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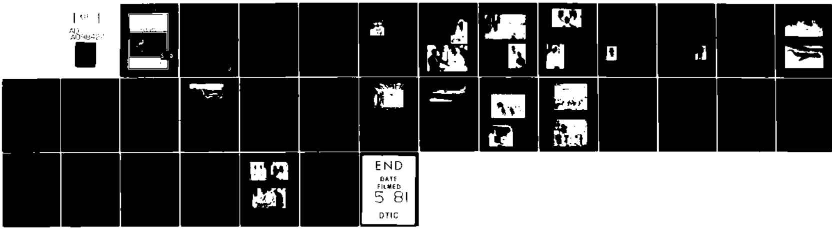

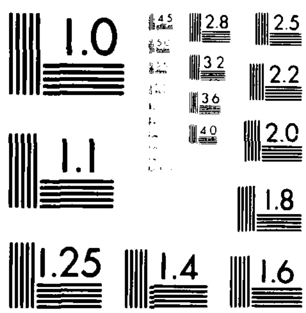

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

AGARD HIGHLIGHTS 81/I

AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

HIGHLIGHTS

NORTH ATLANTIC TREATY ORGANIZATION

AGARD HIGHLIGHTS 81/1
MARCH 1981

THE MISSION OF AGARD

The mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Exchanging of scientific and technical information;
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Providing scientific and technical advice and assistance to the North Atlantic Military Committee in the field of aerospace research and development;
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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All members of AGARD, whether National Delegates, Panel Members or AGARD Staff, are cordially invited to submit articles likely to be of interest to other AGARD members for the next issue of AGARD HIGHLIGHTS which will appear in the Fall of 1981. Articles should be addressed to:

Scientific Publications Executive
AGARD-NATO
7, rue Ancelle
92200 Neuilly sur Seine
France

or, from US and Canada only:

AGARD-NATO
APO New York 09777

Front Cover:

THE VON KÁRMÁN SILVER MEDAL represented on the front cover is the highest award presented each year to NATO Aerospace Scientists who have distinguished themselves by their work or achievements in relation to AGARD.

This medal is a replica of the gold medal presented to Dr von Kármán during the 10th Anniversary of AGARD, in recognition of his inspiring leadership.

Theodore von Kármán 1881-1963

To mark the centenary of the birth of Theodore von Kármán, in Budapest on 11 May 1881, there will be events in Europe and in the United States. For us, in the AGARD community, he is very specially remembered for it was his proposal for cooperative activity among scientists of the member states of the North Atlantic Treaty Organisation which led, in 1952, to the creation of AGARD.

In a lifetime which spanned balloon flight to space exploration von Kármán exerted a truly extraordinary influence upon the course not only of aeronautics but rocketry and astronautics also. He was a scientist, engineer, teacher, director of institutes, president of a corporation, builder of international organizations, articulate and gracious colleague.

Curiously, it was not until after his retirement from Caltech in 1949 at the age of 68 that he embarked on the final chapter of his career which was to involve, among many other things, the creation of AGARD. For the next fourteen years von Kármán was riding the wind, lecturing, organizing cooperative research projects, and attending one conference after another. A trail of technical papers, lost berets, and mislaid mufflers marked his passage.

Before the space age began in 1957, von Kármán participated actively in the annual Congresses of the International Astronautical Federation. The Jet Propulsion Laboratory (JPL) that he had helped found at Caltech soon became an important element in the space business. After the launch of Sputnik I, JPL, with the US Army's Redstone Arsenal, built and launched the first US satellite, Explorer I. Later, under contract to the National Aeronautics and Space Administration, JPL developed the unmanned Ranger, Surveyor, and Mariner spacecraft which explored the moon and inner planets of the solar system.

Having started AGARD, von Kármán served as its chairman for the remainder of his life. In February 1963 he made his last trip back home, to Washington D.C., to receive from President Kennedy the first National Medal of Science. We still have the tape of the award ceremony. "I know of no-one else", said the President, "who so completely represents all the areas involved in this medal -- science, engineering, and education". And von Kármán's reply was simply "I hope my work has shown that the college professor is of some use". After his return to France, he set to work preparing for a schedule of seven international meetings due to take place between June and September. But these meetings went unattended. He travelled to Aix-la-Chappelle for a brief rest and there died on 7 May, 1963, "five days before completing his 82nd voyage around the sun".

Von Kármán Medals 1980

awarded to

Professor Hermann Schlichting (FRG)

and

Mr Frank Thurston (Canada)

Unfortunately, illness prevented Professor Schlichting travelling to The Hague from his home in Germany to receive the award of the von Kármán Medal for his outstanding services in the fields of fluid dynamics and aerodynamics. In consequence the medal was received on his behalf by Dr Meisel (AGARD National Delegate for the Federal Republic), seen here during the award ceremony.

The second 1980 Medal was awarded to Frank Thurston, who has been associated with AGARD since its early days as a member of both the Fluid Dynamics Panel and the Structures and Materials Panel and more recently as AGARD Chairman. Our photograph shows him receiving the medal, and a warm handshake, from present AGARD Chairman, Dr Alan Lovelace (left).

The citations relating to both awards are reproduced in full in our previous issue – Highlights 80/2.

(Photos courtesy of the Audio-Visual Service, Royal Netherlands Navy)

Netherlands Notables in Defence and Aerospace

THE HISTORIC ROLZAAL, in the Dutch Houses of Parliament building (the Binnenhof) in the centre of The Hague, was the setting for the AGARD Meetings. Here, the National Delegates Board, with speakers and guests from the host country, is about to start the business of the 1980 AGARD Annual Meeting.

Willem Frederik van Eekelen was born on 5th February 1931 in Utrecht. After finishing grammar school he studied law at the University of Utrecht. During his study he received a grant to study political sciences at the American Princeton University. He completed his studies in 1954.

After having completed his national service as a reserve officer of the Royal Netherlands Army, Mr van Eekelen joined the Netherlands foreign service. He held diplomatic posts in New Delhi, London and Accra. From 1966 until 1971 he was a member of the Netherlands permanent delegation to NATO.

From 1971 until 1977 he worked at the Ministry of Foreign Affairs in The Hague, first as deputy to the Director-General for Political Affairs and afterwards as Head of the Atlantic Co-operation and Security Affairs Department. In those years he was also a member of the Committee for Defence and the Committee for Foreign Affairs of the Dutch Liberal party. In 1977 Mr van Eekelen was elected to Parliament and subsequently became State Secretary for Defence in the present coalition Government.

During his stay in India as an attaché of the Netherlands Embassy Mr van Eekelen wrote a thesis on "Indian foreign policy and the border dispute with China". He received his doctorate cum laude in 1964.

During his political career Dr van Eekelen has published a number of articles concerning international and political military subjects.

DR W.F. VAN EEKELEN, Dutch Secretary of State for Defence, welcoming guests with his charming wife

PROFESSOR DR-IR. O.H.GERLACH (right) in conversation with AGARD Chairman, Dr Alan Lovelace

Otto H.Gerlach was born in Amsterdam on July 8, 1928. After finishing grammar school he attended the Delft University of Technology, receiving his master's degree in Science in Aeronautical Engineering in 1951 and a doctor's degree at the same university in 1964. During his study at the Delft University of Technology Professor Gerlach spent one year at the Dutch Government Flying School for flight training, leading to a professional pilot's license.

From 1954 until 1972 he was a member of the Advisory Committee of the NLR on flying qualities and aircraft operations. For many years he was a member of the Dutch Civil Aircraft Accident Investigation Board (equivalent to NTSB). In 1959 he was named associate professor and in 1965 became a full professor at the Department of Aerospace Engineering of the Delft University of Technology.

In 1971 he was appointed Chairman of the Board of the Foundation National Aerospace Laboratory.

Professor Gerlach is a Fellow of the Royal Aeronautical Society, Associate Fellow of the American Institute of Aeronautics and Astronautics, member of the "Deutsche Gesellschaft für Luft- und Raumfahrt (DGLR)", and International Member of the Daniel Guggenheim Board of Award.

