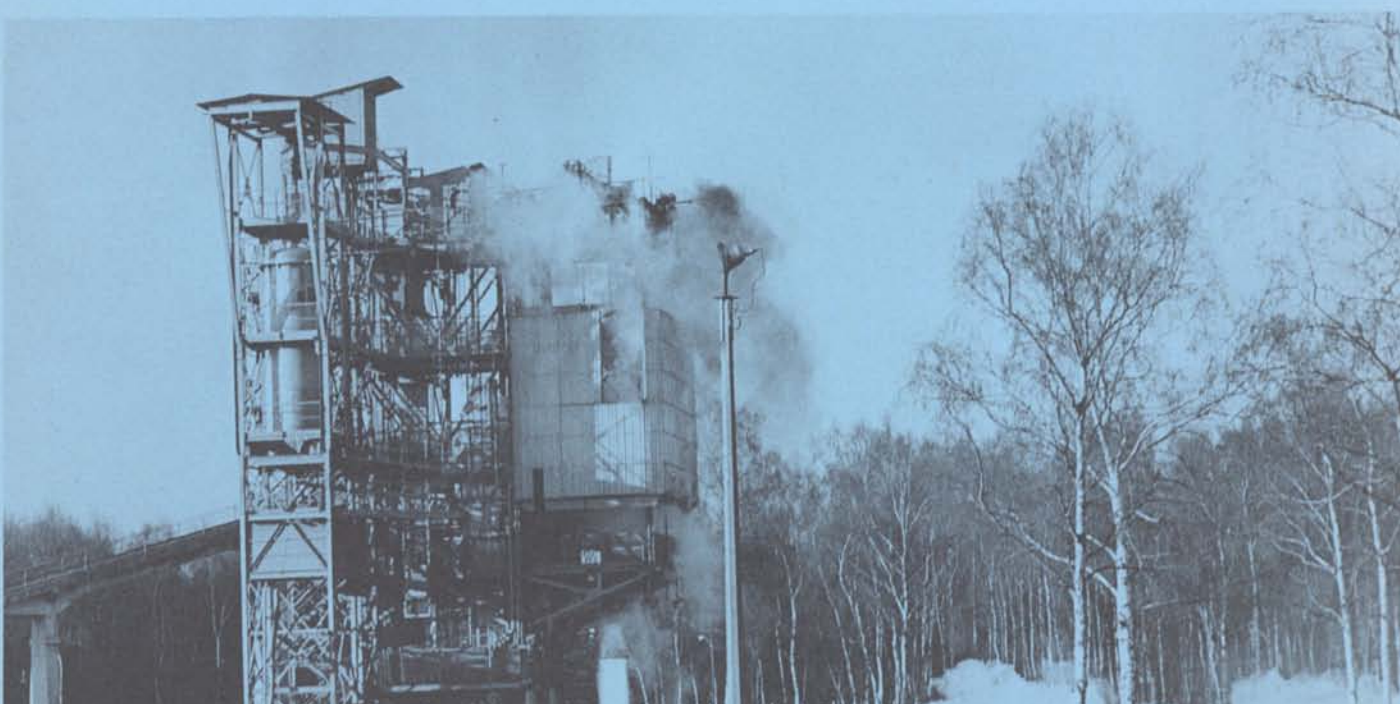
Les visiteurs ont également pu voir la fabrication du réservoir du premier étage; trois réservoirs sont actuellement réalisés et deux autres sont en cours de fabrication.

La SEP (Vernon) est chargé du développement et de la fabrication des ensembles propulsifs des trois étages. A Vernon, les visiteurs ont pu assister à un tir de 80 secondes d'un moteur Viking-II sur le banc PF2. En outre, ils ont pu se rendre compte de l'avancement des travaux sur les bancs cryogéniques PF41, 42 et 43 destinés au développement et à la qualification de l'ensemble propulsif du 3ème étage. Le banc PF41 (destiné aux essais turbopompe et moteur) ainsi que le poste de commande sont pratiquement terminés, le PF41 devant être mis en service en mars 1976. D'autre part, les visiteurs ont pu voir le banc PF20 qui est destiné principalement au tir du *premier étage complet. Après installation et validation des moyens de commande et de mesure prévues pour le printemps 1976, le premier tir de groupement (bâti-moteur équipé de 4 moteurs Viking-II) y sera effectué au début de septembre 1976. Il est rappelé que les essais de l'ensemble propulsif du 2ème étage L33 (moteurs et étage) seront effectués par la DFVLR à Lampoldshausen en Allemagne. Ils commenceront en avril 1976.*

PROGRAMME APEX

Les propositions reçues au 2 décembre 1975 pour le programme APEX (Ariane Passenger EXperiments) couvrent 71 expériences se répartissant suivant le tableau ci-après. A ceci pourraient s'ajouter d'éventuelles propositions d'extension de projets en cours (Météosat, OTS par exemple) que des Délégations feraient en réponse aux suggestions de l'Agence.

Par ailleurs, il faut prévoir une diminution du nombre initial des expériences proposées, principalement pour raisons financières. Sans entrer dans le détail des propositions, on peut faire les commentaires généraux suivants.



Test firing of Viking-II engine at Vernon/Tir au banc du moteur Viking-II à Vernon.

Allemagne

L'idée de base est de faire voler une structure MBB équipée de sous-systèmes (développés ou en cours de développement) préfigurant la plate-forme lourde — du type susceptible d'être lancé par Ariane — des futurs satellites géostationnaires stabilisés 3 axes. L'Allemagne souhaite que soit adjoint un système propulsif pour la circularisation de l'orbite.

France

CNES: Plusieurs objectifs scientifiques et technologiques. En ce qui concerne la plate-forme, le CNES envisage un satellite dérivé d'OTS pour démontrer la capacité d'Ariane de lancer un satellite géostationnaire stabilisé 3 axes.

SNIAS: Objectif principal: promouvoir sa structure de plate-forme géosynchrone adaptable à Ariane, dont il reste à compléter l'équipement en sous-systèmes.

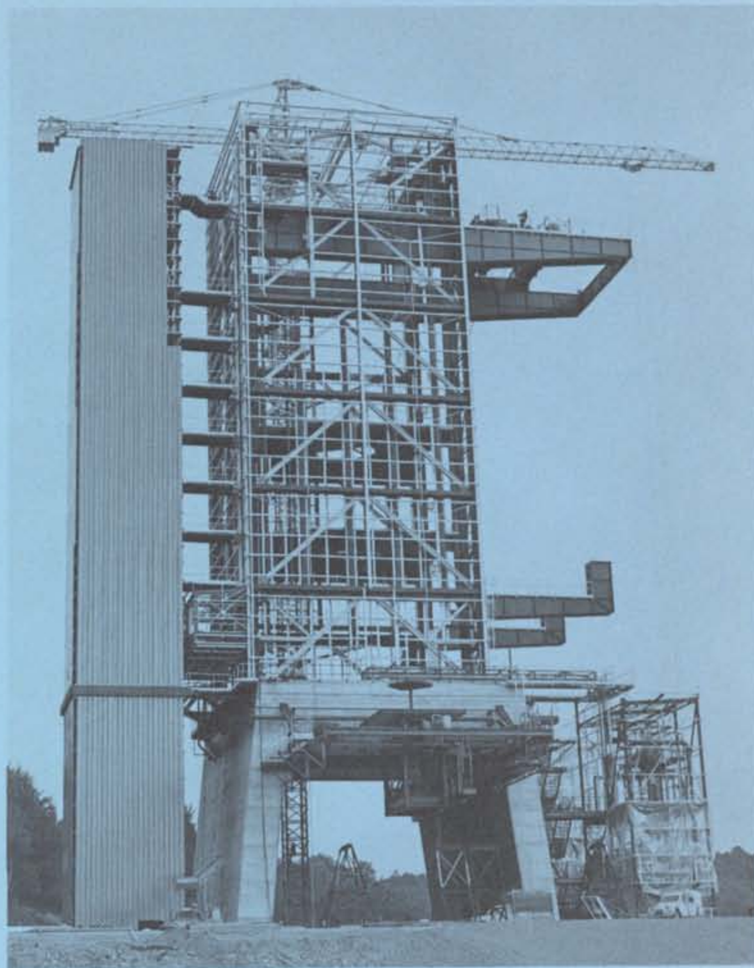
SEP: Propulsion.

