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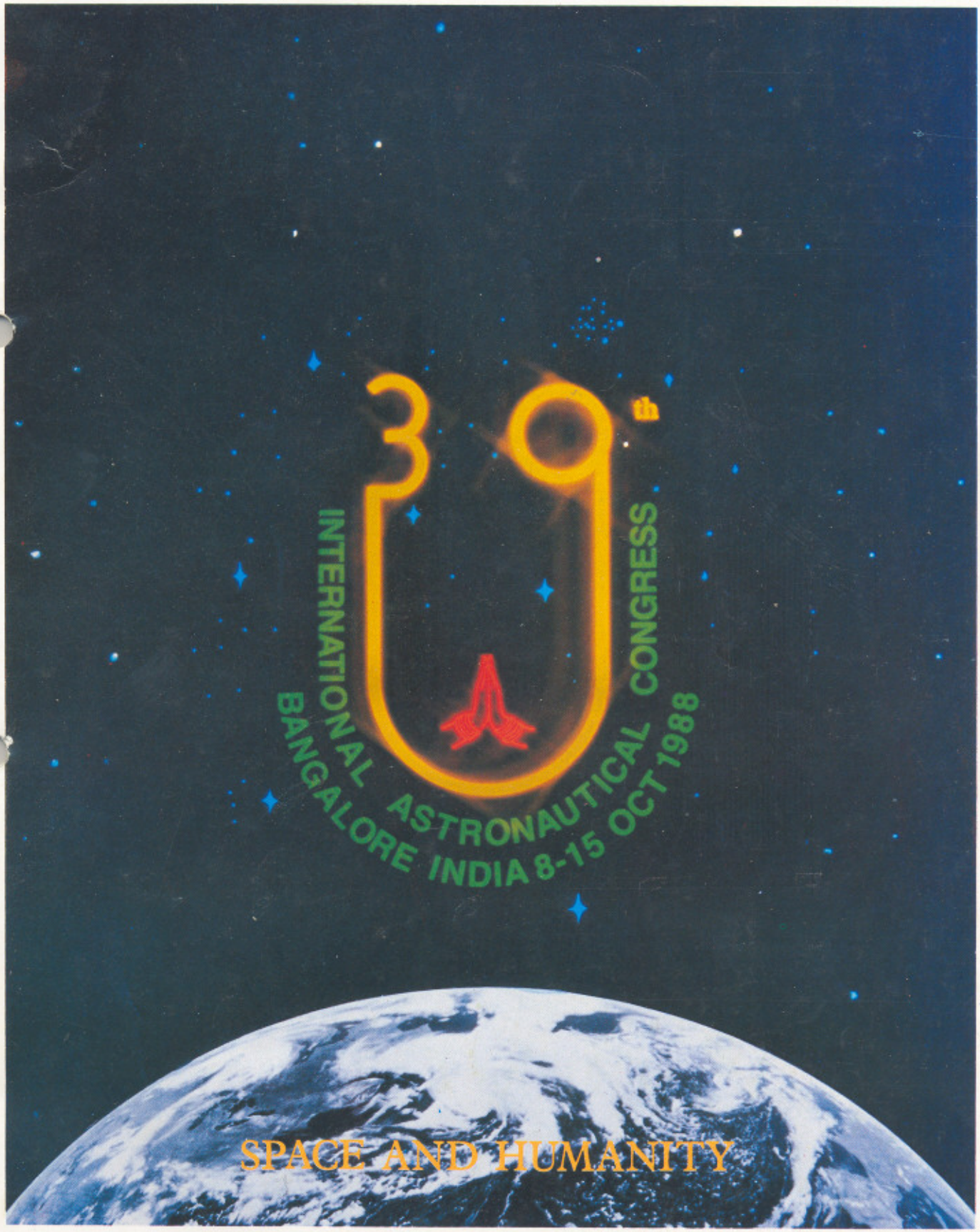
SPACE india



INDIAN SPACE RESEARCH ORGANISATION

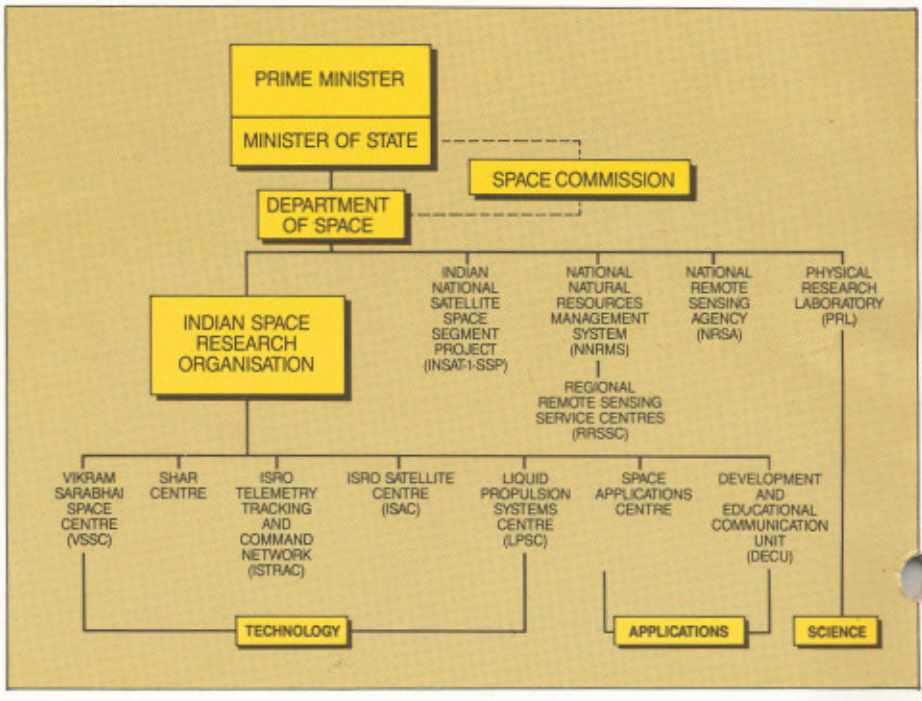
The Indian Space Programme

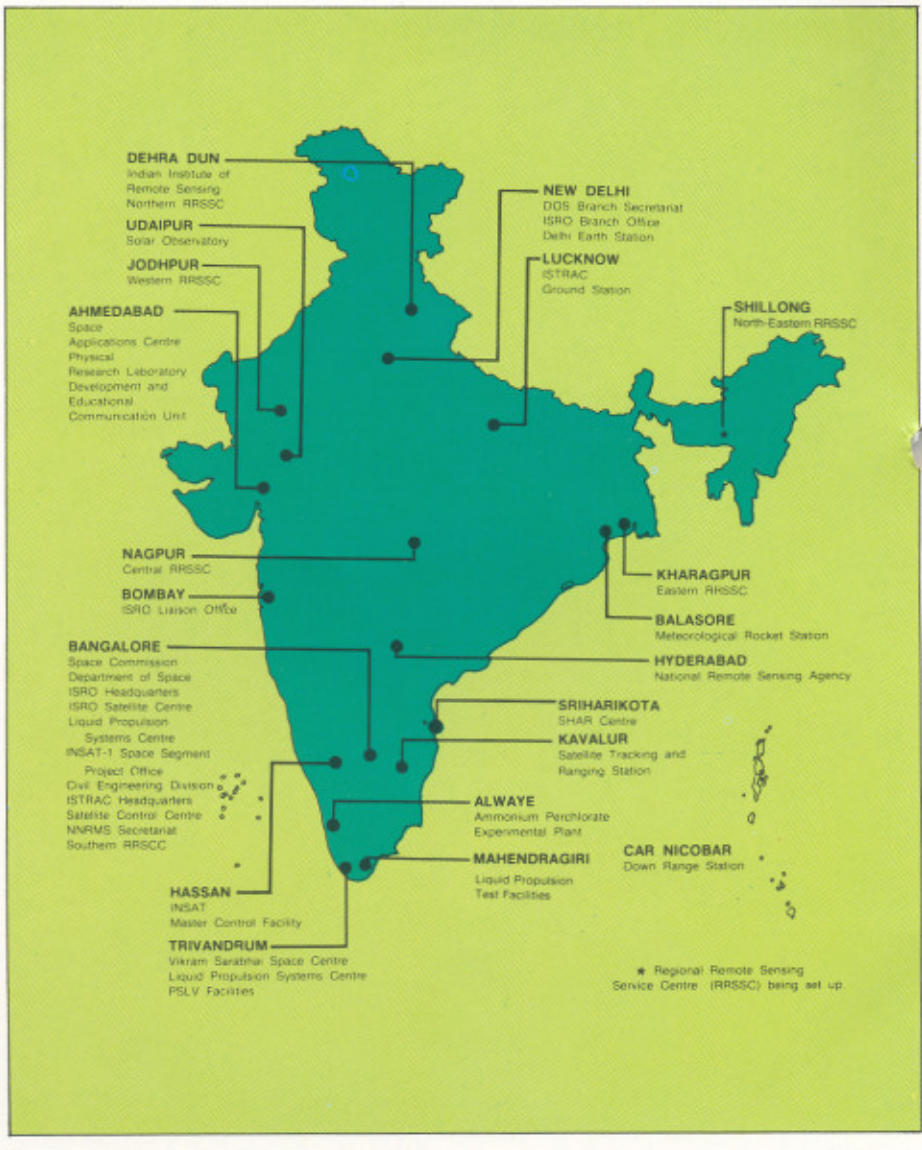
The setting up of the Thumba Equatorial Rocket Launching Station (TERLS) in 1963 marked the beginning of the Indian Space Programme. The Space Commission and the Department of Space (DOS) were established by the Government of India in 1972 to promote unified development and application of space science and technology for identified national objectives.