GENERAL A.J.W.WIJTING, Chief of Defence Staff in The Netherlands, giving the Introductory presentation at the AGARD 1980 Annual Meeting

General Alexander Johannes Wilhelm Wijting, born on 29th June 1925 in Magelang (Indonesia), started his military career during the last World War.

He escaped from the Netherlands in 1942 and joined the Royal Air Force as a volunteer. After finishing his pilot training and becoming qualified as an operational fighter pilot, he joined No.64 Squadron of RAF Fighter Command. He took part in the successful attack on the Gestapo HQ in Copenhagen and the German rocket base at Peenemunde.

After his return to the Netherlands, General Wijting was in command of various operational fighter squadrons. He successfully completed the long course for senior staff officers and held several staff positions, including one with the Second Allied Tactical Air Force in Germany. Later he was appointed Deputy to the Director of Personnel of the Air Force.

In 1973 the General was appointed commanding officer of the Tactical Air Force Command, which includes every operational unit of the Royal Netherlands Air Force assigned to NATO. At the end of the year 1976 he was appointed Chief of Defence Staff and promoted to General.

General Wijting flew Hurricanes, Spitfires and Mustangs during the war and since has flown all the operational jet aircraft of the Royal Netherlands Air Force, 27 types in total.

Aerospace in the Netherlands

This article is based on the presentation given on the occasion of the 1980 AGARD Annual Meeting in The Hague, on 9 October 1980

by

Ir. J.A. van der Bliek
General Director of the NLR
(the Netherlands National Aerospace Laboratory)

and

Lt-Gen. (ret.) A.B.Wolff
Chairman of the Board of NIVR
(the Netherlands Agency for Aerospace Programmes)

SUMMARY

A general overview is given of aerospace activities in the Netherlands. Special attention is given to the activities of NIVR, the Netherlands Agency for Aerospace Programmes, and the close relationship between government, industry, the research laboratory and other interested parties. The research activities of NLR, the National Aerospace Laboratory, are reviewed in relation to the needs in the Netherlands. Not all aerospace R & D in the Netherlands is covered; in particular, the activities within the industry are not enumerated in detail.

It is concluded that an effective structure for aerospace R & D for a medium-size country has been developed, wherein international cooperation plays an important role.

BACKGROUND

Since the emergence of the Netherlands as an independent nation in the 16th century, international trade, exploration, and transportation have been stimulating factors in the development of the country. The country's location, by the North Sea and at the delta of the Rhine and Meuse rivers, was an important factor for the Netherlands, contributing to its becoming a major trading and seafaring nation in the 17th century. This tradition created the proper background for the development of aeronautics in the Netherlands.

JAN ADRIAAN VAN DER BLIEK was born on 28 September 1928 in Goes in Holland. After finishing grammar school he studied aeronautical engineering at the Delft University of Technology, completing his studies in 1953.

After graduation he worked for six years at the High-Speed Aerodynamics Laboratory of the NAE of the National Research Council in Ottawa, Canada. He then moved to the ARO, Arnold Engineering Development Center in Tullahoma, Tennessee, USA, for a period of seven years, the first four years at the Von Kármán Gas Dynamics facility, where he was in charge of the hot-shot tunnel development, high-density shock tubes and other hypervelocity facilities.

In 1963 he was given one year's leave of absence to work as a visiting professor at the Von Kármán Institute for Fluid Dynamics in Brussels, Belgium, under an ARO grant. After his return to ARO in the USA he worked for three years at the space environmental facility and was in charge of the development of solar-vacuum simulation techniques and low-density testing for upper atmosphere research.

In 1967 Ir. Van der Bliek returned to the Netherlands to work for the National Aerospace Laboratory (NLR) in Amsterdam. From 1967 until 1971 he was in charge of the space flight department, after which he was appointed Deputy Director of the NLR. In 1976 he took up the position of General Director of the NLR.

His contacts with AGARD date back to 1 March 1976, when he was appointed as one of the Netherlands National Delegates. He also holds the following functions: member of the board of the German-Dutch Wind Tunnel; member Steering Committee for the European Transonic Windtunnel; council member of ICAS; member of the Committee for Geophysics and Space Research of the Royal Netherlands Academy for Science; alternate member of the board of Netherlands Agency for Aerospace Programs. He is Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA) and also member of various Netherlands aerospace societies and of the KIvI (Royal Institute of Engineers).

Early this century there was a great interest in the achievements in the USA, France and elsewhere. Organized aviation in the Netherlands started in 1913 with the formation of the Aeronautical Department of the Army (LVA) at Soesterberg.

During the first world war the Netherlands was a neutral country. The army air force confiscated over one hundred foreign military aircraft which had made emergency landings here. Many of these were repaired and entered Dutch service.

After the first world war, in 1919, several activities started:

- Albert Plesman founded the KLM, Royal Dutch Airlines, and started the world's first regular airline service, Amsterdam – London.
- Anthony Fokker founded the Netherlands Aircraft Factory and started producing aircraft in the Netherlands for the Army Air Force, KLM and many foreign airlines and air forces.
- The RSL, the Government Aeronautical Service, was founded, from which later the National Aerospace Laboratory developed. Research was already at that time recognised as an integral part of aeronautics.

Before the Aeronautical Department was founded as a separate department at the Delft University of Technology in 1940, that university contributed greatly to the development of aeronautical sciences, and the work of Prof. J.M.Burgers in Aerodynamics and Prof. C.B.Biezeno in Structures must receive particular mention in this connection.

SCOPE OF AEROSPACE IN THE NETHERLANDS

In the following sections the main elements of aerospace in the Netherlands are reviewed.

Education

Aerospace engineering is taught at the Department of Aerospace Engineering of the Delft University of Technology and at the HTS (an advanced technical college) at Haarlem. The Delft University offers a five-year course in aerospace engineering leading towards the degree of Ingenieur, comparable to, for instance, a Master's degree at some of the more advanced universities in the USA. The HTS awards intermediate diplomas after a 4 or 5-year course.

The Aerospace Department in Delft was started in 1940 by Prof. H.J. van der Maas. The department now has 600 students and the staff of 150 includes 12 full-time and 5 part-time professors.

About half of the 950 graduates from this department now constitute the backbone of aerospace engineering in the Netherlands.

The department has modern laboratory equipment: wind tunnels, a flight simulator, a laboratory aircraft, a structures and materials laboratory, etc. It cooperates closely with the NLR, Fokker and KLM. Recently the Department of Electrical Engineering at Delft started courses specializing in Avionics, in cooperation with the Aerospace Department.

Civil Aviation Authority

The Civil Aviation Authority of the Netherlands,

ALBERT BAREND WOLFF was born on 28 February 1914 in Bandung. After finishing grammar school he started his military career in 1931 at the Royal Military Academy in Breda. In 1934 he became a Second Lieutenant of the Royal Artillery and returned to the Netherlands Indies. Soon he applied for a course for aircraft pilot and he completed his training in 1937.

As commanding officer of a squadron of Glenn Martins, Flying Officer Wolff was ordered to Singapore at the outbreak of hostilities between Japan and the Netherlands East Indies, but he had to retreat to Sumatra, Borneo and Java. On the 8th of March 1942, the date of the capitulation, he was able to fly to Australia with the last remaining Glenn Martin.

In May 1942 he went to the USA, where he held the post of Chief Instructor in Leavenworth (Kansas) and Jackson (Mississippi). After his promotion to Flight Lieutenant he became commanding officer of a squadron of B-25 Mitchells, which flew to Australia.

During the last phase of the war he was liaison officer to General Kenney, commander of the Far East Air Forces. In this capacity he participated in the landings in Biak and Morotai.

After the war, as Squadron Leader, he held the post of Chief of Staff of the Bali-Lombok Brigade for a short time, until he became Staff Officer Air in the Netherlands Indies. He was responsible for the air force involvement during the post-war military actions.