Propositions d'expériences APEX au 2.12.1975

Etat	Applications	Technologique		Scientifique		*Total par Etat*
	Autonome	Autonome	Non autonome	Autonome	Non autonome	
Allemagne	–	1*	21	–	4	26
France — CNES	–	2	17	1	12	39
France — SEP	–	–	3	–	–	
France — SNIAS	–	1*	3	–	–	
Suisse (Université de Berne)	–	–	–	1**	–	1
Autriche	–	–	–	–	1	1
Inde	1	–	1	–	1	3
Radio-amateurs	1	–	–	–	–	1
Totaux	2	4	45	2	18	71

* *Plate-forme type Ariane. Elle est classée comme autonome en supposant qu'elle sera équipée des sous-ensembles nécessaires, ce qui a besoin d'être confirmé.*

** *Suggestion de faire voler le prototype de GEOS.*



Test stand PF20 at Vernon, to be used for test firing the complete first stage of Ariane/Banc d'essai PF20 à Vernon, destiné aux essais du premier étage complet d'Ariane.

Souci commun à l'Allemagne et à la France

Il s'agit des systèmes de propulsion à faible puissance (propulsion électrique) et des systèmes de propulsion, à liquides ou à poudre, nécessaires pour la circularisation de l'orbite de transfert et généralement associés à la charge utile. Ces systèmes peuvent être fournis par l'industrie européenne. Le choix du système à faire voler dépendra de la politique de l'Agence en la matière, qui doit être définie au cours du 1er semestre 1976.

Inde

Objectif: télécommunications à usage interne. Le système du satellite autonome proposé (150 kg) est compatible avec le projet INSAT (Indian National Satellite system for TV and Telecommunication). Une expérience scientifique est également prévue.

Radio-amateurs

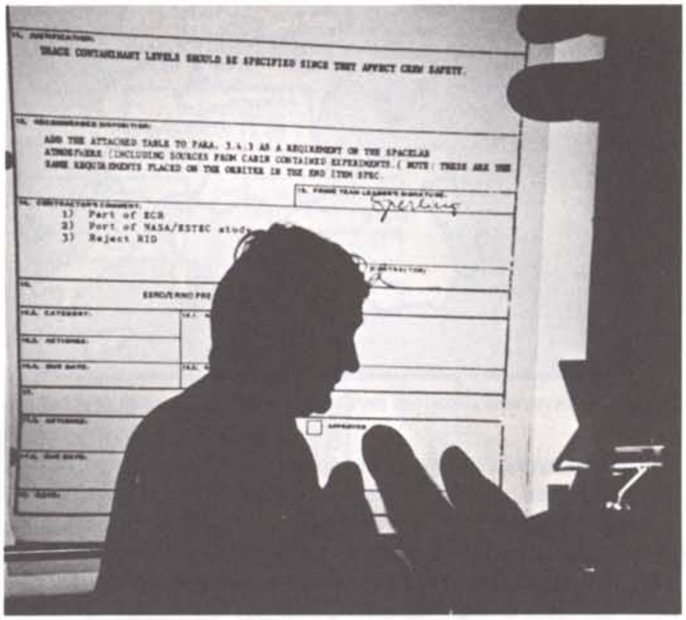
Le satellite autonome proposé (68 kg) est le 8ème de la série des 'OSCAR', dont les 7 premiers ont déjà été lancés. But: service public pour les radio-amateurs, plus mission scientifique: mise en oeuvre de l'accès multiple au répéteur (efficacité multipliée par 4). Orbite finale idéale: polaire elliptique, 8 à 12 heures.

The Organisational Framework of the Spacelab Programme

C. Reinhold, Spacelab Directorate, ESA, Paris

In many respects the Spacelab Programme is a unique undertaking for ESA. Not only does it represent Europe's first venture in manned spaceflight, it also develops the world's first reusable space vehicle, thus invoking novel safety and reliability requirements. In addition, the development of Spacelab must remain consistent with two other processes still in the course of evolution, first the parallel development by NASA of the Shuttle – the vehicle which will carry Spacelab to and from orbit – and secondly the scientists' change of approach from automatic satellite-borne experiments to attended, reusable experiments in Spacelab. Consequently, flexibility in Spacelab concept and design must be kept open for much longer than usual in space projects. Lastly NASA's responsibilities not only for integration of Spacelab into the Shuttle, but also for devising the most efficient plan of Shuttle/Spacelab operations, mean that extraordinarily close and detailed technical interfaces with NASA must be maintained. Never before has a European space project had to meet so many technical, schedule, financial and political constraints.

Hence, from an organisational viewpoint, the Spacelab Programme is undoubtedly highly complicated, making a sound, well-defined organisational and management structure indispensable for successful implementation of the project, for ensuring the correct interfaces, and for providing adequate and timely forum for discussion between ESA, NASA and the various contractors. The two Agencies have tried to establish such co-operation with the underlying but very important objective, in the light of the many constraints on the Programme, of not compromising a technical Spacelab concept that has to be attractive to as many potential experimenters as possible.



FORMAL AGREEMENTS

Three formal international agreements provide the basic framework for the Spacelab Programme:

(i) An intergovernmental agreement between the governments of nine European countries and the United States, 'concerning the development, procurement and use of a Space Laboratory in conjunction with the Space Shuttle System', was concluded in August 1973. It designates NASA and ESRO as the co-operating agencies.

(ii) A Memorandum of Understanding between ESRO and NASA was subsequently signed in September 1973.

(iii) On the European side, an 'Arrangement between certain Member States of ESRO and ESRO concerning the execution of the Spacelab Programme' was opened for signature in March 1973. It established a financial envelope of 308 MAU at mid-1973 prices for the European programme and a mechanism for updating this envelope annually.

The Spacelab Intergovernmental Agreement covers not only the design, development and manufacture of the first Spacelab flight unit, but also the use of the Shuttle and Spacelab systems, as well as the procurement of additional European Spacelabs by the United States. The present Agreement is intended to remain in force until at least 1988, but it provides for expansion and extension of this international co-operation subject to the mutual agreement of all partners.

The Memorandum of Understanding between NASA and ESRO (ESA) forms the basis for the tasks to be performed and for the working relations of the two space agencies. ESA is responsible for the development of Spacelab and for delivery to NASA of one engineering model, one flight unit, two sets of ground support equipment, and initial spares. With the first mission currently planned for the third quarter of 1980, the engineering model is scheduled to be delivered in 1978, and the flight unit in 1979. Under the terms of the Agreement, the first mission will be a joint NASA/ESA mission, with experiments coming from both sides of the Atlantic. NASA's prime responsibility is the operation of the Shuttle/Spacelab system.

Figure 1 — European countries participating in the Spacelab Programme.

ESA SPACELAB BUDGET ALLOCATION

	MAU*
Definition Studies	12
Contract Baseline	233
Special Studies, Modifications and Reserves	83
Support and Internal Cost	68
Total	396
Approx. Million US $	515

* Mid-1975 Prices
1 AU = 1.30 US $

The Arrangement between European Governments and ESA is necessary because, in ESA parlance, the Spacelab Programme is a 'Special Project', i.e. a programme in which participation by all ten ESA Member States is not mandatory, but for which ESA assistance and facilities can be made available. In this case, Sweden is the Member State not participating in the Programme.

The costs of the European part of the Spacelab Programme are met through payment to ESA by the participating states, in the percentage shares indicated in Figure 1.

On the basis of the above formal agreements, both Agencies, ESA and NASA, have established comparable organisations to undertake their respective responsibilities in the manner best suited to their own management structure and philosophy. The following paragraphs outline the organisational frameworks of the major participants in this co-operative programme.

ESA ORGANISATION

The principal governing and executive bodies of the European Space Agency are the Council and the Director General, respectively. The Spacelab Programme Board, composed of representatives of the participating states, is responsible for taking key programme decisions and for establishing the annual budget of the Programme. For Spacelab matters that affect other programmes or are of general concern, the Programme Board advises and consults with the ESA Council.