The Indian Space Programme is directed towards the goal of self-reliant use of Space technology for national development, its main thrusts being: (a) satellite communications for various applications, (b) satellite remote sensing for resources survey and management, environmental monitoring and meteorological services and (c) development and operationalisation of indigenous satellites and launch vehicles for providing these space services.

The Indian Space Research Organisation (ISRO) is the research and development wing of DOS and is responsible for the execution of the national Space programme. ISRO also provides support to universities and other academic institutions in the country for research and development projects relevant to the country's space programme.

Both the DOS and ISRO Headquarters are located at Bangalore. The development activities are carried out at the Centres and Units spread over the country□





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J. Raja
Manoranjan Rao

ASSISTANCE
S.K. Dutta
B. Chandrasekhar

Oct.-Dec., 1988

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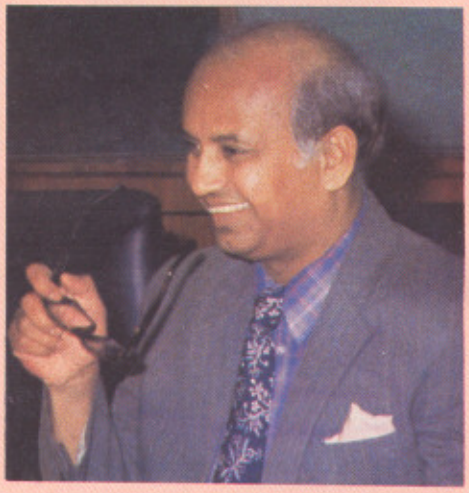
A Letter from Prof. Rao



It has been a proud privilege for us in India to host the 39th Congress of the International Astronautical Federation at Bangalore. The decision of the International Astronautical Federation to have the Congress at Bangalore this year was based on the recognition of the progress made by the Indian Space Programme and to commemorate the 25th anniversary of ISRO, the primary goal of which has always been to harness the full potential of space technology for national development. Space & Humanity, the focal theme of the Bangalore Congress is thus in consonance with our own aspirations and transcends all geographical and political barriers. The proceedings of the Congress, therefore, will be a pointer to nations trying to utilize space technology for development.

This issue of 'Space India' presents a gist of what took place during the Congress at Bangalore. We hope that all our readers will enjoy reading this issue.

(U.R.Rao)
Chairman, ISRO &
President Astronautical Society of India

The inaugural session of the 39th Congress took place at the Chowdiah Memorial hall

The Bangalore Congress

The 39th International Astronautical Federation (IAF) Congress, the largest of its kind on the annual space calendar, opened at Bangalore, India on October 10, 1988. The capital of the southern Indian State of Karnataka, Bangalore is a major industrial and commercial centre. It is also the nucleus of many scientific, technological and research activities; leading hi-tech institutions including the Indian Space Researh Organisation are located in this cosmopolitan city.

Hotel Ashok, the main venue of the Congress wás bustling with activity from October 8th itself. The registration of delegates had already commenced. By the morning of the 10th most of the participants had arrived, though the stream of delegates continued to trickle till the last day of the Congress. The inaugural session of the Congress took place on the morning of 10th at the Chowdiah Memorial Hall — the Violin shaped auditorium built in memory of Mr. T. Chowdiah, the Violin master of Karnataka. The air inside the hall was filled with 'Swagatha Sangeetha' — the music of welcome, played on Nagaswara the traditional pipe instrument of South India. A harbinger of auspicious and joyous things in life, nagaswarà has always been a part of South Indian temple festivals, marriages and other happy occasions.

The inaugural session began with an invocation of a Sanskrit hymn from the Upanishads — the ancient Indian scriptures; this was followed by a devotional song in the Kannada language composed by Sri. Purandaradasa, the saint-poet of Karnataka. The invocation was rendered in the classical Carnatic style of music by the artist-sisters, Kavita Saralaya and Triveni Saralaya of Bangalore. Business started with welcome speeches by Prof. U.R.Rao, President of the Indian Astronautical Society, the host and Dr. J. Ortner, President IAF.

Dr. V. Kopal read out a

message from the Secretary-General of U.N., Dr. Javier Perez de Cuellar, to the Congress. Mr. K.R. Narayanan, Minister of State in the Indian Ministry of Science and Technology inaugurated the Congress by reading out a message from Mr. Rajiv Gandhi, the Prime Minister of India.

The highlights of the morning session were, of course, the invited lecture by Prof. U.R. Rao and a set of five theme session papers — three from USA, one from USSR and one from Japan. After this the venue shifted to the Hotel Ashok where there was a kick-off press conference by Ortner and Rao. More than 60 representatives of the press were registered for the conference, half of them Indian. A comprehensive Media Centre was organised by the Indian Telecommunication Department to cater to the needs of the press. Telex, international subscriber dialling, telegraph and FAX services were available at the Media Centre. In addition, there were daily press briefings by the chairpersons of the various sessions.

This year's Congress was attended by 875 delegates including 33 students. Over 600 papers were presented in 70 technical sessions. The sessions were conducted at three venues; Hotel Ashok, Hotel Windsor Manor and Holiday Inn, all of which are located within a stone's throw from each other. The weather was pleasant and sunny throughout, making stroll from one venue to the other an enjoyable experience. The preprint hall in the Windsor Manor and the majestic banquet hall in Hotel Ashok, where Programme Committee meetings and the Current Event sessions took place, were two of the most sought after places at the conference.

The registration desks at Hotel Ashok were busy from October 8th itself.

Outside the technical sessions, delegates could exchange views and notes during informal meetings at the pool-side receptions in the evenings and during corridor chats. On the 12th evening the delegates were invited to a cultural programme in which the renowned Indian danseuse Malavika Sarukkai gave a delectable Bharata Natyam performance.

The Congress started with an invocation in Sanskrit.

The inaugural session at the Chowdiah Memorial hall.

On Saturday, the 15th, technical tours were arranged to the ISRO Satellite Centre, the assembly bay of the Hindustan Aeronautics Ltd., the Satellite Control Centre of the ISRO tracking network ISTRAC and the interactive image processing facilities of the Regional Remote Sensing Service Centre (RRSSC) at Bangalore. These visits gave the delegates a glimpse of the current activities of the Indian Space Programme. Social programmes including cultural visits provided a choice of excursions to temples and historic places. Special demonstration programmes explaining Indian cooking, wearing a saree etc., were also arranged for the spouses accompanying the delegates. For the delegates who had the time to stay back in India for a few days after the Congress, tours to places like Jaipur, Agra, Madras and Delhi were arranged.

For the Indian participant, the Congress provided an occasion to meet with a galaxy of experts from the leading space agencies and organisations. They could also learn of the latest trends and advances being made by other space-faring nations and agencies.

For the organisers, the Congress proved to be a very challenging and satisfying experience □

Prof. U.R.Rao (third from left), Mr. K.R.Narayanan and Dr.J.Ortner at the inaugural session.

Theme Session on 'Space and Humanity'

Sponsors

The 39th IAF Congress was hosted by the Astronautical Society of India and sponsored by the Department of Space, Government of India. The co-sponsors of the Congress included :

* The Council of Scientific & Industrial Research (CSIR), New Delhi.
* Defence Research & Development Organisation (DRDO), New Delhi.
* Indian Telephone Industries (ITI), Bangalore.
* Larsen and Toubro Limited, Bombay
* National Aeronautical Laboratory (NAL), Bangalore
* University Grants Commission (UGC), New Delhi
* Walchand Nagar Industries Limited, Baroda

Ms. Malavika Surukkai gave a delightful 'Bharata Natyam' on the cultural evening.

Space :

Common Heritage of All Humankind

Mr. Rajiv Gandhi, the Prime Minister of India, who was to have inaugurated the Congress could not make it because of urgent work in New Delhi. "My absence does not in any way diminish the warmth of the welcome we extend to you" the PM said.

Mr. K.R.Narayanan, Minister of State for Science and Technology, read the PM's message. Excerpts:

We are honoured by the presence here of the world's most distinguished space scientists and technologists.

The 39th Congress of the International Astronautical Federation is being held at Bangalore. This is the capital of aerospace activities in India. Your Congress coincides with the 25th anniversary of the Indian Space Programme. This international event also coincides with the birth centenaries of two of our greatest scientists, the Nobel prize winner, CV Raman and the mathematical genuis, Srinivasa Ramanujam, as also that of Jawaharlal Nehru, the prime architect of modern India. The theme you have chosen **"Space and Humanity"** reflects the deep belief of these statesmen and savants in the development of human society through science and technology.

From time immemorial men and women have looked up to the skies in curiosity and wonder, with fear and fascination. Which of us has not been touched by the romance of space exploration? Who has not dreamt of a journey to the stars? However, the exploration of space is not only the province of scientific fiction writers but deeply associated with the future welfare of humanity.

India's scientific tradition in the field of astronomy dates back to ancient times. It reached its apogee in the fifth century with the great astronomer and mathematician, Aryabhata. In spite of such a rich scientific heritage, colonisation virtually halted India's progress, in utilising the capabilities of modern science and technology. The credit for revitalising the scientific tradition after India attained its independence, goes to Jawaharlal Nehru. He said

"Science alone can solve the problems of hunger and poverty, insanitation and illiteracy, of superstition and deadening customs and traditions, of vast resources running to waste, of a rich country inhabited by starving people".