In Spring 1949 he was sent to the Netherlands to take part in organizing the Royal Air Force Staff College. Later, after being promoted to Group Captain, he was appointed Chief of the Section Air of the European Defence Community.

After various operational functions in the Netherlands he was appointed Director of Materiel of the Royal Netherlands Air Force and after one year, in 1965, he became Chief of the Netherlands Air Force Staff. In 1970 he left the Air Force as Air Vice Marshal to become Chairman of the Netherlands Agency for Aerospace Programmes, his present position.

the Rijksluchtvaartdienst (RLD), has four Directorates:

- *Air Transport Policy*, which deals with the Netherlands aviation policy and, in particular, with the international agreements and representations in ICAO and ECAC, the European Civil Aviation Conference.
- *Airfields*, which is concerned with the control and supervision of airfields, buildings, safety, fire prevention, lighting, etc. This directorate also provides the aeronautical information service bulletins and notices.
- *Aeronautical Inspection*. This directorate is responsible for the registration and the regulations concerning aircraft and pilots. Particularly important for the Netherlands aeronautical development capability is the Airworthiness Department and the Aircraft Inspection Department. The RLD has the capability to certify imported aircraft as well as aircraft developed in the Netherlands.

  This directorate is also responsible for various aspects of flight operations and the regulations concerning noise around airfields.
- *Air Traffic and Communication*. This directorate operates the civil air traffic control centre and the various associated stations. It is also responsible for the various ATC and communications installations.

The RLD is fully staffed (over 1000) to handle all civil aeronautical affairs of the Netherlands. The RLD also operates the RLS, the Government Flying School at Eelde (near Groningen), where civil airline pilot training takes place. The school also provides part of the training for military pilots.

Military Aviation

The Netherlands Air Force and the Naval Air Service are part of the NATO forces.

The Royal Netherlands Air Force (started in 1913 as the Army Air Force, and established as a separate Air Force in 1953) with a total personnel of 22,000, has a Tactical Air Command, including all combat elements, a Logistics and a Training Command.

The aircraft in service are: (data from latest surveys in "Flight")

- 117 Lockheed F-104G and TF-104 G aircraft. (The F-104s are being replaced by 102 F-16A and F-16B.)
- 105 Canadian-built Northrop NF-5A and NF-5B
- 12 Fokker F27, of which nine are of the Troopship version
- 72 Alouette III helicopters, and
- 30 MBB-B-105C helicopters.

  The helicopters are flown and operated by the Air Force on behalf of the Army, which has the operational control.

  The Royal Netherlands Naval Air Service operates long-range maritime patrol aircraft and helicopters:
- 7 Breguet-Atlantic SP-13H
- 15 Lockheed Neptunes SP-2H

  The Neptunes are being replaced by 13 Lockheed Orions P-3C and 2 Fokker F27, MP version, the latter to be based at Curaçao.
- 16 Westland UH-14A and B Lynx helicopters are being delivered
- Still in use are 10 Westland AH-12A Wasp helicopters, to be replaced in the next few years.

Air Transportation

The Netherlands now has several companies operating commercial aircraft. The total employment in this branch is about 22,000 with an estimated total income of *DG 4×10^9. By far the largest company is the Royal Dutch Airlines, KLM, with 18,900 employees and an annual turnover of DG 3.2×10^9. It carries 4.5 m passengers and 220 m kg of freight annually. It operates 52 airliners, including 13 B-747s and has a total value of DG 1.5×10^9 aircraft on order, including ten Airbus A-310s.

A subsidiary of KLM, KLM Helicopters, operates mainly on the North Sea while another subsidiary, the NLM, operates a regional network. The other companies, Martinair, Transavia, Schreiner, and a few smaller ones, are mainly active as passenger and cargo charter companies, air taxi and aerial photographic services, etc.

Airports

Of the 26 military and civil airfields in the Netherlands, Schiphol is by far the largest with 63 scheduled airlines and many charter airlines operating from it and a total of 10 million passengers and 300,000 tons of air cargo per year. It handles 190,000 take-offs and landings annually.

It ranks sixth in Europe as far as aircraft movements and passengers is concerned and it ranks fourth in cargo handling.

The airport houses also 320 offices and shops, resulting in employment for over 20,000 people. Including indirect employment, the aeronautical activities at and around Schiphol amount to more than 10% of the total employment of the Amsterdam region: aeronautics thus constitutes a major source of income in that area. About 1% of the gross national product of the Netherlands originates at Schiphol.

The Aerospace Industry

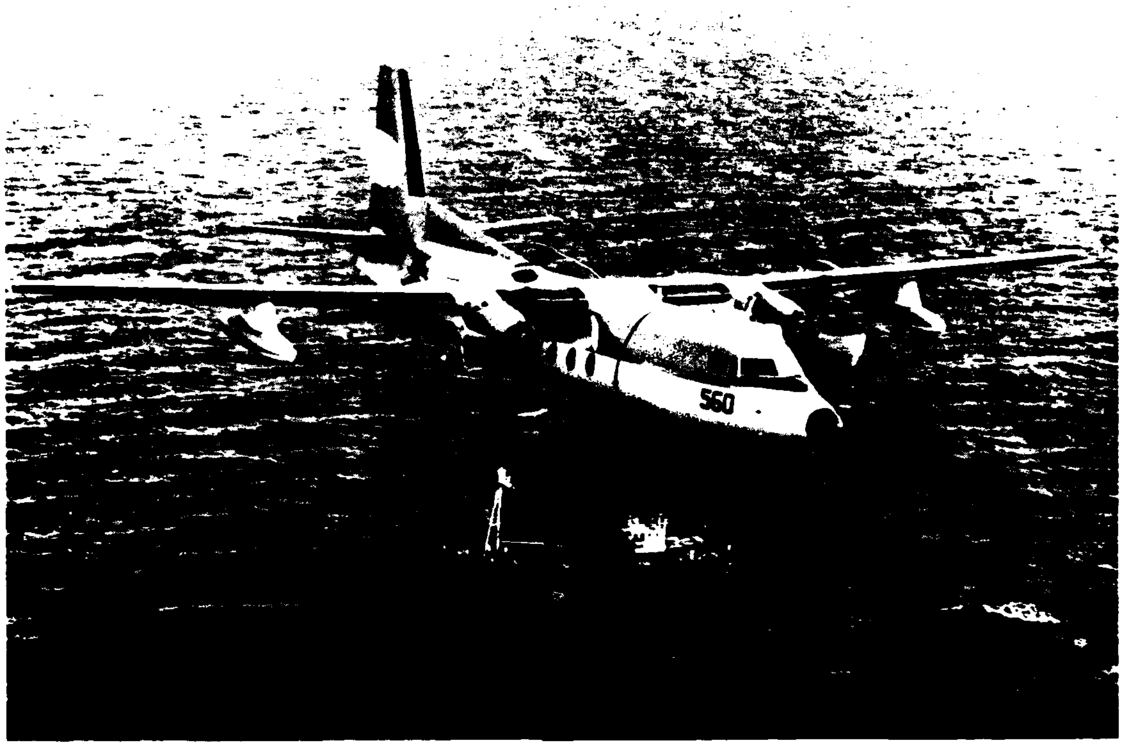
The Netherlands *aircraft* industry since the late fifties is completely concentrated in the Royal Netherlands Aircraft Factory Fokker. This factory was founded on 21 July 1919 in Amsterdam by A.G.H.Fokker, who himself started flying in 1911. The company has 8000 employees at five plants in the Netherlands.

The total turnover is about DG 1000 m.

Presently the main products are:

- The F27, Friendship, a twin-engined turboprop transport, of which already 720 have been sold, some of which have flown over 55,000 hours.
- The F28, Fellowship, a twin-engined jet transport (60–85 passengers), with 162 sold.

* 1 Dutch Guilder equals US $0.50 approximately.



The F27 Maritime Patrol Aircraft, the latest version of the F27 as medium-range maritime patrol and surveillance aircraft. (Photo: Fokker BV)

The Fokker F28 Mark 4000 aircraft. (Photo: Fokker BV)

- The moving parts of the wing of the A300 Airbus
- A small participation in the A310 production
- The wings of the Short SD3-30.