The following ESA Directors, all of whom report directly to the Director General, carry Spacelab-related responsibilities:

- Director of the Spacelab Programme
- Director of Planning and Future Programmes
- Director of Administration
- Director of Scientific and Meteorological Programmes
- Director of ESTEC.

The Director of the Spacelab Programme, located at ESA Headquarters in Paris and supported by a small staff (≃ 10), is responsible for implementation of the total programme as entrusted to ESA. The Spacelab Programme Directorate staff at Headquarters deal with:

- budgetary, short- and long-term planning
- policy questions relating to manpower and contracts
- liaison with the Council and the Spacelab Programme Board and other delegate bodies of ESA
- interface with NASA Headquarters
- planning for the utilisation and follow-on production of Spacelab.

Reporting to the Programme Director are the Project Manager for Spacelab development and the Manager of the SPICE (Spacelab Payload Integration and Co-ordination in Europe) Group (Fig. 2).

The Spacelab Project Manager and his team (≃ 100 staff) are located at ESTEC, Netherlands. The project team handle the technical and contractual direction and monitoring of the main development contract and related studies, and also provide liaison with Marshall Space Flight Center, the NASA lead centre for Spacelab. Specialist technological and scientific support to the project team is provided by ESTEC's Development and Technology Department, and ESA's Space Science Department, also located at ESTEC.

Whereas the planning of Spacelab's European payloads is the

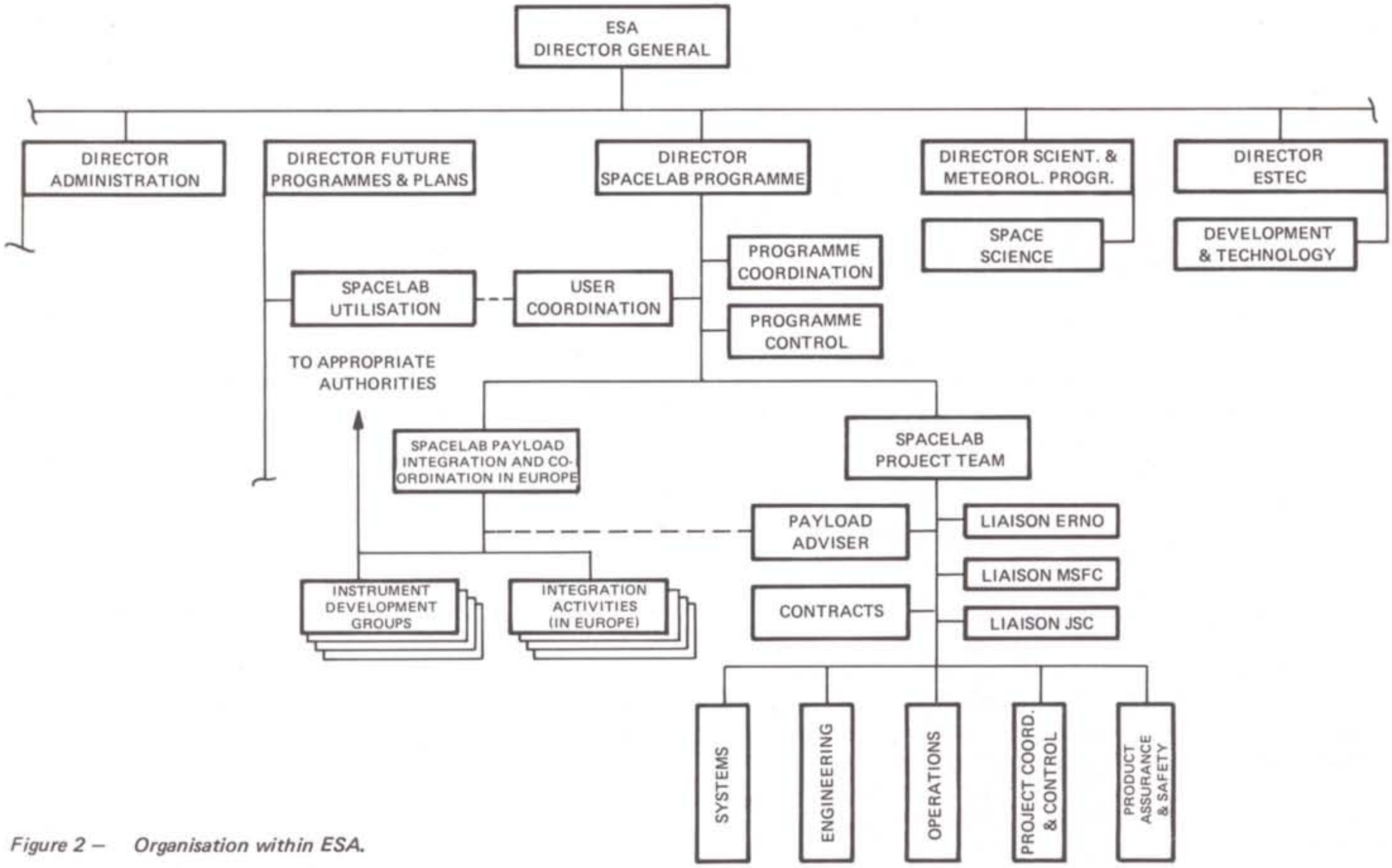


Figure 2 — Organisation within ESA.

responsibility of the Director of Planning and Future Programmes, the implementation of agreed payloads is the responsibility of the Director of the Spacelab Programme. It is for this latter purpose that the SPICE Group has been established, reporting to the Programme Director, and responsible for co-ordinating payload development and integration activities in Europe. Pending a final decision by Council, the SPICE Group will be located at the DFVLR facility at Porz-Wahn, Germany.

NASA ORGANISATION

NASA's major research and development effort is furnished by five major 'Program Offices', which assign individual research and development projects to NASA research centres for execution. The Spacelab Programme is the responsibility of the Office of Space Flight, which is also responsible for development of the Space Transportation System, including the Shuttle and advanced elements such as the Interim Upper Stage.

While some research is accomplished 'in house' by NASA's own laboratories, most of the development effort is contracted out to industry and to universities, with NASA field centres assuming the role of contract managers for the development contracts.

In addition to being the principal agents for space research and development, the field centres are also responsible for all operational aspects of the Spacelab Programme, including launching, mission control, crew training, data processing and analysis.

Principal NASA centres involved in the Spacelab Programme are Marshall Space Flight Center (MSFC), Huntsville, Alabama, as lead centre and responsible for development of Spacelab peripheral components, Johnson Space Center (JSC), Houston, Texas, responsible for Shuttle development, and Kennedy Space Center (KSC), Florida, responsible for Shuttle/Spacelab operations.

The NASA Spacelab Program Office, located at NASA Headquarters, is under the overall direction of the Associate Administrator for Space Flight. The Director of the Spacelab Program, assisted by a small staff of technical personnel, is responsible for overall technical and programme direction of NASA's participation in Spacelab development. Day-to-day management of those elements of Spacelab development for which NASA is responsible has been assigned to the MSFC Spacelab Program Office, under the direction of a Spacelab Program Manager. He is supported by a group of engineers responsible for the design and procurement of peripheral flight hardware, such as the crew transfer tunnel, and for giving technical support to ESA (Fig. 3).

While the NASA Spacelab Program Office was originally established as the primary focal point, not only for Spacelab development and testing, but also for developing the required operational capabilities and eventual operation of the Spacelab, a recent organisational change at NASA has resulted in a division of operational and development responsibilities. With the establishment of a Space Transportation System Operations Office in the NASA Office of Space Flight, the responsibility for development of Space Transportation Systems operations capabilities, and for operating, have been assumed by this office. As a consequence, the NASA Spacelab Program Office is now concerned only with the design, development and procurement, and flight testing of Spacelab hardware and software. This includes the first two Spacelab missions, which are considered 'verification' flights. For operational planning and capability development, a Shuttle Payload Integration and Development Program Office has been established at Johnson Space Center, which is responsible for co-ordinating such Spacelab operational requirements as mission planning, mission control and crew training. At Kennedy Space Center, a group in the Payloads Integration Office is responsible for planning Spacelab ground operations requirements. This group is developing facilities, hardware and software for Spacelab pre-launch checkout, payload integration, and post-landing refurbishment. As the Spacelab Programme matures, additional organisations will be established at other NASA field centres to develop operational facilities, and to operate the Spacelab under the overall direction of the Space Transportation System Operations Office.