Nehru saw science not just as a tool for economic development but also as a means for the emancipation of humankind. To him, the scientific temper was the true religion which had to percolate to the people. Only thus, he believed could the qualitative transformation of society be achieved.

India has been following the path set out by Jawaharlal Nehru. Considerable progress has been achieved in the field of science. Important strides have also been made in the Space Programme. Our Space Programme is closely linked with development needs. Space technology when put to use in various areas of development, touches virtually every facet of human life - communication, meteorology, agriculture, education, industrial growth, resource management, environment, disaster mitigation, health and entertainment. More important still, the benefits flowing from space technology become available to both urban and remote rural areas, as well as developed and developing regions. Space technology provides instantaneous access to programmes, shrinking both time and distance, helping transcend narrow walls. Space science and technology have the potentials of providing a new perspective of our own planet that of a single global village. The concept of the oneness of humankind has been an integral part of our ancient

heritage. Our great epic, the Mahabharatha says:

> "This is mine that is anothers,
> such reckonings are for
> the narrow minded.
> For the noble hearted,
> the whole world is
> one family".

International co-operation in science and technology, particularly in the field of Space, can go a long way towards ensuring a better standard of life for all humankind. Many important activities such as the monitoring of the environment, meteorological phenomena, and ocean-atmospheric dynamics are global in nature. On the other hand, a large number of problems such as domestic communications, education, rural development, and resource management require the application of space technology, based on the aspirations of the people of each developing country and their economic, cultural, social and technical background.....

We believe that much greater concerted international effort is required to enable developing countries to have full access to the benefits of space technology. On our part having derived considerable benefits from international co-operation, we have regarded it as our moral obligation to initiate a new programme on a "sharing of experiences in space" called SHARES. Under this programme we have already trained a number of scientists from developing countries in areas of relevance to them. We reiterate our firm and unequivocal commitment to international co-operation in the peaceful exploration and utilisation of outer space, for the development of humanity as a whole.

If, as recognised by the United Nations, Space is to be treated as the "common heritage of all mankind", its pristine tranquility must not be jeopardised by extending our quarrels on earth into space. Recent attempts to extend the introduction of destructive weapons into space are ominous developments, of great concern to humanity. Every step taken with a view to creating impenetrable defences has only escalated the arms race and brought humankind that much closer to its end. More than ever today, human survival depends upon concerted action and immediate negotiations to usher in a world free of nuclear weapons and rooted in non-violence. With this in view an action plan was submitted by India to the Third Special Session on Disarmament of the United Nations General Assembly. The action plan calls upon the international community to negotiate a binding commitment, a commitment that is total and without reservation, to general and complete disarmament. The action plan seeks the elimination of all nuclear weapons, in stages, by the year 2010 at the latest. We believe that if the nations and peoples of the world act together and with sagacity, it is possible for the human race to survive the second millenium and also ensure peace, security and survival into the third millenium and beyond.

I applaud the efforts of the community of scientists belonging to the IAF, which is truly an international organisation representing all shades of political, economic, cultural and idealogical systems. I would hope your discussions here will not be restricted to technological developments alone but also cover the larger dimension of the peaceful uses of space technology for the benefit of humankind. You work in an area often referred to as the "Heavens". The heavens must remain serene, tranquil and peaceful. While expanding the frontiers of science and technology, you must also provide a new vision of humanity. Your work must serve as a bridge between the east and the west, the south and the north, the developing and the developed, the deprived and the affluent □

Mr. K.R.Narayanan, Minister of State for Science and Technology read out the Prime Minister's Message.

Visions in International Cooperation

J. Ortner

First of all I would like to thank you, Prof. Rao, for your cordial welcome and express on behalf of the IAF and its associate organisations, the International Academy of Astronautics and the International Institute of Space Law, our great appreciation for all you and your collaborators have done in order to prepare this congress.

When I was elected President of the IAF in 1986 I was reflecting on what initiatives should be taken in order to strengthen the scientific and technical cooperation throughout the world. As regards the big space powers I expressed the hope that the big future visions like the manned mission to the planet Mars, a human settlement on the Moon or the Solar Power Satellite project should be undertaken jointly sharing expertise, experience and financial resources. After the successful completion of the recent Discovery mission, seeing the continued success of the long duration flights of the Soviet Union on the Mir Station and taking into account the tremendous efforts of Western Europe, Japan and other space nations the vision of accomplishing jointly such futuristic project becomes more and more realistic.

The second and may be still more important goal was to motivate all nations of our earth to work together in space for the benefit of mankind. This year the Congress takes place for the first time in India demonstrating the emphasis the IAF has put on the development perspective of space activities having dedicated the theme to "Space and Humanity". India is showing in an exceptional way how a developing country is able to contribute by means of space research and technology and its applications to the well-being of

Dr. J. Ortner delivering his Presidential address.

Space

This invited theme lecture by Prof. U.R. Rao, appreciated widely by the delegates to the Congress, is available as a 25 page special publication No. ISRO-SP-39-88, on request. Excerpts:

Amongst all the great scientific advances of the 20th century, Space exploration is undoubtedly the most momentous one not because of the great scientific discoveries about the universe around us or the impetus it provided for all round development of technology, or the spectacular human feats in Space including landing on the Moon and perhaps even landing on Mars which may follow soon, or even the fact that human dream of exploring infinity has been realised but primarily because of the immense impact Space has on the whole of humanity providing for the first time a ray of hope, to ensure its very survival with an improved quality of life.....

its people.

Here an excellent example has been set that it is possible to make important achievements with relatively limited funds.

At this stage preparations are being made for the International Space Year in 1992 with particular emphasis on a project called "Mission to Planet Earth". This undertaking will provide an outstanding opportunity of bringing together space nations with developing countries all over the world in order to make this project a success.

Still institutional frameworks have to be set up to give developing nations especially those which so far have not yet been involved in space activities, the chance to participate. Here the IAF should also play a major role. Another important task for the future would be to make Space still more attractive for young people. Here the IAF has a great responsibility for the next generation.

When I became President this Federation counted about 80 members from 37 nations. Today I am proud to say that at our General Assembly this afternoon the IAF family will most likely grow to more than 100 members from 38 nations. But our member societies and industries belong to only ¼ of the nations of the world. Therefore still much work has to be done to make the IAF a real worldwide Federation, embracing in particular additional countries from the Third World.

Some of you - when waiting for airline connections in Bombay - may have recognised on a wall of the airport a statement of Indira Gandhi saying "Our world is small, but it has room for all of us to live together and to improve the quality of lives of our people in peace and beauty". Let's contribute to this □

and Humanity

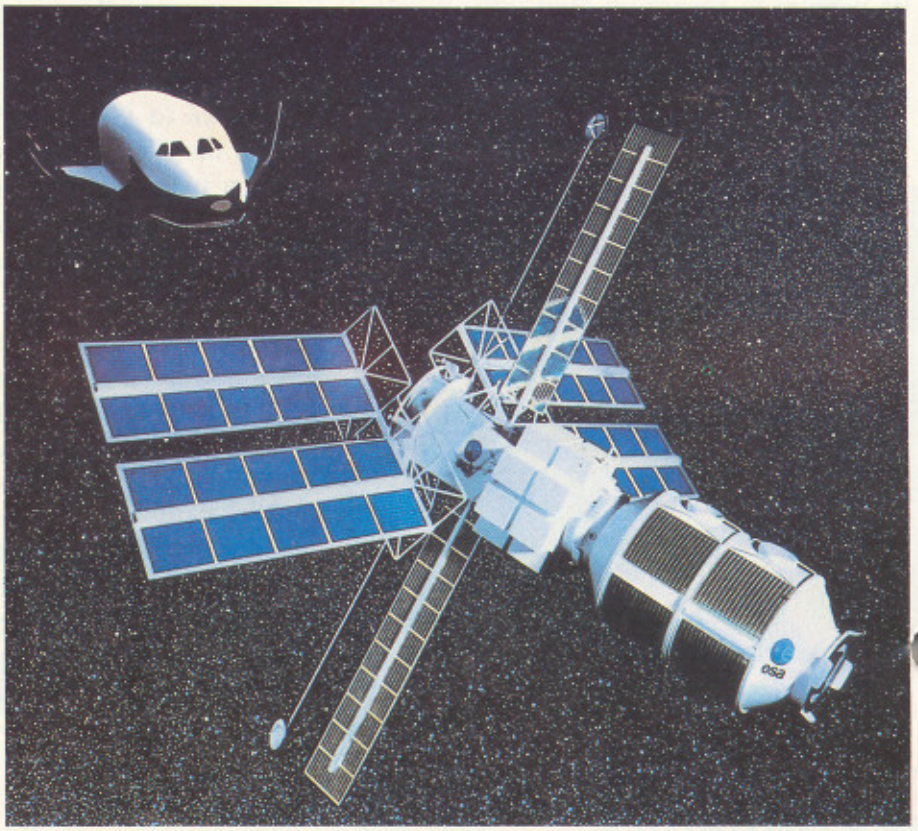
In just about three decades since humankind entered the new Space age, the phenomenal development in Space activities has enabled the world to realise extensive benefits. Space has thus provided a new perspective of our planet, that of a single global village. If only we can overcome our narrow human prejudices ..... and forge international cooperation ..... Space and Humanity will become synonymous .....