Furthermore, Fokker is involved in:

- Assembly of the General Dynamics F-16 (one of the three assembly lines, together with G.D., USA, and SABCA, Belgium).
- Maintenance and repair of military and civil aircraft and the Hawk missiles.

In the area of *space technology* Fokker cooperates with HSA (Signaal), a Philips company, in an industrial consortium (ICIRAS) for the development of the Infrared Astronomical Satellite (IRAS), a project being carried out jointly by NASA, the British Science Research Council, and the Netherlands. Earlier, the Astronomical Netherlands Satellite, ANS, was developed and launched in cooperation with NASA. Furthermore, Fokker as well as HSA participate separately in various ESA programmes. Both have built up expertise in several subsystems, such as solar panel structures, thermal control, on-board computers, attitude stabilization and control, etc.

At present Fokker is engaged in the last part of the preliminary phase, the definition phase, for the F29 project, a 130–160 passenger, twin-engined jet transport. It is expected that the development phase of this advanced transport aircraft will begin in late 1981, with first deliveries in 1985. The F29 will be developed and built in cooperation with foreign partners.

Apart from Fokker and HSA, which is also a very successful manufacturer of air traffic and fire control systems, including radar equipment, there are in the Netherlands about thirty companies combined in the Netherlands Aerospace Group, NAG, involved in subcontract work and production under licence of aircraft components and spacecraft components.

ESTEC

The Netherlands is fortunate to have the European Space Research and Technology Centre (ESTEC) of the European Space Agency (ESA) located at Noordwijk, north of Den Haag, where about half of the total staff of 1400 of the ESA organization are employed. The closeness of ESTEC, combined with the fact that the requirements dictated by the Netherlands space programme do not justify the national build-up of large space environmental test facilities, has led to a great reliance on these ESA facilities for our national space projects.

The Importance of Aerospace

The importance of aeronautics and space technology for the Netherlands can be summed up as follows:

Total employment (all figures are approximate):

Military (Air Force and Naval Aviation)	25,000
Air transportation	22,000
Aerospace industry	10,000
Government services, education, NIVR, NLR, Airports, etc.	3,000
Total	60,000

Roughly 1000 civil and 500 military aircraft are operated from the Netherlands.

The annual turnover in aeronautics and space is approximately DG 8.5×10^9, which is equal to 2.5% of the G.N.P. All in all, about 3% of the Netherlands population depends directly on aerospace. Obviously, the significance of aeronautics for the economy of the Netherlands is not properly expressed by the 2.5% contribution to the G.N.P., since it fulfills an important spearhead function for the whole economy.

THE ROLE OF NIVR

The period after the second world war has been characterized, in the field of aeronautics, by a close cooperation between government, industry and research. Of special importance was the establishment, in 1946, of NIVR, The Netherlands Agency for Aerospace Programmes.

Immediately hostilities ceased in 1945 the Netherlands government decided to re-build the war-devastated aircraft industry. To that end a committee under the chairmanship of Mr Theo Tromp, vice-president of Philips Company, was set up to implement this decision. Mr Tromp, an industrialist of great experience and vision, came up with three principles:

- the government should support – financially and technically – the development of aircraft projects, thus enabling the aircraft industry to have its own projects instead of being a mere subcontractor;
- *this financial support should not be given as a subsidy* but as a loan which, in case of success, should be repaid from series production; and thirdly
- a separate agency should be set up to execute this policy: that agency has become NIVR. Aeronautical policy is still executed along these lines.

The first Chairman of the Board of NIVR was Prof. van der Maas, well-known in AGARD circles, who led NIVR during the first post-war aeronautical design period from 1946 onwards and until 1970.

Before discussing the activities of NIVR in more detail, reference is made to Figure 1, where the *relationship between government and industry* is illustrated. The Ministry of Economic Affairs is responsible for the industrial aspects of the aerospace industry. The budget of NIVR, which is a Foundation according to private law, is submitted to this Ministry.

Air transportation aspects are the responsibility of the Netherlands Civil Aviation Agency, falling under the Ministry of Transport and Public Works. The aerospace research budget of NLR is submitted to this Ministry.

NIVR is a non-profit foundation, with the statutory task of promoting aerospace industrial activities in the Netherlands. Through the composition of the Board, the responsibility for these activities is commonly shared by the government, the industry, and the technical-scientific community.

This concentration of all interested parties on the Board of NIVR promotes the communication and the

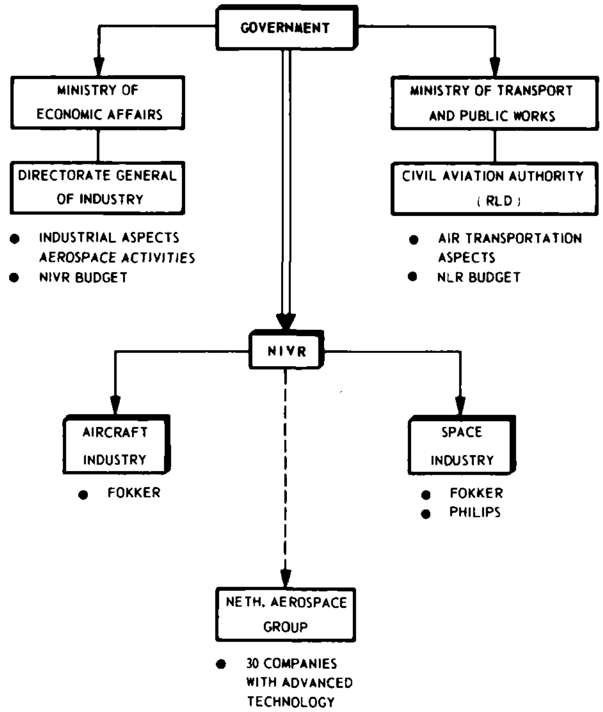


Fig.1 Relationship between government and industry

cooperation between these various sectors in the Netherlands. It also avoids duplication of efforts in the government and the private sector.

Note that there is in the Netherlands only one aircraft industry (Fokker), one National Aerospace Laboratory, and an NIVR in which all interested parties work closely together in defining civil programmes and research activities.

The Board of NIVR consists of representatives from the:

- Ministry of Economic Affairs
- Ministry of Transport and Public Works
- Ministry of Defence (Air Force)
- Ministry of Defence (Navy)
- Ministry of Finance
- Ministry of Foreign Affairs
- Ministry of Education and Science
- Fokker Aircraft Industry, two members at board level
- Philips, one member at board level
- KLM, Royal Dutch Airlines, one member at board level
- NLR, National Aerospace Laboratory, chairman
- TNO, Organization for Industrial Research
- Independent experts interested in aerospace.

NIVR operates a small Bureau with a staff of approx. 25 (technical, financial and administrative) with the task of preparing the necessary documentation for the Board and the implementation of the Board's decisions. The Bureau monitors and supervises technically and financially the various projects funded through NIVR.

It must be stated clearly that NIVR does *not* itself carry out research or develop aircraft or spacecraft. The first is the task of NLR; the second the task of the industry.

But the task of NIVR is:

- to advise the Netherlands government on all aspects of industrial aerospace matters which are of concern to the government. In particular, NIVR advises on aircraft and space development projects;
- to monitor for the government the aerospace programme carried out by the industry and which are funded by NIVR, either directly from NIVR-funds or from funds provided by the government;
- to monitor the aerospace research programmes, which are executed by NLR or other institutions, and financed by NIVR;
- to represent the Netherlands government in international projects for which the government or NIVR made available funds, e.g., the Netherlands participation in the Airbus project.

The role of NIVR is further illustrated in Figure 2, where the position of NIVR between the government on the one hand and the industry on the other hand is shown. This figure also indicates the funding of aerospace research related to project development by the industry and carried out by NLR. NIVR, through its funding and the staff of the Bureau, provides continuity in the technological research, which is important for future projects.