ESA/NASA LIAISON

The need for the closest possible co-operation between the major participants on both sides of the Atlantic has already been mentioned. Liaison and co-ordination arrangements reflecting this need have been established, with the objective of providing a mechanism for achieving agreements and joint decisions without compromising either performance or cost objectives.

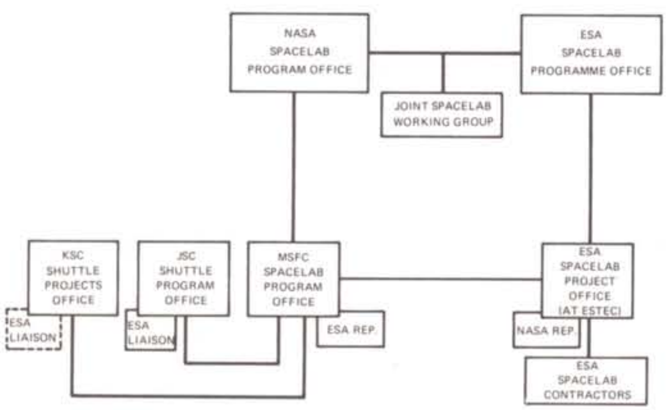


Figure 3 — Programme management organisation.

To keep NASA's Administrator and ESA's Director General informed of Spacelab Programme progress and to resolve top-level management issues, joint annual programme reviews at their level are held. The principal monitoring and co-ordinating body is, however, the NASA/ESA Joint Spacelab Working Group (Figs. 3 and 4), which is co-chaired by the NASA and ESA Spacelab Programme Directors. This Group meets every other month, alternately in Europe and the United States, to discuss interface items, problems and solutions. The Programme Directors jointly approve and control key programme documentation, such as the Joint Programme Plan, the Programme Requirements Document and other 'level-one' interface documents.

All major programme and technical decisions, including the establishing of requirements and the approval of major design changes, are taken by this body, based on information provided by ESA, NASA and their contractors. Ad-hoc working groups composed of ESA and NASA personnel are instituted by the Joint Spacelab Working Group to resolve particular technical interface issues (Shuttle/Spacelab avionics, operations, etc.).

Another important link in the management structure is the Joint Users' Requirements Group, composed of representatives of NASA and ESA payload offices. Its primary function is to act as a focal point for collecting requirements from potential users and to ensure that due consideration is given to user requirements in Spacelab design and operations. In addition, a Joint NASA/ESA Programme Integration Committee has been established to co-ordinate planning for the first mission, and to select candidate experiments for the first payload (Fig. 4).

To ensure maximum co-ordination during the programme-development phases, NASA and ESA offices interface directly at corresponding management levels, the major point of contact being the ESA Liaison Office at MSFC and the NASA Liaison Office at ESTEC (Fig. 3). In addition, NASA technical personnel have been assigned to ESA to promote even closer co-operation at a technical level. To reduce the cost of overseas travel, and to improve information flow, direct communication links (voice, teletype and facsimile) have been established between NASA, ESA and ERNO (prime contractor for Spacelab). During the programme-development phase, joint reviews are being conducted at major programme milestones, to approve requirements, establish baseline designs, and to verify test results. All key programme documentation is issued jointly and changes must be approved by both Agencies. Furthermore, NASA and ESA provide each other regular access to Space Shuttle and Spacelab progress reviews by the respective contractors.

INDUSTRIAL ORGANISATION

Overall industrial responsibility is assigned by ESA to the prime contractor, VFW-Fokker/ERNO. Though Spacelab is the first space programme for which ERNO has assumed the role of the prime contractor, the company brings to the programme valuable experience from many European space ventures and from several successful aircraft projects.

To develop Spacelab, ERNO has assembled an industrial team of ten major European co-contractors, responsible for particular Spacelab subsystems (Fig. 5). The total manpower of prime and co-contractors will peak at approximately 1500 early in 1976. Many of the companies concerned have already worked together on past space projects, and the distribution of work between participating countries is commensurate with the financial contributions of their governments.

Co-ordination of the work of the prime contractor and the co-contractors occurs at three levels:

- The Spacelab Board of Directors, comprising directors of the contracting companies, in order to provide quick access to company resources. The Board meets approximately once every two months.
- The Spacelab Project Manager of ERNO consults with the co-contractors' local project managers on all principal decisions.
- The co-contractor management department at ERNO is in daily contact with the co-contractor teams.

In addition, monthly ESA/contractor management meetings take place, with co-contractor participation.

USER ORGANISATION

The organisational schemes described so far have dealt with the currently agreed phases of the Spacelab Programme. When the Space Shuttle/Spacelab system becomes operational in 1980, the main emphasis of space activities will move from hardware development and checkout to operational flights. As a result, many new participants in the United States and Europe will be involved in space activities, ranging from individual scientists and experimenters to large corporations, industry and government agencies. New organisational concepts and structures will have to be created, quite different from those used in previous space research and development projects.

Frequent, routine access to space will make it necessary to provide services and perform functions more akin to airline operations than space research. These will include marketing, scheduling, maintenance, customer services and economic analysis. NASA may, in effect, have to operate a Spacelab 'ferry service', carrying passengers and cargo into Earth orbit and returning them after each mission.

Questions of user charges, reimbursement policies and proprietary rights have to be resolved in the context of planning for routine space operations. Selection and training of international Spacelab crews require international agreements and

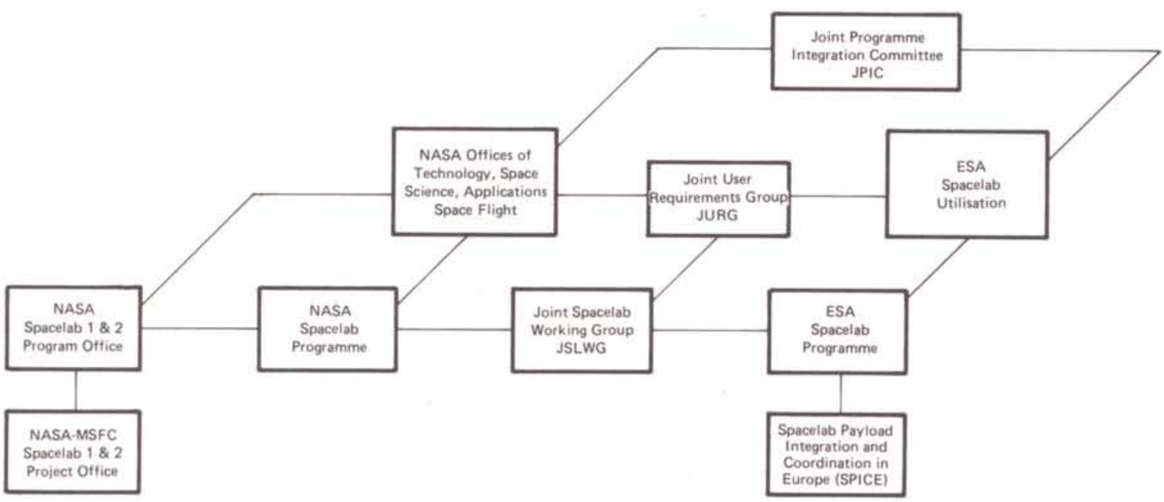


Figure 4 — Flights 1 and 2 management organisation.