The promise is great but the challenges to the international community are greater. The key towards consolidating the gains already achieved and for realising the promise that Space holds for the future, lies in effective international cooperation. To ensure that the world scene is conducive for promoting such cooperation, it is vital that Space is freed from weapons of any kind. If weaponisation of Space becomes a reality it will deal a major blow to international cooperation. A great challenge before all of us assembled here is to try to ensure that this does not happen.....

The role of Space community should be to use Space to forge the concept of global unity in the interest of entire humankind instead of being used as tool for further dividing the north and the south, and to ensure that unfettered commercialisation resulting in high cost of Space services are checked to make available the benefits of space to all countries at affordable prices. If we fail in this endeavour, the human civilisation will inevitably face an explosive turmoil compared to which the present inequity in human society will be in significant. If, on the other hand, wisdom prevails and Space community as a whole works for the betterment of human society with adequate backing of political will, we human beings then will be able to keep our tryst with destiny and will fulfil all the promise that Space holds for the entire humankind □

Prof. U.R.Rao's invited talk was the highlight of the theme session.

The Soviet Mir Station.



The Man-Tended Free-Flyer (MTFF) is an European automatic laboratory for experiments in microgravity. MTFF will form a part of COLOMBUS international space station and be serviced by HERMES crew.

Technical Sessions Round-up

The scope of technical deliberations at the Congress can be gauged from the following statistics. There were, in all, over 70 sessions covering more than 20 major subjects spread over just four days; at any time there were eight parallel sessions in progress. About 600 technical papers were presented and discussed. In addition there were 'Current Event' Sessions in the evenings, Press Briefings by Chairpersons of Sessions every day at noon and so on.

It is something of an impossibility even to attempt to give brief summaries of all the subjects covered. Nevertheless, the following 'Chiaroscuro' should convey some flavour of what transpired during the technical sessions .

Space Stations

One of the hottest subjects to be discussed at the Congress was *'Space Stations'*; the Soviets presenting the results from MIR + KVANT and the West, led by the U.S.A. presenting their plans for international Space Station, Freedom

A minipert chart for Space Station Freedom looks like this:

* PDR — 14 months from October 1988.
* Work packages — 4 contracts already signed
* First operational Test Launch — 1995

As is well known Freedom is joint collaborative effort by the U.S.A., Europe, Canada and Japan. The financial

commitments are roughly, (in billions of U.S. $)

USA — 14.5
Europe — 4.0
Japan — 3.0
Canada — 1.0

It is claimed that Freedom is 100 times more effective than the Shuttle, as far as the users are concerned. Well, that looks like a good selling point.

The main European contribution to Freedom is Columbus, while Japan pitches in the JEM (Japanese Experiment Module). Canada provides with Mobile Servicing System.

The Soviets, who hold records for many Space-firsts, including longest stay in orbit, have presented their results from MIR + KVANT complex and from SALYUT-7, SOYUZ-T.

For the first time in IAF, manned-systems were discussed in great detail. Similarly, there was lively discussions on standardisation of man-rated systems, but no consensus seems to have been arrived at.

Space Transportation

One of the subjects to excite lot of interest was 'Space Transportation', for which four sessions were devoted. The transportation systems discussed ranged from India's Polar Satellite Launch Vehicle (PSLV) to the Soviet's Energia, the most powerful rocket in the world today with a payload capability of over 100 tons in the low earth orbit.

The American presentations dealt mostly with commercial aspects of carriers like Atlas/Centaur, Delta and so on.

The Japanese are developing their H-II as their main workhorse for the 90's; H-II is a 2-stage cryogenic vehicle with solid

Energia lift off.

Technical Sessions

The Bangalore Congress hosted 70 technical sessions with as many as eight sessions running parallelly at any given time. Following are the topics covered in these sessions:

- ★ Space education
- ★ Space transportation
- ★ Space stations
- ★ Space exploration
- ★ Microgravity sciences & processes
- ★ Space systems
- ★ Astrodynamics
- ★ Space & global change
- ★ Life sciences
- ★ Space propulsion
- ★ Earth observations
- ★ Safety & rescúe
- ★ Space plans & policies
- ★ Materials & structures
- ★ Space power
- ★ Benefits to society from space activities
- ★ History of astronautics
- ★ Economics of space operations
- ★ Satellite communications
- ★ Search for extra terrestrial intelligence
- ★ Law of outer space
- ★ Space sciences.

A spectacular sunrise as seen by the shuttle "Discovery".

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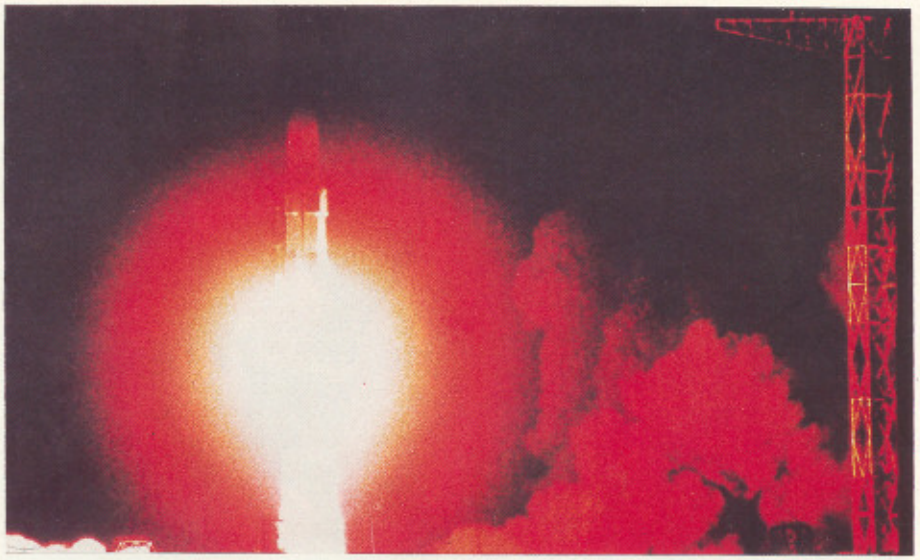


Energia lift off.

Technical Sessions

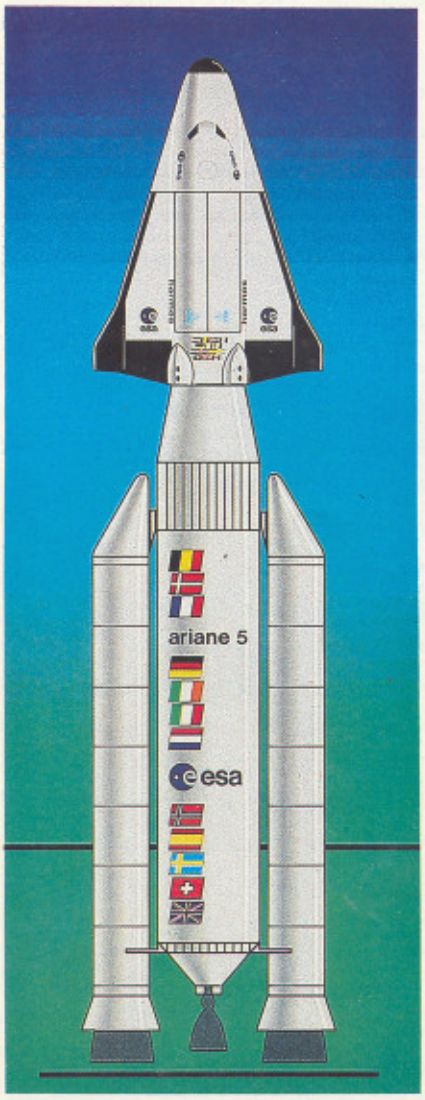
The Bangalore Congress hosted 70 technical sessions with as many as eight sessions running parallelly at any given time. Following are the topics covered in these sessions:

★ Space education
★ Space transportation
★ Space stations
★ Space exploration
★ Microgravity sciences & processes
★ Space systems
★ Astrodynamics
★ Space & global change
★ Life sciences
★ Space propulsion
★ Earth observations
★ Safety & rescue
★ Space plans & policies
★ Materials & structures
★ Space power
★ Benefits to society from space activities
★ History of astronautics
★ Economics of space operations
★ Satellite communications
★ Search for extra terrestrial intelligence
★ Law of outer space
★ Space sciences.

A spectacular sunrise as seen by the shuttle "Discovery".

The microgravity environment in space.

The 'Hermes' space plane on the Ariane-5.



The Chinese Long March-2 rocket.

rocket boosters and has a payload capability of 4 tons in GTO and 10 tons in LEO. The maiden flight is scheduled for 1992.