As indicated above, one of the principles of the NIVR set-up is that NIVR finances the development phase of aircraft programmes and the related research. Series-production financing is up until now a question to be settled by industry.

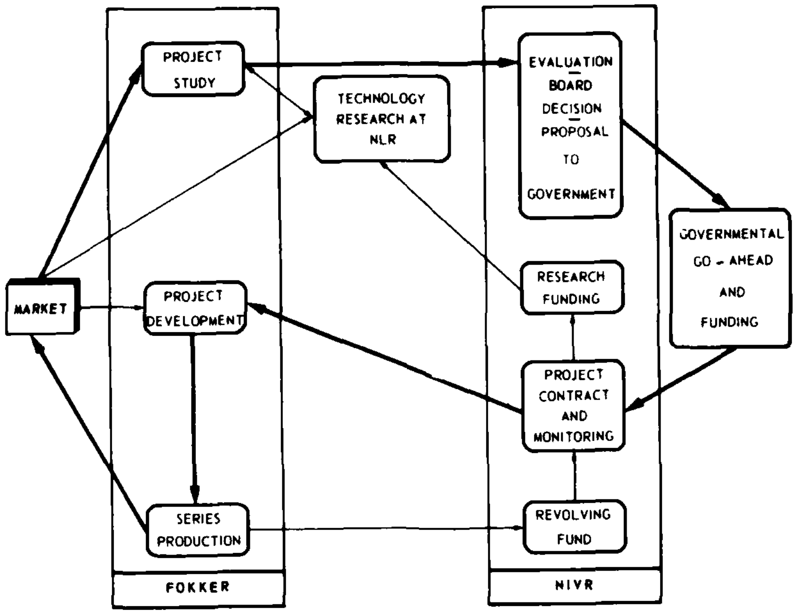


Fig.2 From market to airplane: position of NIVR between government and industry

The development costs have to be re-paid by the industry from the proceeds of the series production aircraft. After repayment of the development costs, a royalty has to be paid for every following aircraft sold. Repayment ends when the series production stops.

Should a project stop before development costs have been repaid in full, there is no obligation on the industry to continue payments. That is where the risk-carrying role of NIVR comes in.

The repayments are made by the industry to NIVR and these repayments and the subsequent royalties provide NIVR with financial means for supporting following projects and relevant research. This results then in a *revolving fund*.

The annual NIVR expenditures in excess of income are financed by the government via the budget of the Ministry of Economic Affairs. This procedure does not (yet) apply to space projects. Here the government generally finances the projects and requires only a small (incentive) financial participation from the industry. Table 1 illustrates the financial status of some of the present projects in which NIVR participates.

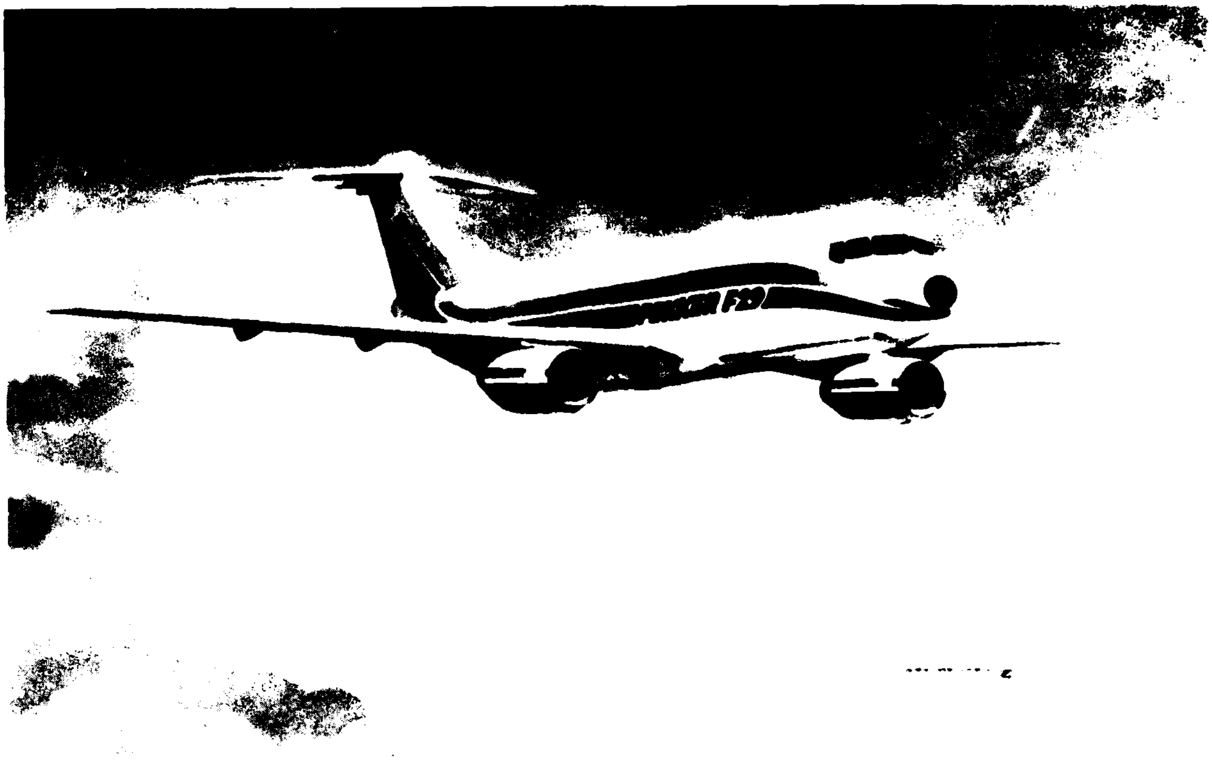
The major current aircraft project is the Fokker F29: a 136-seater for short and medium-haul distances to be launched in international cooperation. During the project initiation phase, 1975–1979, the NIVR financed DG 50.8 million and Fokker funded approx. DG 20 m. A similar ratio applies to the current (1980–1981) project definition phase, which is estimated at DG 45.7 million.

The involvement of NIVR with space technology started in 1969 with the development of the Astronomical Netherlands Satellite (ANS) in cooperation with NASA. The infrastructure and the capabilities

TABLE 1

Development Costs of Some Aerospace Projects (Dutch Part)
(Thousands of Guilders)

Aircraft Project	*Basic Development*	*Further Development*	*Total Costs*	*Repayment Until 1980*
F27	27,000	8,050	35,050	84,634
F28	142,490	53,300	195,790	156,160
A300	113,910	13,471	127,381	8,580
Space Project				
ANS			57,356	
IRAS			150,000	



Artist's impression of the Fokker F29 advanced-technology airliner. (Photo: Fokker BV)

in the Netherlands are well suited for the development of an astronomical satellite. The following elements are important:

- strong tradition in astronomy and active astronomers
- active aircraft industry (Fokker)
- advanced electronic industry (Philips)
- and, last but not least, high quality of research and education (NLR, Delft University of Technology).

This first satellite, launched in August 1974, gave the industry the opportunity to develop its space technology capability to a sufficient quantitative and qualitative level to lay the foundation for successful participation in future space projects, national or international. The successful launching of the ANS satellite was followed by the development of the IRAS, Infrared Astronomical Satellite, in cooperation with NASA and the British Science Research Council. The IRAS will be launched in August 1982.

Apart from these two nationally-managed programmes, NIVR funds a more basic space technology programme and stimulates participation of the Netherlands industry in ESA space programmes.