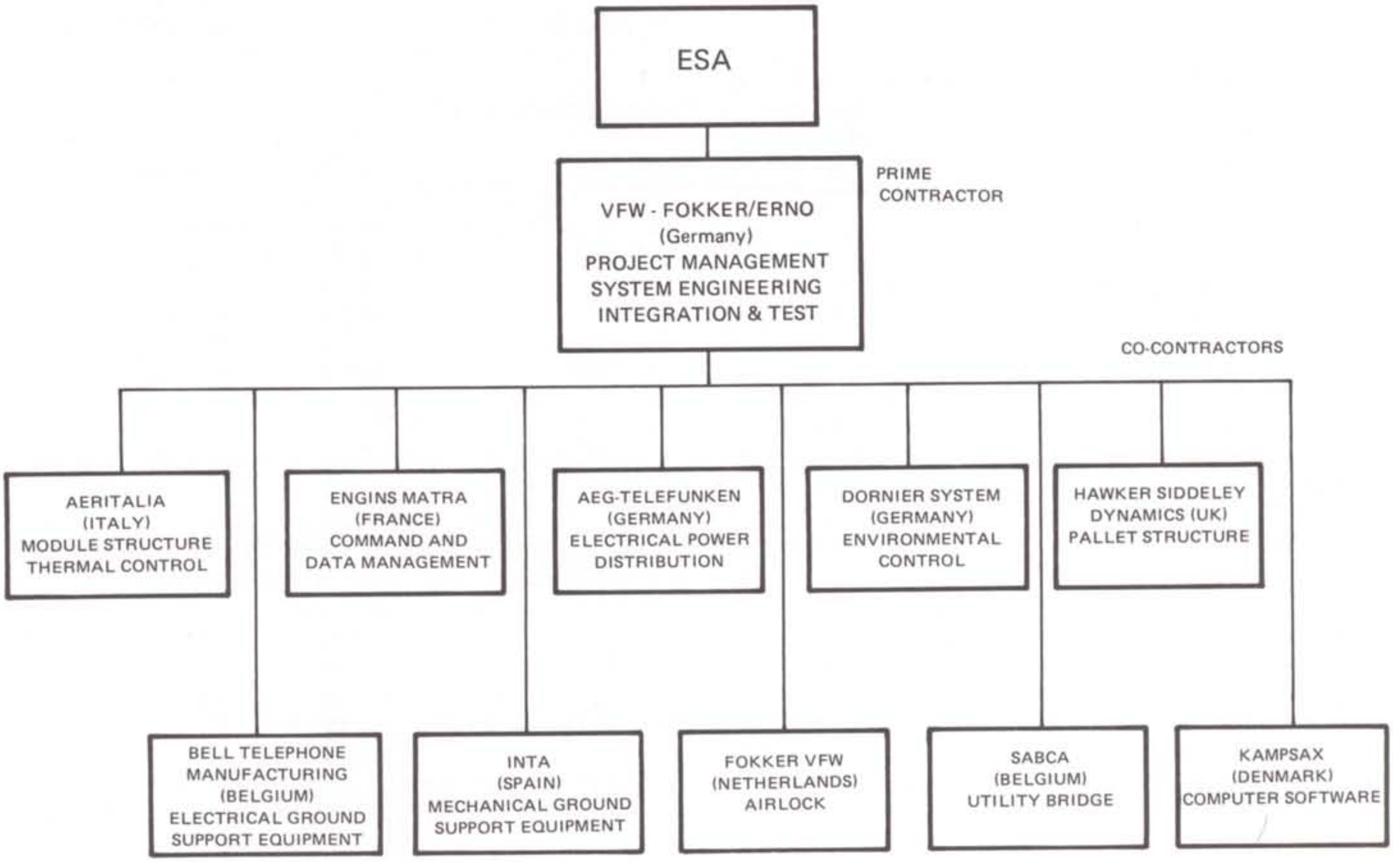


Figure 5 — European industrial contractor team.

assignments of responsibilities. The newly created Space Transportation System Operations Office at NASA Headquarters provides a focal point for these planning activities.

To define prospective payloads, a Space Shuttle Payload Planning Steering Group has been established at NASA, headed by the NASA Associate Administrator for Space Science. A number of potential user organisations including ESA are represented in this group, which meets monthly to establish priorities, define requirements and make decisions as to potential payloads. Within ESA, a Scientific Advisory Committee and four Scientific Working Groups, for Astronomy, Life Sciences, Material Sciences and disciplines related to the Solar System, advise the Director General on all prospective space-borne payloads, including those destined for Spacelab.

FOLLOW-ON SPACELAB ACTIVITIES

In addition to the emphasis on the development and utilisation aspects of Spacelab, NASA and ESA are actively considering the planning of follow-on Spacelab production and procurement. NASA is committed to procure at least one additional Spacelab flight unit from ESA, and a first detailed order is expected to be placed in 1977.

In preparation for this activity, the Joint Spacelab Working Group has formed a joint NASA/ESA ad-hoc group. Related negotiations between ESA and NASA will soon lead to a new arrangement and an appropriate organisation of the tasks. Since the relationship between NASA, ESA and the prime contractor will differ during the production phase from that during development, new interfaces and management procedures will have to be defined.

Joint ESA/NASA Spacelab Experiment Simulation Programme

J. de Waard and D.J. Shapland, Spacelab Directorate, ESA, Paris

Similarities between the method of experiment accommodation and operations planned for Spacelab and the methods used in conducting experiments aboard aircraft by NASA's Ames Airborne Science Office led to the jointly planned ESA-NASA ASSESS I mission using a CV 990 aircraft (ASSESS standing for 'Airborne Science Spacelab Experiment Simulation System'). This mission included one week of simulated Spacelab operation, during which the experiments were 'proxy-operated' by Experiment Operators who fulfilled similar tasks to those projected for the Payload Specialists on board Spacelab.

Typical equipment aboard Convair aircraft. Above - power distribution station. Below - polarising interferometer.

PROGRAMME OBJECTIVES

The programme objectives of this joint ASSESS mission were defined so that certain aspects of a Spacelab mission could be simulated and factors influencing experiment design, experiment operations, Spacelab subsystem design and the human factor in space experimentation could be evaluated. In addition, the programme allowed certain management procedures to be tried out.

THE PAYLOAD

A basic ground rule that authentic science had to be performed was applied. In addition, the equipment had to be compatible with the aircraft and the objectives outlined above. The experiments selected were devoted, in the main, to measurements of infrared radiation from the atmosphere and space. They are listed, together with their scientific objectives, in Table 1.

MANAGEMENT

The overall programme policy was planned and guided by a joint Mission Planning Group consisting of representatives from ESA and NASA Headquarters, Marshall Space Flight Center, Johnson Space Center and Ames Research Center.

Implementation of the joint mission was the responsibility of a Mission Manager, who ensured that all ASSESS activities were carried out in accordance with the policies established by the Mission Planning Group. During the actual Spacelab simulation phase, a Mission Scientist was assigned to co-ordinate the Principal Investigators, who remained on the ground, and to act as single point of contact with the Mission Manager on board the aircraft. The Mission Manager performed similar tasks to those presently foreseen for the Mission Specialist to be carried aboard Spacelab.

The experiments were proxy-operated by a team of two European and two American Experiment Operators who were selected and trained by ESA and NASA, respectively. The Experiment Operators and the Mission Manager were confined on board the Convair CV 990 aircraft for the duration of the simulation period. A two-man ESA-NASA panel was set up to which policy decisions involving agency interests could be referred.

TABLE 1
ASSESS experiments and their scientific objectives

Organisation	Instrumentation	Measurements
Observatoire de Meudon CNRS-Verrières	30-cm Cassegrain telescope with filter wheel IR photometer	High-resolution mapping of dark clouds and HII regions
University of Groningen	Cooled Ge bolometer	
Queen Mary College, London	Polarising interferometer. Cooled Ge bolometer	IR emission spectrum of upper atmosphere
University of Southampton	Imaging Isocon TV camera. IR photometer All-sky camera	Observation of OH airglow clouds
NASA/Ames Research Center	30-cm Cassegrain telescope (Meudon) with variable filter-wedge spectrometer. Cooled InSb detector	Near IR spectra of Venus and late type stars
NASA/Jet Propulsion Laboratory	Tunable acousto-optical filter spectrometers (2) with telescopes	UV and visible measurements of atmospheric transparency, solar flux, planetary atmospheres, and interstellar molecules
University of Alaska	1-m Ebert-Fastie spectrometer-telescope and stabilised mirror	
University of Colorado	12.5-cm Ebert-Fastie UV spectrometer	
University of New Mexico	35-mm camera with IR image intensifier. 16-mm camera with image intensifier for time-lapse photography. IR photometer	IR photography of OH airglow clouds

SCHEDULE

The joint ASSESS mission was executed only 16 months after the Announcement of Flight Opportunity was issued by ESA, thus demonstrating that short lead times are indeed feasible for Spacelab-type experiments. The constrained period, simulating the Spacelab flight, started on 2 June and ended on 7 June 1975. During this period, five flights were conducted, each lasting approximately six hours. Between flights, the operators and Mission Manager remained on board the aircraft or in the adjacent sleeping quarters. Following this constraint period, two additional weeks were devoted to unconstrained flights during which the experiments were operated by the respective investigators, thus permitting comparison between proxy and direct operation and allowing the data provided during the constrained flight to be supplemented.