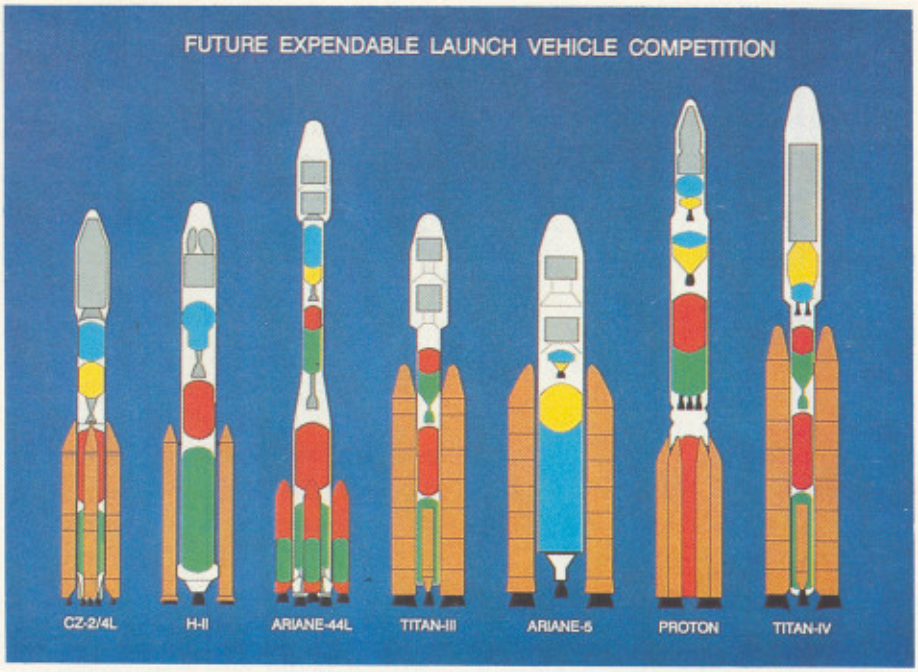
The star attraction is, of course, the Energia which weighs an awesome 2000 tons at lift-off and can launch a 100 ton payload into LEO. The sheer power of Energia can be gauged from the fact that each of the 4 unified liquid engines in the first stage develops a thrust of more than 800 tons! Energia is the major element of the reusable space transportation system being developed by the USSR.

Both the Americans and the Europeans unvieled their plans for the future. The former have their eyes set on the Advanced Launch System that can bring down launch costs to US $300 per pound of payload in LEO by the year 2005. The Europeans talked about EARL (European Advanced Rocket Launcher) — a post-Ariane-5 vehicle likely to be operationalised by 2005. Some details of the Ariane-5 Transfer Vehicle (ATV) were also presented. The ATV is an unmanned vehicle designed to transport logistics needed to resupply the International Space Station.

The Chairpersons briefing the Press said that most of the interesting discussions were related to the commercial competition between various types of launchers presently available in the market, the Government subsidies, etc.

Space Propulsion

Space Propulsion is, undoubtedly, a very crucial field if only because without it you can't leave the mother earth. Yet, the papers presented at these sessions

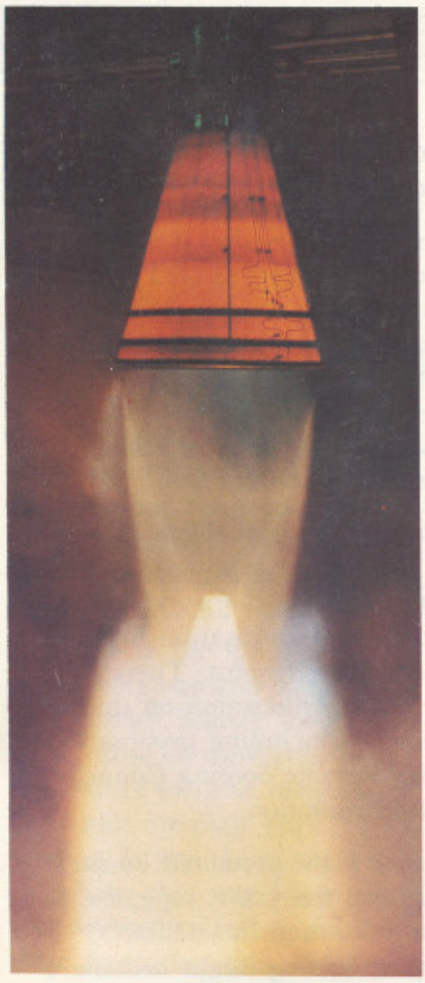


devoted to space propulsion reveal an interesting (or disappointing?) story. From the big-league spacefaring nations like the U.S.A., U.S.S.R., Europe (E.S.A.) and Japan there was not a single paper which describes a real working engine used for primary propulsion! Yes, there were half-a-dozen papers dealing with electric or ion engines with a suggestion or two on how to use them for transferring a spacecraft from LEO to GEO. There were also conceptual descriptions of fancy engines making use of matter-antimatter annihilation processes which border on science fiction (at least from the today's point-of-view)! A couple of purely theoretical papers were also presented but none dealing with big engines. Well, there may be a message here for us to ponder over!

Ironically, the exception is India which may not belong to the big-league. There were six presentations from India which dealt with both solid and liquid systems used for primary and auxiliary propulsion.

A cursory glance at the abstracts of papers presented shows renewed interest in air breathing propulsion systems to which, experts seem to agree, the future belongs.

The Indian 'Vikas' Engine.



Earth Observations

Covered in seven sessions and over 50 presentations "Earth Observations" stands as the most widely discussed subject at the Congress. Not surprisingly, the Indian contribution, measured in terms of number of papers, is also highest in this subject; altogether 15 Indian papers were presented.

Remote Sensing, perhaps, is one field of space applications that interests both the developed and developing countries equally. Evidently, every nation wants to have a good handle on its resources whether they are underground, over the surface or under the oceans. And Remote Sensing is one technology that can be used to study all these resources.

The Indian presentation on 'Project Vasundhara' seemed to have excited lot of interest. Vasundhara Project's main objective is to intensify search for additional mineral deposits.

Astronautics in Ancient India

A rather unusual paper presented at the conference was that by Dr. Roberto Pinotti of Italy entitled 'Indo-Aryan Traditions and History of Astronautics' the paper describes in some detail the Vimanas mentioned in ancient texts like Ramayana and Mahabharatha and in Rig Veda.

Dr. Pinotti pointed out how the descriptions of Vimanas in flight closely resemble present day descriptions of rockets in flight. Some examples from Mahabharatha:

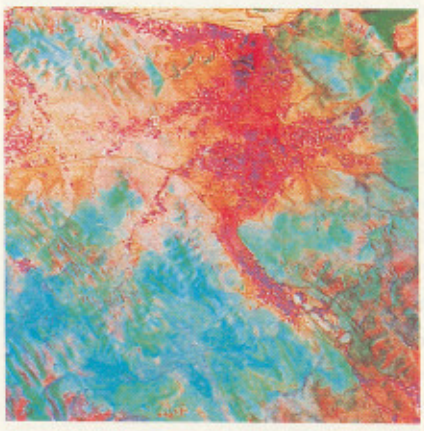
"The radiant vimana gave forth a fierce glow"
"the whole sky was ablaze when (vimana) ascended..."
"...(vimanas) whose noise was like roaring of thunderclouds".

No one who has witnessed a modern rocket lifting off can deny the similarity, Dr. Pinotti also points out that most Vimanas were not winged!

Speaking to 'Space India' Dr. Pinotti freely admitted that he knew no Sanskrit. He had read only English translations and yet he is convinced that our ancients had something up their sleeves. His theme is not merely based on 'descriptions of flights of vimanas', of course. He rather quotes Lord Davenports' (an Airforce Pilot, born in India and well-versed in Sanskrit) analysis of the Sanskrit text 'Vimanika Shastra' (which may be translated as 'Science of Astronautics'). This text originally by Maharishi Bharadwaja, was published in its present form by Pandit Subbaraya Sastry around 1920. It had nothing to do with Indian gods or mythology; it was indeed a technical manual on Vimanas! The Shakuna Vimana, according to Dr. Pinotti, was a cross-between a rocket and a plane, thus recalling to one's mind the present day space shuttle.

Dr. Pinotti's paper gives a detailed description of various types of Vimanas. It should be emphasised that Dr. Pinotti is not a naive amateur dabbling in sensationalism or revivalism; he is a sincere researcher averse to dismissing away any ancient text as mere rubbish. Speaking to 'Space India', Dr. Pinotti made a fervent appeal to Indian scientists and engineers to examine old texts like Vaimanika Shastra with cold eyes of modern science and technology! □

The 'Vasundhara' project studied the geological features in South India.



It is a joint venture between the Geological Survey of India and the ISRO. It covers the major part of south India; to be precise it covers an area of 400,000 sq. km. South of the 17° parallel.

The growth in remote sensing applications in India can be seen from the fact that while in 1980 the data products produced was 700, in 1988 it exceeded 10,000.

The African nation Kenya presented an integrated approach to receive data from many a remote sensing satellite: LANDSAT, SPOT, ERS, etc. Similarly, the Chinese spoke about Meteorological Satellite data reception systems.

The one great problem faced by the remote sensing community in the world is the lack of standardisation in earth observation systems. There were lively discussion on this question, including proposals for a Remote Sensing Council for coordination.

Future plans presented by the west and the USSR suggest that 5 m resolution in satellite remote sensing might become a

A view of one of the technical sessions

reality soon.

Space Science Missions on the decline?

It is widely recognised that Space Technology has over taken Space Science. Except for some high-profile projects like planetary probes and solar system exploration, one does not find much of Space Science being studied. Europe which had good Space Science Missions in the 70's, seems to have joined the big-league by de-emphasising Space Science projects in the late 80's — at least that's the impression one gathered at the Press Briefings by Chairpersons of concerned sessions. The only exception seems to be Japan which repeats same or similar missions every five years or so. The result is that youngsters are guaranteed at least one mission in their academic life-time. Thus Japan has clearly demonstrated its concern for its future generations of Space Scientists.

India, on her part, has plans to provide one spacecraft every year in which aeronomy and astronomy missions are expected to alternate.