THE ACTIVITIES OF NLR

In 1919 the Government Aeronautical Services, RSL, was founded with the main task of carrying out investigations in support of aeronautics in the Netherlands. In 1937 this government service was transformed into an independent, non-profit organization, subsidized by the government. This foundation, the National Aerospace Laboratory (NLR), is governed by a Board, similar to the NIVR. Here again the main parties in the Netherlands with an interest in aerospace research are represented on the Board:

- The Chairman (Prof. dr. ir. O.H.Gerlach) is appointed by the five ministries involved. The other Board members are appointed by:
- Ministry of Transport and Public Works (two representatives: one from the RLD (Civil Aviation Authority) and one from the PTT)
- Ministry of Defence (two representatives: one from the Air Force and one from the Navy)
- Ministry of Economic Affairs
- Ministry of Education and Science
- Ministry of Finance
- Fokker Aircraft industry
- KLM, Royal Dutch Airlines
- KNVvL (Royal Netherlands Aeronautical Society)
- TNO – Organization for Industrial Research
- NIVR – Netherlands Agency for Aerospace Programmes.

The Board is assisted by a small office in Delft, under the guidance of the Chairman.

The *task of the NLR* is to carry out research in aeronautics and space technology on a non-profit basis in support of:

- government services, civil and military
- aircraft operators
- aircraft and spacecraft development.

Besides this work on a contract basis the NLR carries out its own programme consisting of research proper and the development of equipment and experimental techniques. This programme is financed by the government through annual subsidies.

Apart from direct aerospace research, some related activities are carried out, such as studies on environmental effects (wind, pollution), remote sensing, informatics and participation in the national energy programme.

Much of the research is carried out in close cooperation with the industry, the University of Technology in Delft, other universities and foreign sister organizations.

The organization diagram (Fig.3) indicates the main disciplines at NLR. The total employment of the laboratory is 750; about 60% is located at the facilities in Amsterdam and 40% in the Noordoostpolder, 110 km east of Amsterdam. Close to two-thirds of the personnel hold a University or advanced technical college degree.

The total income for 1980 is estimated at DG 84 million, 65% of which comes from NIVR contracts, the Royal Netherlands Air Force, the RLD, and other national and foreign organizations. The remainder of the income, provided by the government as a subsidy, is used to finance the NLR's own research programme, as indicated above.

Investment funds are mainly obtained from government subsidies and to a lesser extent (20–30%) from amortization charged in connection with contracts.

The planning of the research activities receives much attention. Inputs for the annual and longer term (5-year) workplans are derived from periodic contacts with the RLD, the Air Force, the Navy, NIVR, Fokker and KLM. For the NIVR, the Air Force, and the RLD, so-called rolling budgets and 5-year workplans exist and these rolling budgets are updated annually. The technical responsible personnel of these organizations assist the NLR in forecasting the need for research by participating in the periodic reviews and by reviewing the quarterly progress reports. More and more the long-range planning of research activities is influenced by international cooperation. In several instances the result of this cooperation is substantially more than just the sum of two national programmes.

An independent *Scientific Committee* with five sub-committees advises the Board of NLR, the Board of NIVR, and the Director of NLR on the programmes and publications. It consists of 40 scientists and engineers from the aerospace community and the universities, selected on the basis of their expertise in the disciplines in which the NLR is active. Each sub-committee meets two to four times per year and reviews critically the publications with the authors present.

The laboratory is *organized* along the lines of specific disciplines, but the work is carried out in the form of projects with project-teams consisting of members of the various departments as required; the matrix type of organization is practiced as much as possible. The relatively large number of contracts, ranging from 1000 to several million guilders, makes it mandatory to exercise a tight project control. A computerized accounting system with inputs (man-hours spent, the use of equipment, and external costs) makes it possible for all project leaders to have available periodic status reports, as required. On a laboratory scale the financial status is reviewed every two weeks. Customers receive progress reports, technical and financial, as required by the contracts.

The activities in the area of *Fluid Dynamics* comprise both theoretical and experimental aerodynamics, including computational fluid dynamics. Particularly in the area of transonic aerodynamics much progress has