LESSONS LEARNED FOR SPACELAB

The ASSESS mission has illustrated that a low-cost programme with a low level of preparatory requirements, testing and documentation can be operated successfully with a proper management approach. Appropriate and timely information on constraints and capabilities, as well as guidance for hardware development, enhance the chances of success. Some of the major lessons learned were as follows:

- proxy operation of experiments by a trained payload specialist for one or more Principal Investigator(s) is perfectly feasible
- some payload specialist participation in all stages of experiment evolution is highly desirable, and some payload level training is deemed essential

Payload operators, Beckman (ESTEC), Parker (Johnson Space Center), Wells (University of Sussex), Haughney (Ames Research Center) and Dick (University of Maryland) on the steps of the Convair.

- pre-integration in Europe of Spacelab experiments is technically feasible
- electromagnetic compatibility must be given serious consideration throughout the payload design process
- centralised handling of housekeeping data is important, but possible use of minicomputers by experimenters must be recognised in the centralised data-management system design
- an aircraft can act as a platform for optimising the methodology, design and operation aspects of experiments conceived for Spacelab
- a Mission Planning Group with representation from all participating organisations is an effective means of establishing policy and guidelines for mission implementation
- a Mission Manager, acting as the single point of contact for all integration-related activities, can effectively execute the policies of the Mission Planning Group
- the control-centre approach of ASSESS provides guidelines for Spacelab mission operations control.

FUTURE PROSPECTS

Not all aspects of a typical Spacelab mission could be addressed during the first series of flights. In addition, the capabilities of Spacelab and its resources and the payload integration and co-ordination requirements are now better defined. Consequently, an even more realistic simulation of a typical Spacelab mission would enable the Agency to extend and 'update' the lessons learned from ASSESS I. ESA has therefore proposed to NASA to conduct a second ASSESS mission, tentatively scheduled to be flown during early 1977. An announcement of flight opportunity for this ASSESS II mission was issued by the Director General of ESA on 27 November 1975. □

Utilisation of Spacelab for Life-Science Experiments

G. Seibert, Directorate of Planning and Future Programmes, ESA, Paris

In the 1980's, the scientific community will have a new tool, Spacelab, at its disposal for conducting experiments in space. For Europe, this will make research possible in fields like life sciences, which have been almost totally ignored so far in space research, due to the limited capabilities of conventional automatic satellites.

The life sciences include all those disciplines that seek to understand, measure, or control life processes at the sub-cellular, cellular, systemic, organism, or multi-organism levels, including biology and physiology, medicine, behavioural and social sciences, biomedical engineering, life-support systems engineering, human factors engineering and all allied disciplines.

Past American and Russian life-sciences flight experiments have been focussed on evaluating possible hazards to crew health and identifying factors that could impair crew performance. While these objectives will continue to be important in the 1980's, the increase in flight experiment opportunities will allow an increase in the number of basic research experiments. These flight experiments will use the unique properties of spaceflight environments to study the basic mechanisms controlling life on Earth. Thus, the two primary objectives of a Life Sciences programme should be:

(a) to enhance man's well-being and productivity in space, and
(b) to utilise the space environment to achieve a better understanding of all life processes.

POTENTIAL SCIENTIFIC OBJECTIVES

Biomedicine

The space environment makes possible new approaches in the study of fundamental physiological control systems. In addition, certain human functions are altered during space travel and corrective or preventive measures must be sought in order that man may perform properly. Spaceflight can also provide unique opportunities for studying the prevention, diagnosis and treatment of diseases.

Research into the basic nature of physiological mechanisms and into means for enhancing man's well-being in space and on Earth are undoubtedly significant fields for exploration.

Biology

All forms of life on Earth have evolved under the influence of the gravitational field and the various life processes, such as embryogenesis and growth, may therefore be considered to be gravity influenced. Other biological processes may be affected by factors that can be conveniently found in space, for example high-energy particles.

The Life Sciences programme might include biological research that uses the unique opportunities of space to foster a better understanding of life processes, as well as investigations which provide insight into the biological effects of long-term exposure to spaceflight.

Behaviour

While indirect evidence has been gathered concerning man's capabilities in space, there is a need to quantify his performance, to assist in planning for his effective utilisation in all modes of spaceflight activity, particularly on extended missions. Crew tasks on future missions will be sufficiently varied to be used to investigate man's visual, auditory, mental and psychomotor responses under conditions of stress, boredom, confinement and fatigue.

Included in flight experiments will be behavioural studies aimed at increasing man's effectiveness and efficiency in space, as well as other studies to measure the effects of flight conditions on psychological and psychophysiological mechanisms.

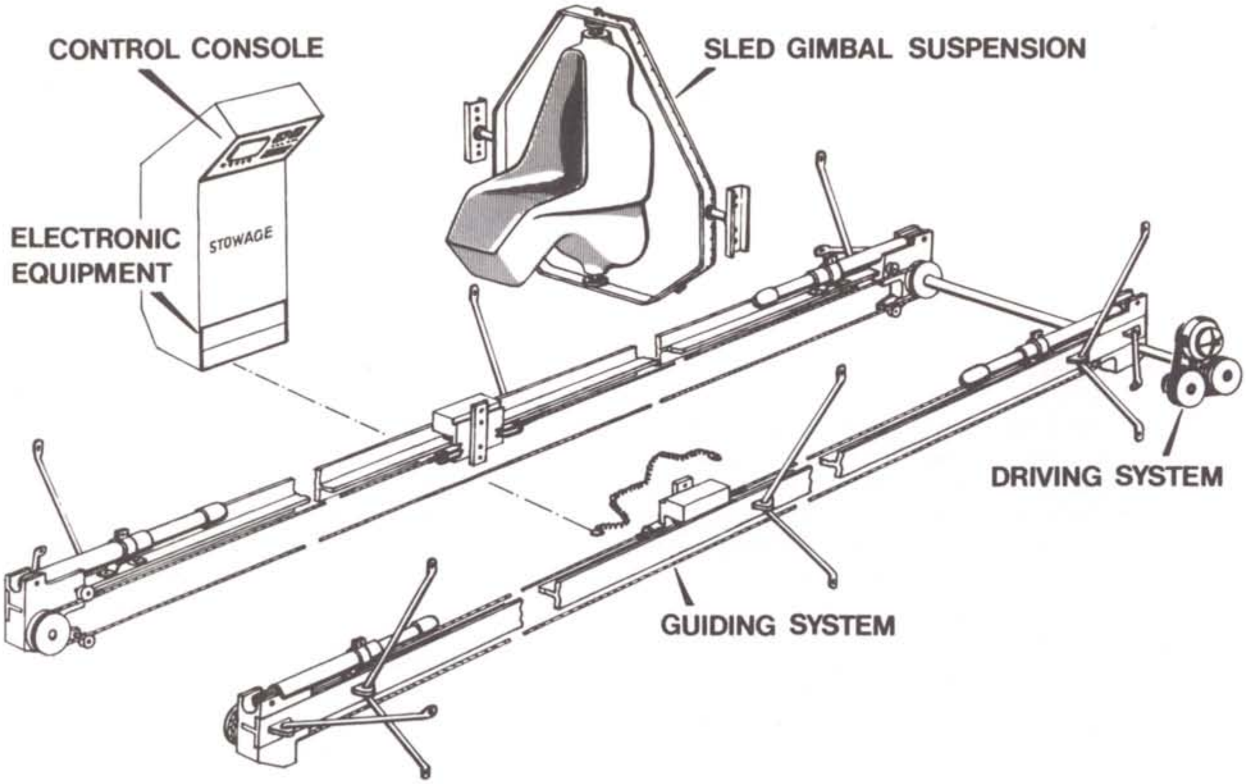
Technology

Man's well-being and productivity in space are, to a large extent, dependent on the effectiveness of life-support systems, working aids and instruments to monitor his health. These technologies must be developed to increase system capabilities, to reduce costs, and to provide operational lifetimes compatible with prolonged space missions.