Benefits from Space Technology

No country in this world pursues Space Technology for any altruistic purpose. The benefits that acrue to a nation developing Space Technology are so varied and so numerous that it is difficult not to succumb to the lure. Even those scientists who want to study Space Science for its own sake, must be conversant with the nature of these benefits, to get funds for their pure science. It was therefore, not surprising that one full session was devoted to taking stock of these Space benefits.

Depending on one's tastes and predespositions, these benefits can be variously described as scientific, social, economic, cultural, psychological and even metaphysical. "The conviction that such benefits exist is what motivates national Governments to provide funding..." said Prof. Stephen E. Doyle of the U.S.A.

If one were to make an exhaustive list of all those benefits, it would be too long to be contained in this issue of Space India; this is no exaggeration because, the Technology Transfer process at NASA alone has, to quote Barbara Stone, "resulted in over 30,000 Spin-Offs". Some of the products we use in daily life, like the Velcro, have become so common that we do not even suspect them to have any association with Space Technology

We in ISRO mainly emphasise the wide range of benefits derived from satellite communications and remote sensing. But it would be interesting to note how others look at our efforts. We quote Doyle again:

"Although fascinating stories of courageous development programs in astronautics can be told of programs in Argentina, Brazil, Indonesia, Kenya, Mexico and other countries, there is perhaps no story as dramatic as the story of India as it undertook and pursued major space program development over the past 30 years. Examined in some detail, the story of India indicates clearly how participation in space exploration and use produces benefits to a national society as well as to the international society of mankind." □

Astronomy for the Visually Handicapped

Astronomy basically is a 'visual science' in the sense that observations demand optical instruments like telescopes. Space Technology similarly demands perception of three dimensions. That being the situation, who can think of a course, however elementary, for the visually impaired? The answer to this question is that RT Moses and C.Wickham of the University of Bristol in the United Kingdom not ony had conceived such a course but had actually conducted it! The fact that the course had the limited objective of providing only an introduction to astronomy and Space Technology in no way diminishes the importance of their remarkable experiment.

These authors first ran a one-day course as a pilot project; encouraged by the enthusiasm displayed by the handicapped, they conducted one week course successfully. The paper describes in detail how they planned these courses. The authors concluded: "...the overall objective had been successfully achieved... this was a valuable, although demanding mode of educational delivery to an attentive, sharply intelligent, and enthusiastic audience, which forced us to reconsider our preconceived notions of student back-ground, delivery technique, audio visual requirements..."

Certainly, this remarkable piece of work done by Moses and Wickham, is worthy of emulation by any society which cares for the handicapped. (Paper No. IAF-88-474) □

Current Events

For a generalist attending the Astronautical Congress, the problem faced every day was choosing a session from amongst eight parallel sessions. The only exception were 'Current Events' in the evenings which had no parallel sessions. Naturally, these 'unparalelled sessions' were held at the elegant Banquet Hall of the Hotel Ashok, and were, well attended on all the days.

All the maor Space Powers made presentations detailing their immediate and long-term plans. India, being the host, made special presentations on the first and fourth day of the Congress. The others to participate were the U.S.A. (NASA), Europe (ESA) and the USSR (Glavcosmos).

On the first day, Prof. U.R. Rao briefed the delegates on the progress made by India over the last two and half decades. This was followed by a video programme on the Indian Space Programme. The second presentation made by India focussed on 'Drought Management'.

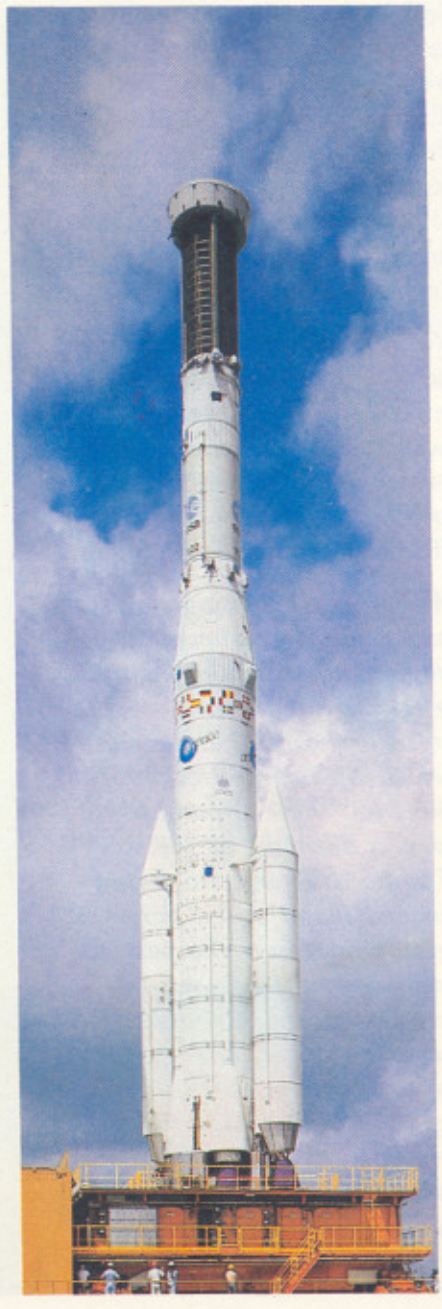
The presentations in the Current Event Sessions were made by some of the top-brass of the space agencies. Liberal use was made of video projection in all these presentations.

The following capsule summaries are, therefore, intended to give the reader a rough idea of the presentations.

Ariane doing well

This combined presentation pivoted around the Ariane family of vehicles; the session started with a video programme on INSAT-IC launch.

The European Current Event session was on the European policies for Launch Vehicle.



The Europeans made the point that Ariane 4 is really new vehicle; they stressed this by pointing out that the liquid engine for the strap-on booster was new and that the sophisticated Flight Control System was also new. It is well-known that following the unfortunate Challenger incident, there was a seller's market for launch services (in the west) which was well exploited by Arianespace. Hence the emphasis on commercial aspects in this presentation.

It was stated that Ariane 4 was available in six versions so that buyers have a wide choice. Twenty vehicles are already in production with 15 more in the pipeline. Describing how they now have two launch pads that can be operated in parallel, they presented their manifest till 1989. Schedules indicate 9 launches per year. From the 1989 summer onwards all launches will be Ariane 4. They forsee a demand for at least 50 Ariane launchers in the next decade.

With so much at stake, the planners of Arianespace are taking no chances. They are negotiating with manufacturers for the fabrication of 400 Viking Engines which are used in strapons as well as in first and second stages. Also, as an insurance against obsolescence they are entering into similar long-term contracts with manufacturers of electronics systems and components. With this kind of planning, they hope to cut down production costs, ensure uninterrupted

The Banquet Hall at Hotel Ashok was the venue where the Current Event sessions took place.

supply of components and subsystems and guarantee high reliability.

NASA is 'Back on the Track'

The NASA presentation at the Current Event Session started on a note of new-found confidence when Dr. W.F. Ballhaus, the Acting Associate Administrator of NASA declared : "We are back on the track". Dr. Ballhaus was referring to the successful completion of mission by Discovery after a 2-year frustrating period following the tragic 'Challenger' incident.

Yes, the Shuttle is back in business, "We have plans for 14 launches per year" said Dr. Ballhaus. Evidently NASA has to cope with a huge back-log of satellite launch contracts.

Another Project on which NASA is presently concentrating is the International Space Station called "FREEDOM", to be built in collaboration with Canada, ESA and Japan. The Programme Director of the Project Mr. Thomas L. Moser explained why the name Freedom was chosen : "It represents cooperative efforts to enhance the freedom of the people in the world. It (also) represents freedom from gravity ....and freedom from the umbilical which connects man to earth". Unlike the earlier programmes of Apollo, Spacelab and Skylab which were all built in single stages, the Freedom will be built in over a dozen stages in the orbit. Measuring over 500 feet in length, the Freedom will cost nearly US $24 billion. It will be spacious enough to let 8 astronauts work simultaneously on a 24-hour a day and 365 days-a-year basis; it is designed for a life-time of 30 years.

One of the objectives of the Americans is to progressively reduce launch costs to as low as $300 per pound of payload in LEO. Towards this end, they unvieled plans for what is called the Advanced Launch System of which five different configurations are presently being studied.

Conscious of the criticism that science is being ignored, NASA took special pains to explain the significance of science projects like Magellan, Galileo and Hubble Telescope. While Magellan is an attempt to study Venus, Galileo analyses the atmosphere of Jupiter. The Hubble Telescope is a free-flying observatory that is expected to yield observational data capable of answering some of the most fundamental questions in cosmology, like the evolution of the Universe □

'USA is back in Space' was the main theme of the American Current Event session.

India evolves a Drought Management System

Drought and floods are the two major natural and endemic disasters in India. The havoc wrought by drought needs no emphasis .Hence the need for drought-management whose primary aim is to provide objective, reliable and timely information about drought occurrence all over the country. Today, at a national level, droughts are monitored through three indicators: (i) anomalies in ground measured rain-fall, (ii) anomalies in ground computed aridity and (iii) anomalies in ground observed drought conditions as reported by field officers. As both rainfall and aridity are only sparsely measured, they fail to provide reliable information on drought occurence. Again, the relationship between rainfall and vegetation development does not seem to be unique in space or time. Aridity for instance is based on observations at 194 stations in the country; this sampling is not dense enough to provide representative values at district level. It is in this context that a need was felt for developing a national drought monitoring system.