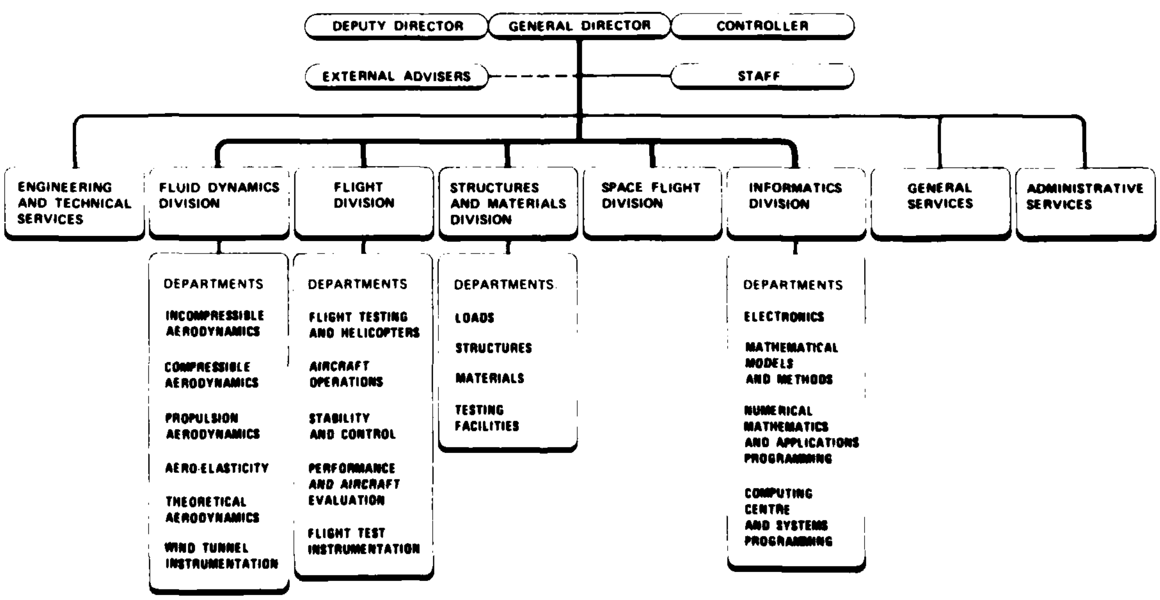


Fig.3 Organization diagram of NLR, indicating the main disciplines of NLR

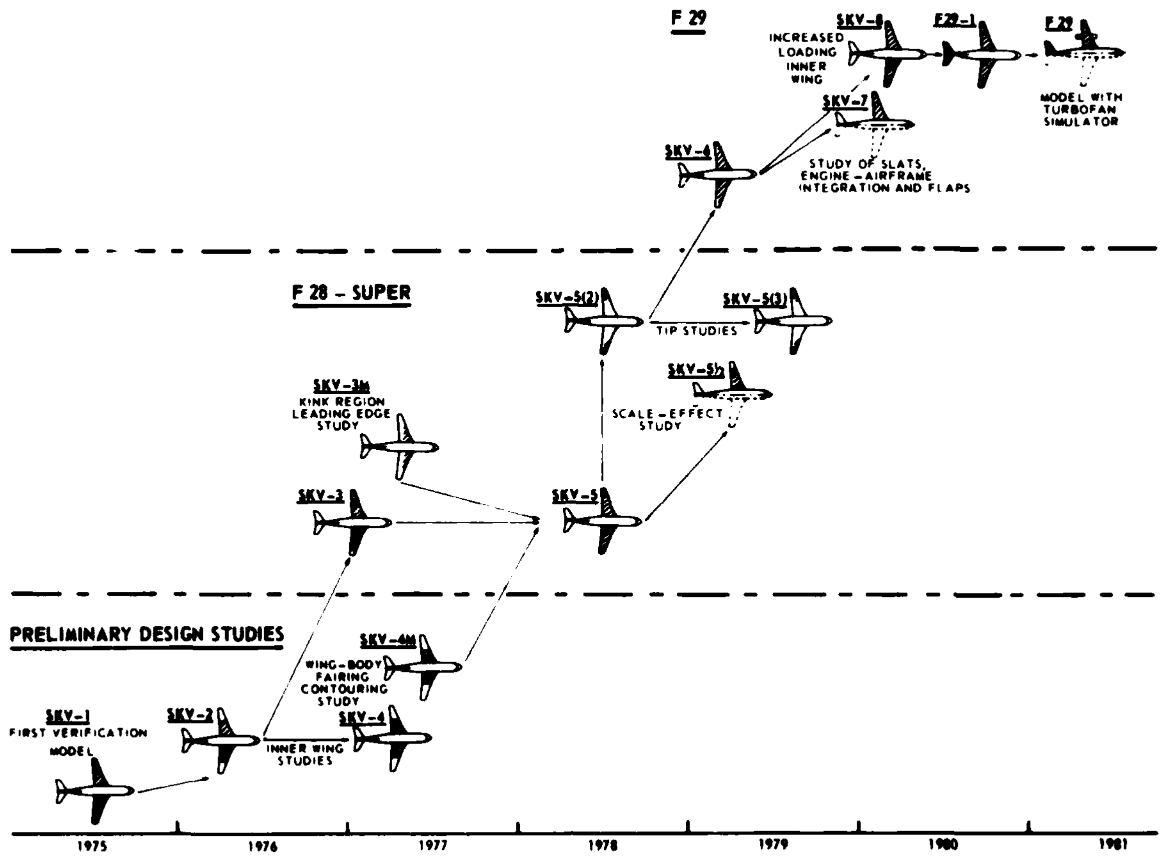


Fig.4 The stages in the development of modern transonic wings at NLR, applied by Fokker in the design studies for the F29

been made since the 60s when the first theoretical (at NLR) and experimental (at NPL) results of shock-free transonic airfoils were obtained. The work at NLR has resulted in design methods for modern transonic wings, now applied by Fokker in design studies for the F29. Figure 4 illustrates the stages in the development of this wing. So far more than 6000 hours of wind tunnel testing have been carried out in support of this aircraft development.

Since the 1920s flutter research and instationary aerodynamics, now applied to transonic configurations, have been important activities at NLR.

During the last ten years, aero-acoustics and propulsion aerodynamics have gained in importance as research topics. In cooperation with Fokker and Rolls-Royce substantial jet noise reductions of the Fokker Fellowship, F28, have been achieved. Emphasis is now placed on noise reduction using sound-absorbing materials.

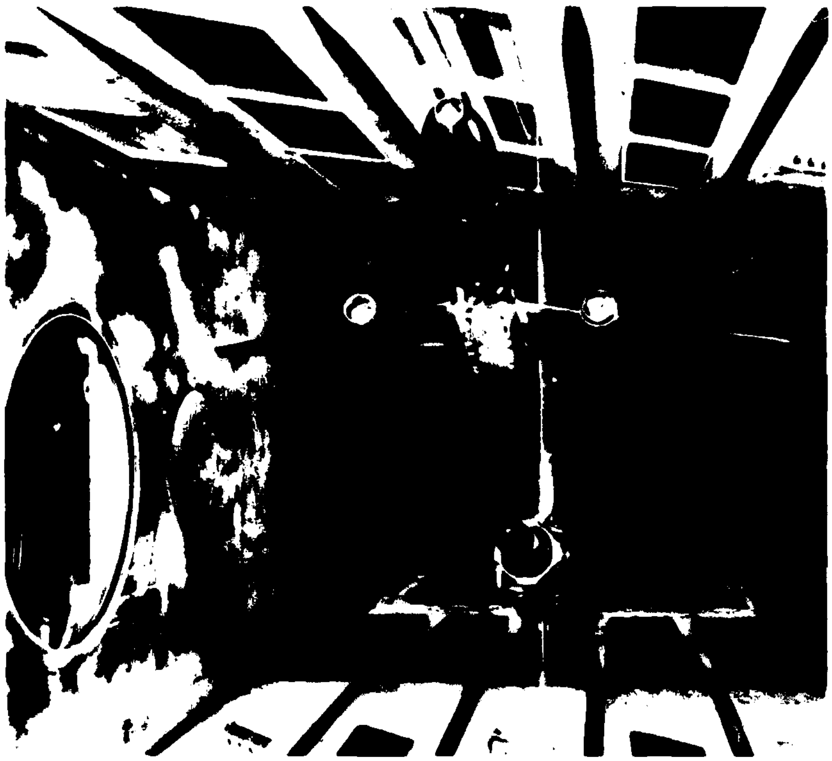
The laboratory operates ten wind-tunnel installations covering the speed range from low subsonic to $M = 6$. The latest addition is the participation in the DNW, the German-Dutch Wind-Tunnel, built and operated jointly with the German sister organization DFVLR.

The work in *Flight Mechanics, Flight testing* and *Flight Operations* is carried out in close cooperation with the industry and government organizations. Notable topics are studies in the handling qualities of aircraft, the studies of pilot performance and take-off and landing procedures.

The NLR is responsible for the design and operation of the flight test system to be used during the flight testing of the F29. In this system a total of 1500 parameters is to be measured at a rate of 10,000 samples per second. The largest part (1200 parameters) are to be recorded during flight and about 80 critical parameters will be telemetered in digital form to a ground station.

The NLR assists the Air Force in the certification of weapons and stores and the measurement and analysis of mission effectiveness. Closely related are operational research activities for the Air Force, often carried out in cooperation with the RVO, the Netherlands Defence Research Organization. In the area of civil aircraft operation, research is carried out for the air traffic control authorities. For various authorities noise contours around airfields are calculated and the effects of alternate route and runway structures are studied. The laboratory is equipped with flight simulators, laboratory aircraft and flight test equipment for carrying out the various research projects.

The *Structures and Materials* activities are also geared towards applications by the aircraft industry and the aircraft operators in the Netherlands.



Pre-F29 model with advanced wing geometry in the high-speed wind tunnel of NLR.
(Photo: NLR)

The recording of aircraft loads, in close cooperation with the Air Force and KLM, provides useful data for the analysis of experimental and theoretical laboratory tests and the prediction and control of fatigue life of aircraft structures.

Due to the corrosive atmosphere in the Netherlands, much emphasis is placed on the evaluation of aircraft materials in corrosive atmospheres and the effectiveness of coatings on compressor and turbine blades.

An important activity is the laboratory evaluation of new material properties, including crack growth characteristics and fracture mechanics of new aluminium and titanium alloys and carbon-fibre-reinforced plastics (CFRPs). In close cooperation with Fokker and the Delft University of Technology the applications of CFRPs and so-called mixed structures (combination of light metal and carbon-fibre materials) are being studied. In passing it should be mentioned that Fokker carries out an extensive research and development programme in the area of CFRP structures for aircraft and spacecraft applications. The long experience at Fokker in metal bonding of aircraft structures, since the 50s, is also applied to the so-called mixed structures.

The NLR carries out investigations on the failure of aircraft components during the operation of military and civil aircraft in the Netherlands. These investigations provide valuable knowledge for the aircraft designers and operators. The laboratory is equipped with modern mechanical testing machinery, including automated fatigue testing, and equipment for material investigations.

The specific *Space Flight Technology* activities at NLR developed along the needs of the national and international space programme in which the Netherlands participates. The main specializations are now satellite attitude measurement and control system analysis and testing; the design, analysis and operation of ground control systems, including the programming of on-board computers and certain aspects of thermal control such as heat pipe development and thermal blanket testing and analysis.

For the testing of attitude control systems, the laboratory is equipped with several motion simulators. Current projects include the systems testing of the attitude control systems of the IRAS and the ESA Exosat satellites.

For the operation of the astronomical ANS and the IRAS satellites NLR provided teams working from the beginning in very close cooperation with the industry, the experimenters and the control centres.

For experiments in thermal control and for space environmental testing of components the NLR is equipped with small space chambers, while complete satellite environmental testing is carried out at the ESA facilities in Noordwijk.

Finally, the *Informatics Division* must be mentioned.

During the last ten years the occupation with information systems, in close cooperation with other departments and the ultimate users, led to the maturing of informatics as a discipline within the laboratory.

The Swearingen Metro II laboratory aircraft of NLR. (Photo: NLR)

The major elements in this discipline are:

- applied mathematics
- numerical analysis
- application programming
- operation of the computer centre with terminals
- system programming
- electronics.