ENVISAGED LIFE-SCIENCE EXPERIMENTS

Vestibular function

In the light of the American Apollo programme and Skylab flights, and data made available from Russian spaceflights, it



Possible Space Sled facility for examining the effects of acceleration on astronauts under weightless conditions.

has become apparent that 'space sickness' or 'stomach awareness' is going to be a major problem in the immediate future. This effect of vestibular dysfunction due to zero-g has become more obvious recently because space vehicles are now larger, allowing greater freedom of movement for the occupants. Because of the relatively short duration of Spacelab flights, the possible two or three days of partial incapacitation of the crew pose a major difficulty. The re-adaptation problem during re-entry and landing poses particular difficulties to the pilot. However, the most disturbing aspect of the problem is the almost total inability of existing ground-test and screening procedures to predict which members of a crew are likely to suffer from space sickness.

If spaceflight is to become a more routine activity, then research into vestibular functioning is urgently needed. The availability of a reasonably sized laboratory with zero-gravity facilities offers a good opportunity to perform dynamic testing, either on animals or crew members, by use of a small centrifuge or a chair mounted on rails, without the disturbing effect of a constant gravitational field.

Human physiology and psychology experiments

It has already been demonstrated that during spaceflight there is a shift in blood electrolyte balance and a loss of bone calcium, together with a loss of blood plasma. There is also a change in red blood cell mass. All these effects clear up within a few weeks of return to Earth, but their causal mechanisms are not well understood.

Clearly, the other major effect of zero gravity will be on the circulation system, since the heart is normally engaged in pumping blood in the presence of gravity. The compensatory mechanisms adopted by the body under zero-gravity conditions might be expected to shed some light on the underlying control systems. A 'free floating' human being could be investigated by ballisto-cardiography; some quite simple measurements made under zero gravity can determine what happens, for example, to venous pressure.

The effects of gravity on time estimation by the crew, together with any effects on circadian rhythm, could be ascertained in these experiments.

Animal experiments

It is very convenient to use the scientists themselves for some experiments. Other experiments must, however, involve an element of risk and these could most conveniently be conducted with animals. These include experiments involving poisonous chemicals, radiating materials, or electrode implantation. Small animals can often be conveniently used to obtain particular types of information, as has already been demonstrated by using minnows for vestibular experiments. Such animals also reproduce rapidly, making them suitable for genetic experiments. Facilities will be required in the space laboratory to provide 'life support' functions for the animals, together with some means of preserving laboratory specimens, etc. It is most important that any animal species selected for work in space should already have been very thoroughly investigated on Earth, to establish their 'normal' reactions. Some experiments can be conducted only by pre- and post-flight examinations.

Effects of hard radiation

The other vital issue in prolonged spaceflight is the effect of radiation on humans, animals, plants and lower organisms. The 'hard' radiation (such as HZE particles) found in space cannot be duplicated on Earth because, although it is not very intense, the various types occurring naturally and simultaneously in space cannot be produced simultaneously by ground equipment.

It is important to know the effects of this radiation on living organisms, because the weight limitations on space vehicles preclude complete shielding. Radiation experiments are a good example of the role that experiments with animals can play.

One of the most dangerous effects of radiation is the production of mutations in cells during reproduction. When this possibility is considered in relation to man and animals, the effects of introducing a new disease to the Earth could be extremely serious. It is also essential to avoid the introduction of extraterrestrial organisms to our planet and the contamination of other planets with Earth organisms.

From the point of view of scientific interest, the effects of radiation at cellular level and the mechanisms of lesion production should be investigated. It may prove useful to determine the effect of combined hard radiation and vacuum on organic chemicals to see if any change is produced which might indicate how life forms evolved from simpler compounds.

The absence of gravity can be used to facilitate or to more nearly theoretically 'perfect' certain physico-chemical processes used for biological experimentation, such as electrophoretic separation.

Plant experiments

When long spaceflights are envisaged, knowledge about the growth of plants for food purposes will be needed. A major factor in determining the organisation and growth responses of plants on Earth is the particular orientation of the growing elements in relation to external stimuli, such as light and gravity.

Much of the mechanism of plant responses resides in the inherent polarity of the individual constituent cells and in the polarity of movement of growth regulatory chemicals from one cell to another. The redistribution of these chemicals that occurs in an organ when it is displaced from its 'proper orientation' to gravity is recognised as instrumental in reinstating the normal growth pattern. The precise mechanisms involved, however, await elucidation.

Whereas experiments can be, and are, conducted on Earth in uniform gravitational fields by proper rotation of the subject, the condition of zero gravity is available only in space. The combined conditions of cosmic radiation and weightlessness are likewise unique to the space environment.

CONCLUSIONS

The prime reasons why life-science experiments in space are of such interest are that the conditions of zero gravity and the availability of a wide spectrum of hard radiation are unique to the space environment. Life-science investigations may be undertaken for two main reasons: firstly, to ensure safety and efficiency of working in a space environment, and secondly for the scientific interest in the effects of weightlessness and cosmic radiation. Essential knowledge is needed about the performance of the vestibular balancing mechanism and the related problem of 'stomach awareness'. The safety of crews in the presence of cosmic radiation is considered vital.

The effect of zero gravity on the cardiovascular system will be studied. The effect of circulatory changes in the brain, possible psychological stress, and effects on exercise tolerance will be measured. Such experiments can include critical experiments on animals.

Experiments in which gravity can be controlled right down to zero will make it possible to investigate a biological system in a manner impossible on Earth.

Due to their rapid reproduction, important information may be gained from micro-organisms in respect of mutation rates when exposed to radiation. Plants depend, to some extent, on gravity in germination and growth. Of particular interest here is the relative importance of gravitational and photonic influences.

With the advent of the Space Shuttle and Spacelab, the restrictions of past manned spaceflight, such as limitations on weight and volume, crew time and frequency of missions, will be relaxed substantially. Thus, the Shuttle/Spacelab era will open up many opportunities for life scientists to perform flight experiments as part of an overall Life Sciences Programme. □

New Director of ESTEC takes up Duty

Dr. Johan Berghuis (50), who took up duty as Director of ESTEC on 1 November 1975, was born and educated in Amsterdam. A student of Mathematics and Physics, his first post after receiving his Master's degree in Mathematics was with the Mathematical Centre, Amsterdam, a government-sponsored institute carrying out research and consultancy work in pure and applied mathematics. In 1955, he joined the staff of the Technical University of Delft, where he completed his Doctor's thesis in Technical Sciences.

Dr. Berghuis comes to ESA from Philips, with whom he has worked since June 1964, and where he was lately both Computer Systems Manager (Philips Electrologica BV) and Plans and Programmes Manager for Unidata, a company operated jointly by CII, Philips and Siemens. His first ties with the computer industry date from the late fifties, when he was Scientific Adviser to Compagnie des Machines Bull, in Paris. He is a co-founder of the Netherlands Computer Society, and from 1968 to 1973 was Professor of Project Management and Applied Mathematics at Delft University. □

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Copies of the Review are available free of charge. Requests to be placed on the distribution list should be addressed to ESA Scientific and Technical Information Branch, c/o ESTEC, Domeinweg, Noordwijk, Netherlands.

The following papers were published in Vol. 1, No. 3:

Payload of the 'GEOS' Scientific Geostationary Satellite, *by K. Knott*

ABSTRACT

This paper describes the payload of the European scientific geostationary satellite GEOS, to be launched early in 1977. Following a short outline of the mission, each of the satellite's seven experiments is described in terms of its scientific objectives, its measuring techniques, and its functional and major operational aspects. In the sections on experiment functioning, emphasis has been given to presentation of the satellite's telemetry and telecommand interfaces. The description of the telemetry and telecommand functions is based on mid-1975 concepts. While small details may be subject to change, no changes are expected in the main data channels or in the basic content of the telecommand words.

RESUME

On décrit la charge utile du satellite scientifique géostationnaire européen GEOS qui sera mis sur orbite au début de 1977. Après une brève présentation de la mission du satellite, on décrit les objectifs scientifiques, les techniques de mesure, ainsi que le fonctionnement et l'opération en orbite de chacune des sept expériences embarquées. Dans les sections consacrées au fonctionnement des expériences, on met l'accent sur les interfaces du système télémesure/télécommande, en se basant sur la conception en vigueur au milieu de 1975. Si des modifications mineures peuvent encore intervenir, on ne doit par contre s'attendre à aucun changement dans les principaux

canaux de données ni dans le contenu des ordres de télécommande.