The Remote Sensing Application Mission on drought has the objective of developing an operational system for periodic monitoring of agricultural draught condition all over the country with district as the reference unit. The first phase will consist of monitoring during the Kharif season which is the major agricultural season in India. Once successful, it will be extended to Rabi season also. The major input of this system will be the NOAA-VHRR data that is obtained daily at the earth station 60 km from NRSA, Hyderabad. The project was started around mid 1986 and is expected to be completed by the end of 1989. Besides basic definition, the Project addressed questions like how drought can be characterised, whether drought can be early-warned or predicted and what could be the remote sensing contribution in the Indian context taking into account the satellite data that is being received in India. The process software for generation of time composed vegetation index imagery, on a weekly or two-weekly basis has been evolved and this package is being operationalised in the three Regional Remote Sensing Service Centres in the country.

The drought session speakers. From left to right Mr. A. Valenzuela, Mr. B. Choudhury and Mr. S. Thiruvengadachari.

Simultaneous ground truth information from various district in different states in terms of the croping pattern, the crop calendar and the crop condition, and also information of rainfall intensity and observed moisture stress condition, are obtained.

The following vegetation index parameters have been identified for use in the drought monitoring system. The primary parameter will be the vegetation index averaged over the total geographic area of the district. The other two parameters are the percentage of the cloud cover and the percentage of vegetation area of the district.

From the experience in the four States of Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh, a drought monitoring system has been configured.

Finally we hope to have a composite system which should be able to monitor the drought condition at the national level with district as the reference unit and at the State level with Thasil, which is a sub-district unit, as the reference unit; we will be using the vegetation index information from the high resolution earth resources satellite such as the Indian Remote Sensing Satellite, supplemented by information from other earth resources satellites. This project is slated for completion by the end of 1989.

The Soviet Programme

Dunayev speaks to *Space India*

With the Current Event Session V devoted to the Soviet Plans, Space India made a scoop of sorts by meeting with the Chief of Glavcosmos, V.I. Dunayev. In this interview, held much before the Press Conference or the Current Events Session, Dunayev answered in detail all our questions about the Soviet Space Programme. Excerpts :

Q: *The Soviet Union has been in the lead in Space technology and in applications. We would like a few words on your plans.*

A: As is known, great attention is paid for the development of cosmonautics in the Soviet Union. We are presently engaged in enlarging space activities.

One of the major directions of space activities is the manned flight. As you may be aware, Soviet Union has in orbit the MIR space station docked with the module Quant, a Cargo ship and a manned space ship. Our task is to launch by the middle of next year two more model stations to dock with it and it is planned to set up the full complement of MIR by 1990-91 made up of five stations and 200 tons in weight.

The second direction is the development of a heavy lift vehicle Energia and a reuseable space shuttle which is slated for launch from Baikonur. It should enable transportation of heavy loads of the order of 200 tons.

We continue our activities connected with space research. As is known a planetary probe PHOBOS is on its way to Mars. Plans are drawn out for the next 10 years to carry out work in the fields of communication, mapping, navigation, geodesy, cartography etc. so as to boost the national economy. Particular attention is paid to remote sensing of natural resources.

Q: *Are there any plans for MARS landing?*

A: Soviet Union does have such a plan. This question is being discussed. We feel the cost of realisation of such a plan is too great to be borne by any single country and it can be done only by international collaboration with USSR and USA taking leading roles in it.

If we succeed in forming this international cooperation during 1988-89, it would be realistic to state that we shall be able to organise the flight of a few people to Mars by 2015-2017 which, of course depends upon the cooperation of the countries involved.

Q: *Any moon-landing planned?*

A: We would go ahead with our automatic probes in the next ten years. Though we do seriously think of moon-landing, no priority is given to it.

'PHOBOS' was the main theme of the USSR Current Event sessions.

V.I.Dunayev, Chief of Glavcosmos.

Q: *What are the main missions planned for Energia?*

A: The main task for Energia now is to finalise the design of the universal space transport system complex consisting of the rocket Energia and the reuseable space shuttle. It will be realised in two steps; the first will be an unmanned flight. The results of this flight could pave way to manned missions.

The other task is that besides carrying the reuseable space shuttle, Energia can also be used as a carrier rocket for heavy space ships.

Q: *Is Soviet Union planning to commercialise Energia?*

A: I shall tackle this question thus: Let us first of all create a payload capability of say 100 tons, then, we will think of commercialising it. Right now, we have a sufficiently large arsenal of rockets namely Cosmos, Soyuz, Vostok, Proton etc. to cater to any payload. However, when need arises to use Energia, it will be considered □

"The most important work is done outside of the conference. Personal contacts get established during these meetings. The IAF is an umbrella society for space organisations, space agencies and space societies. During the meeting once a year engineers, technologists and scientists come together to exchange their views and their achievements of last year and also to make plans for future cooperation. This does not happen during meetings; it happens during receptions, lunch time, etc."

J. Ortner
President, IAF.

True to what Prof. Ortner said, 'Space India' met and talked to a wide spectrum of delegates: Specialists, administrators, journalists and others to elicit their views on a broad range of subjects. Excerpts:

Japan Plans for 2010

"We are developing on board systems for geostationary platforms (likely to be ready) around the year 2010 or so ..... We are working on fundamental techniques for high power TWT's of 22 GHz, and also 30m deployable antennas ..... May be the H2 launch vehicle will be used. For assembly, robotic techniques will be needed ..... Though Japan is a small country we need communication satellites for mobile systems".

Yuichi Otsu
Director Research Planning
Space Communications
Research Corporation
Japan

J. Ortner

Strong sense of optimism in NASA

"I think the two year gap (following the Challenger incident) was frustrating for scientific community. Now there is a strong sense of optimism because we are back on track and we have some very good exciting science missions coming up like Galelio, the Hubble telescope .....

There are some things that are better done by machines and somethings better done by humans because humans can think and we don't have yet machines which can think. So there is a tremendous advantage in having humans in places where you expect discoveries to be made ..... in space stations when we do research in microgravity, life sciences, etc. .....

Recently we used some artificial intelligence techniques for classifying data. It has the ability to discover trends while sorting out large masses of data ..... to discover previously undiscovered phenomena. When we used this class of software on the data base we discovered a number of infrared sources".

W.F. Ballhaus
Acting Associate Administrator, NASA & president American Institute of Aeronautics & Astronautics

Vimanas of the Indian Lore

"We have mention of this strange aerial vehicle called Vimana in your ancient literature. You may find all these not only in your epics Ramayana and Mahabharata but in books published at the beginning of this century. The little book called Vimanika sastra describes in vivid detail all the machinery of this strange vehicle. These descriptions should be seen by engineers and scientists in a new light. It is important to check everything ..... probably in your past there may be something of your future and may be even of the world's future.

The problem is even the English translations of your sanskrit books are no longer available. I think you should try to preserve your culture.

Roberto Pinotti
Social Scientist
Italy

Corridor

W.F.Ballhaus

Roberto Pinotti

Chat

Space and Humanity

"Space today has become a separate field of development of science, industry and technology which (gives direct effect to the) national economies and which helps man in his day to day life. I do not want to cite the innumerable examples which were discussed in this 39th IAF congress in the fields of study of natural resources, meteorology, navigation, communication etc. Without space we won't be able to live and practically all countries are deriving benefits from space. Many problems which were solved in space have (benefitted us) on the earth. It is hoped that space is the new sphere of human activity which will flourish and which will solve man's economic, social and day to day problems.

Thus man cannot live today without space.

A. I. Dunayev
Chairman, Glavkosmos
USSR

On the Bangalore Congress

This is one of the conferences have been attending for about 15 years and I find that this year it is extremely exciting because for the first time we are able to hear more about the needs from space of developing countries. Also we have the world's space experts and they are learning how their technology ..... can be applied to help countries in this part of the world ..... It is a very good experience for both the researchers here in India and for the scientists and technicians around the world.

Jeffrey M. Lenorovitz
European Editor
Aviation Week & Space Technology

Jean Pierre Haignere

First Hermes Flight in 1998

"Hermes is the first manned space flight programme of Europe. We have to build the Hermes itself and all the associated facilities together with the training tools for the crew. It was not the same for the US space shuttle because they had before the Apollo programme, the Gemini programme .... and the training facilities were already available. I suppose it was the same for the USSR. I can say (our programme) is completely new and has no relationship with the US shuttle. As far as piloting is concerned, we are using a lot of high technology avionics in the cockpit design and some machineries will be completely new.....
The first flight of Hermes in 1998 will be unmanned, depending on whose success the manned flights will follow.....

The training of Hermes crew will be operational about 5 years before the first flight, that is in 1993. So we have to organise something between now and 1993.....

My main duty now is to take care of logistics for Jean Loup Chretien who is training in the USSR for a joint Mission on M I R in November this year. This manned flight will be one month's duration ..... and Jean Loup Chretien who is the prime candidate for this flight is expected to take part in EVA. He has already made a space flight with the Soviets in 1982. ..... I am a sort of a standby for this flight.