Table de simulation de mouvements pour l'étalonnage d'instruments d'astronomie spatiale, *par T. Nguyen Trong & J. Raynard*

ABSTRACT

The simulation table is an instrument for performing the motions of a solid body about a fixed point. The motion is composed of three independent rotations, pitch (α_X), roll (α_Y) and yaw (α_Z), which are measured with a precision of $1/100^\circ$. The angles α_x and α_y can vary within a range of $\pm 15^\circ$, and α_z within a range of $\pm 360^\circ$. The instrument is designed to operate in a vacuum chamber at 10^{-6} torr and is controlled from the outside, either manually from a console, or by a computer. The zero position may be chosen at will and monitored by an optical system through an airlock in the chamber.

This instrument has been used to calibrate the astronomical experiment packages for rocket programmes (JANUS and FAUST) and for the D-2B satellite.

RESUME

La table de simulation est un instrument réalisant le mouvement du corps solide à point fixe. Ce mouvement se décompose en trois rotations indépendantes: tangage (α_x), roulis (α_y), lacet (α_z). Ces trois paramètres sont mesurés avec une précision de $1/100^\circ$. Les angles α_x et α_y peuvent varier sur une plage de $\pm 15^\circ$, α_z sur une plage de $\pm 360^\circ$. L'instrument est conçu pour fonctionner dans une cuve à vide (10^{-6} torr); il est commandé de l'extérieur soit manuellement à partir d'un pupitre, soit par un ordinateur. La position du zéro peut être choisie à volonté et contrôlée en redondance par un système optique utilisant un hublot de la cuve.

Cet instrument a été utilisé pour les étalonnages des expériences astronomiques embarquées sur fusées (JANUS, FAUST) et sur le satellite D-2B.

A Guideline for the Analysis and Synthesis of a Nonrigid-Spacecraft Control System, *by D.H.L. Poelaert*

ABSTRACT

A convenient mathematical model using the eigenmodes of the complete structure is recommended for the dynamic analysis and control design of a flexible spacecraft. The effect of mode truncation is discussed through energy considerations. The design of an optimal linear control is presented using a state observer, and the sensitivity of such a closed-loop system to parameter uncertainties is examined. The suggested approach is applied to a typical example of a three-axis stabilised satellite with two flexible solar panels.

RESUME

On recommande d'établir un modèle mathématique pratique à partir de modes propres de la structure complète pour effectuer l'analyse dynamique et l'étude de la stabilisation d'attitude d'un véhicule spatial flexible. On traite des conséquences de l'utilisation de modes tronqués en faisant appel à des considérations énergétiques. A l'aide d'un observateur d'état, on présente la conception d'une loi de commande linéaire optimale et on examine la sensibilité aux incertitudes sur les paramètres de ce système de boucle fermée. La méthode proposée est appliquée à un exemple typique de satellite stabilisé 'trois axes' et muni de deux panneaux solaires flexibles.

Space Application of CCD Image Sensors, *by H. Samuelsson*

ABSTRACT

Image sensors based on CCD (Charge Coupled Device) technology appear attractive for use in space. This article reviews some applications envisaged for future space projects and attempts to identify the requirements each application will impose on the sensor. Areas are indicated where particular efforts are required to make a CCD sensor compatible with these requirements.

RESUME

Les senseurs d'images basés sur la technologie des dispositifs à couplage de charge (CCD) présentent des caractéristiques intéressantes pour une utilisation spatiale. Cet article passe en revue quelques applications envisagées pour des projets spatiaux futurs et essaie d'identifier les exigences propres à chaque application pour ce type de senseur. On indique les domaines où des efforts particuliers sont demandés afin de réaliser un senseur à dispositif à couplage de charge compatible avec ces exigences. □

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PROCEDURES, STANDARDS AND SPECIFICATIONS

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ECDB-1 Resistor reference book, *by Electronic Components Databank Section, ESA Space Documentation Service.*

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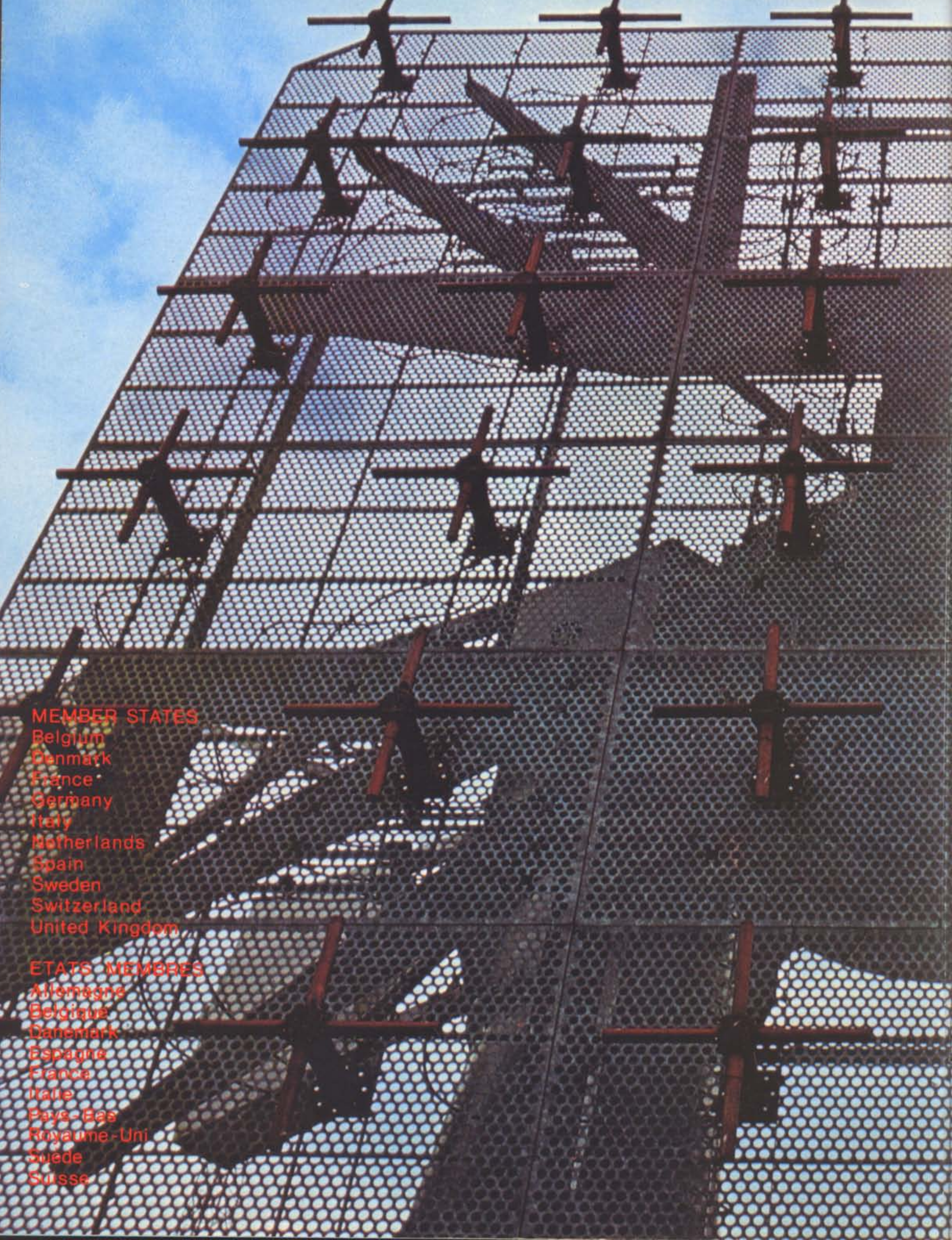
The Scientific Satellite Programme during the International Magnetospheric Study – Proceedings of the 10th ESLAB Symposium, held at Vienna, Austria, 10–13 June 1975, Reidel, Dordrecht, January 1976. *Edited by K. Knott and B. Battrick.*



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