Jean Pierre Haignere
Project test pilot and
Head Manned Space Flight Division
CNES, France

Models of Progress

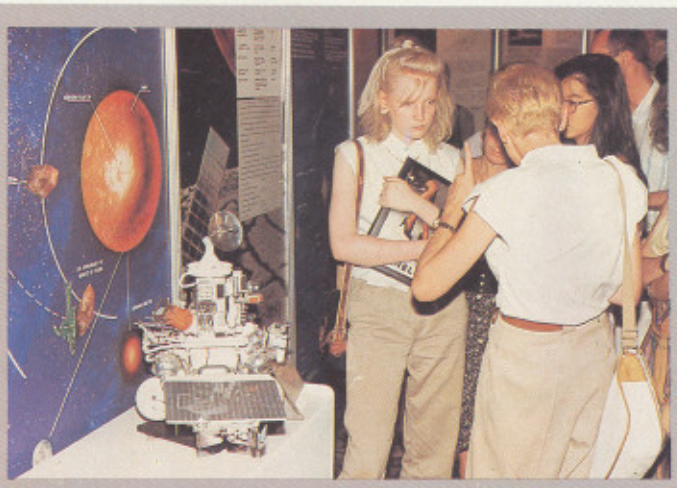
Space '88

An attractive feature of the Bangalore Congress was the SPACE'88 exhibition. As many as 26 industries and eight space agencies participated in this show of aerospace marvels spread over 1600 sq.m. of space at three venues. The French pavilion occupied the pride of place in an exclusive space at Hotel Ashok, heralding the arrival of the Festival of France in India planned for the coming year.

The exhibition showed a wide range of products from the replica of the Tipu Sultan rocket to the imposing launchers of the future such as the Ariane-5; models of the space shuttles from USA, USSR, ESA and Japan vied with each other, as did the Phobos, MIR, Columbus and Freedom models, in attracting the attention of visitors.

The communications revolution brought about by the INSAT and the space-based resource management efforts were depicted in the ISRO pavilion besides a number of models and hardware of the indigenous space programme of the host country.

The exhibition thus provided an opportunity to visitors to have a look at the shape of things to come in the future.

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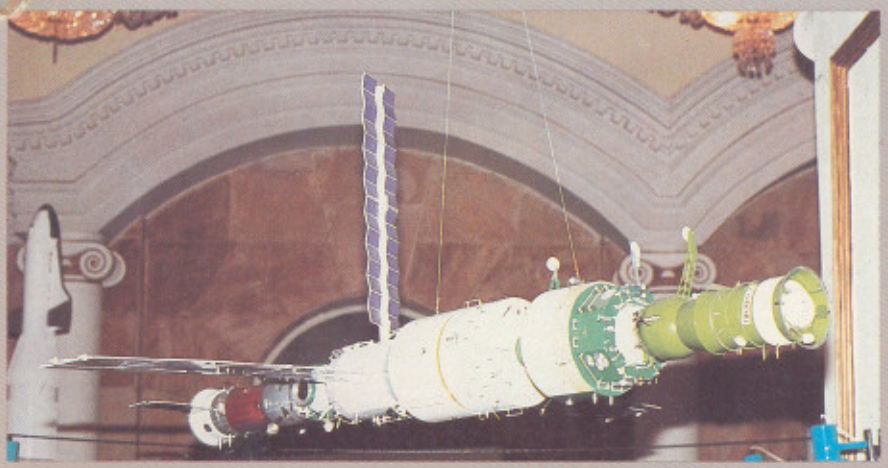


JAPAN
NASDA
宇宙開発事業団
NIPPON


SLV3


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centre
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Space Explorers in Bangalore

A popular event in any IAF Congress is a meeting with the men from outer space — astronauts and cosmonaut, who saw the sun rising in the sky every 90 minutes like 'diamonds exploding in the sky'. The Bangalore Congress was no exception. There were six of them, including John Fabian of the USA who flew in the space shuttle twice and Jean-Pierre Haignere, the would-be Hermes Spacecnaut from France.
The tall and 'big' Jon McBride flew in the American shuttle in 1984 which was the 13th shuttle flight with 7 people on-board including two women and a Canadian astronaut. McBride was the lead pilot during the first shuttle Columbia, flight in 1981 and would have been the commander of the 26th flight if the 'Challenger' (25th flight) incident had not intervened. 'It's like losing seven members of your family' he said of the ill-fated Challenger flight. McBride who also presented the 'back in space' story of the 'Discovery' flight, during the Current Event session is expecting to fly again in 1990.

The 50 year old, two-flight veteran John Fabian 'will fly again — if allowed'. Asked how he felt when the 25th shuttle exploded — 'I wish I were on-board' he said.
Alexander Alexandrov from Bulgaria was fresh from his Soyuz TM5 flight in may 1988. During his ten days stay in the MIR station he conducted experiment on sleeping in space! Bertolan Farkas from Hungary who flew in Soyuz 36 and spent eight days in space in 1980, said he not only slept but also dreamt in space — though 'only in black & white'.

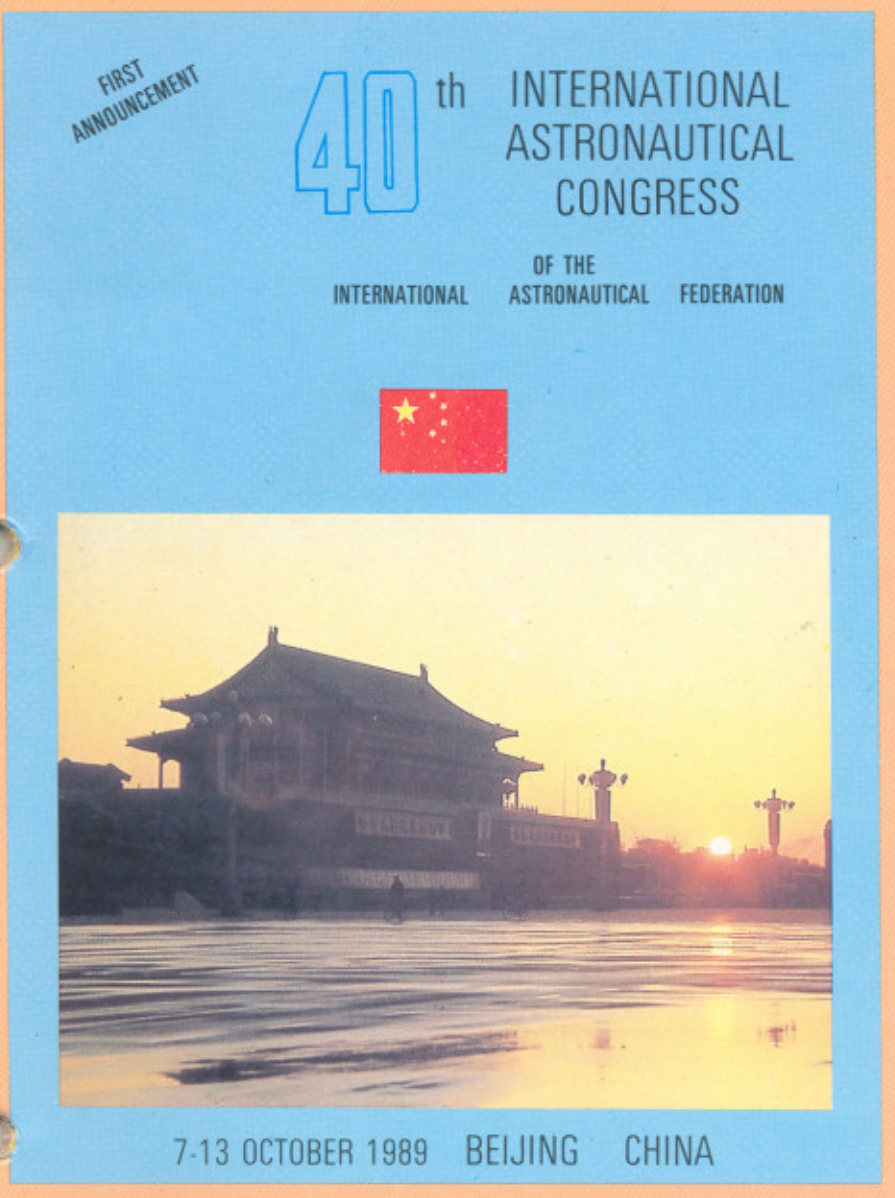
Prof. U.R.Rao and Dr. J.Ortner flanked by the Space explorers.

left to right: Bertolan Farkas (Hungary), Jon A.Mc Bride (USA), Alexander Alexandrov (Bulgaria), John M. Fabian (USA), Sigmund Jahn (GDR) and Jean Pierre Haignere (France).

Dr. Singmund Jahn of GDR who visited the Salyut-6 space station in August 1978 said that dreams on earth and in space are similar but differed from individual to individual. According to Dr. Jahn long stay in space results in depletion of calcium in bones and softening of the muscles. Though human size is no problem in space, Dr. Jahn felt that ideally spaceman should have five or six arms, no hair and only one leg ! □

Alexander Alexandrov displaying the chart showing 'sleeping activity' in space.

From Bangalore to Beijing



The Bangalore Congress was also the venue where the first announcement of the 40th Congress of the IAF was made. The Chinese Society of Astronautics (CSA) will host the next meeting in 1989 at Beijing.

In keeping with the IAF's special stress on the use of Space Technology for the benefit of humankind, the 40th Congress will have a Current Event session on 'Space and Flood Management'. The theme of the Congress itself will be ' Space and Environment '.

The Beijing Congress will also have a new IAF President. On the last day of the Congress in Bangalore Dr. George Van Reeth of Belgium was elected President of the IAF as Dr. J. Ortner completed his two-year term of office. Dr. Van Reeth is ESA's Director of Administration □

Mr. Van Reeth, the new President flanked by the hosts of this year's Congress and the next years.

The venue of 39th IAF Congress at Bangalore.