Examples of major information systems in which the NLR is involved are:

- wind tunnel data handling systems
- flight test data systems
- remote sensing data systems
- management information systems for aircraft operators
- astronomical satellite data systems.

INTERNATIONAL RELATIONS

Aerospace engineering research in the Netherlands is concentrated at NLR. In many instances the laboratory cooperates with other laboratories in the Netherlands; for example, in the area of defence, co-operation exists with the RVO-TNO, the Netherlands Defence Research Organization, an organization with 820 personnel covering most of the national, non-aerospace needs.

Although aerospace research in the Netherlands is of necessity mainly limited to those subjects which are of direct interest for applications, now or in the foreseeable future, it is obvious that, even with those limitations, international cooperation is extremely important for a relatively small laboratory such as NLR in a relatively small country. The international cooperation ranges from exchange of information to the execution of joint research programmes and the joint construction and operation of facilities.

Information exchange is formalized through:

- AGARD, Eurovisc, ICAF, ICAS, IAF, etc.

Joint research is carried out with:

- DFVLR-FRG, RAE-UK, ONERA-F, NASA-USA, USAF-USA, GARTEUR (FRG, F, NL, UK), etc.

Particularly with DFVLR, the RAE and ONERA, joint research programmes are now carried out on a regular basis. With DFVLR, the joint construction of a large low-speed wind tunnel was started in 1976 and the joint operation, through a newly-established foundation DNW, has now started. Similarly, the joint construction and operation of the so-called European Transonic Wind Tunnel (ETW) is now being prepared by West-Germany, France, the United Kingdom and the Netherlands. In spite of the added complications involved in carrying out research jointly with foreign organizations, considerable progress has been made in the last ten years.

It is realized that, in order to establish true co-operation, it is necessary to contribute in selected areas at an internationally acceptable level; in other words something of interest must be offered from both sides.

It is gratifying to note that many of the successful cooperative efforts found their origin in contacts and ideas generated by AGARD.

CONCLUDING REMARKS

Civil and military aviation and space technology are important advanced technological activities in the Netherlands. By joining governmental and non-governmental forces, the NIVR has developed into an effective mechanism to guide and stimulate aerospace development.

Aerospace research is carried out by NLR through a system of contracting and government subsidies; it operates as an independent foundation in which all interested parties are represented at Board level.

With the aid of the organizations of NLR and NIVR it has been possible for the Netherlands to develop competitive aerospace products.

A Memorable Evening....

. . . . and in the most beautiful surroundings, as our photos show, was enjoyed by the guests of the Dutch government and the Municipality of The Hague on the occasion of the Reception given to participants in AGARD's National Delegates Board meeting in October last year. The evening was spent in The Town Hall buildings which are a remarkable architectural blend of old and new, the original part contrasting sharply with the recently-added extension. Hosts for the evening were State Secretary for Defence, Dr W.F. van Eekelen, and Mrs Vos van Gortel, representing the Municipality of The Hague.

PRINCIPAL HOSTS AND GUESTS at the reception. Flanked by the two Netherlands National Delegates to AGARD, Ir. J.A. van der Bliek (extreme left) and Professor Dr-Ir. O.H.Gerlach (extreme right), are Jack Burnham and Alan Lovelace (AGARD Director and Chairman, respectively), Mrs Vos van Gortel (Alderwoman of The Hague), and Dr W.F. van Eekelen (Dutch State Secretary for Defence).

VOYAGER MISSION photograph is here presented to Dr van Eekelen by AGARD Chairman Dr Alan Lovelace, at the time Deputy Administrator of the US National Aeronautics and Space Administration.

SCENE AT SUPPER with the unmistakably Dutch oil-paintings echoing the past and the dramatic decor and lighting very much of the present.

CANDELABRA AND COCKTAILS. Early arrivals included (on the right) Colonel Philip Pryor (US Army), Chief of AGARD's Military Committee Studies Division, and Mr Earl Reese (NASA), here being offered a glass of sherry in the elegant gilded reception hall.

SUMMARY OF 1981 MEETING THEMES

AEROSPACE MEDICAL PANEL

Specialists' Meeting: **Aural Communication in Aviation**
30 March 3 April 1981, Soesterberg, Netherlands

With the need for pilots of high-performance aircraft to perceive and respond to audio warnings instantly and with the minimum of effort, the quality of airborne voice communications systems has to be improved.

The aim of the meeting is to cover the entire field of speech communication in flight, from the characteristics of speech to ideal systems designed for its transmission and reception. Sessions will also be devoted to discussing the cost of inefficient systems in terms of damage to hearing and reduced operational capability, hearing conservation, and speech intelligibility tests.

38th Panel Business Meeting
5 8 October 1981, Fürstenfeldbruck, Germany

Invited speakers will present to Panel Members "Recent Advances in Aerospace Medicine".

AVIONICS PANEL

41st Panel Meeting/Symposium: **Tactical Airborne Distributed Computing and Networks**
22 26 June 1981, Røros, Norway

With the growing emphasis and resulting major trend to distributed computing and computer netting, it is very appropriate and timely for AVP to hold a symposium on airborne applications of this technology. The advent of modern digital micro-electronics, digital micro-computing devices, recent agreements on standardizations of internal bus communications, structures and developments in the area of secure high-rate external data links had indicated the practical capability for implementation and utilisation of airborne distributed and network systems. This symposium will bring out for discussion and review the various technologies and methodologies under current development or consideration.

42nd Panel Meeting/Symposium: **Impact of Advanced Avionics Technology on Ground Attack Weapon Systems** (Classified)
19 23 October 1981, Athens, Greece

New technology including new electromagnetic and electro-optic sensors, high density data and signal processors, digital exchanges and advanced man-machine interfaces as well as new components and materials will allow for concepts of new smaller and cheaper tactical fighters with all weather, day-and-night capabilities. This Symposium will review technology advances and the enhanced capabilities which they will provide for countering armor attacks as well as providing air support and interdiction capabilities under all conditions.

ELECTROMAGNETIC WAVE PROPAGATION PANEL

30th Panel Meeting/Symposium: **Special Topics in Optical Propagation** (Classified)
6 10 April, 1981, Monterey, California, USA

This Symposium will address such diverse topics as: optical transmission in the marine boundary layer for tactical communications at sea, pulse-stretching due to scatter of high-power blue-green laser propagation between satellites and submarines, theory of radiative light transfer across the ocean surface, and high-altitude propagation effects including earth limb radiance fluctuation in the infrared and effects of earth background on early warning sensors.

31st Panel Meeting/Symposium: **Medium, Long and Very-Long Wave Propagation (at Frequencies less than 3000 kHz)**
21–25 September, 1981, Brussels, Belgium

Use of these frequency bands has remained relatively constant despite some of their disadvantages. Much new propagation information has been obtained, principally at ELF and VLF frequencies, since the last AGARD Symposium on this topic. New techniques have not been applied below 3000 kHz. This Symposium will summarize the current state of knowledge in this frequency band in areas of propagation, antennas and radio communications technology; present recently acquired data and knowledge; and speculate on trends and future use of these bands.

FLIGHT MECHANICS PANEL

58th Panel Meeting/Symposium: **The Impact of Military Applications on Rotorcraft and V/STOL Aircraft Design** (Classified)
6–10 April 1981, Paris, France

This Symposium is intended to bring together both technologists and users in the field of V/STOL and rotorcraft. Jet-lift V/STOL aircraft are now operational with four nations, and the role of rotorcraft in the battlefield arena may be assuming a greater importance. It appears timely to review the technological position in the light of operational possibilities and needs. The meeting will be classified NATO Secret.

Topics to be addressed will include:

- Lessons from operational experience (mission effectiveness compared to conventional aircraft; use under adverse weather conditions; availability/maintainability in the field; etc.).
- Status of technology (particular projects; application of composite materials; new control technology; etc.).
- Technological deficiencies (why are the Harrier and helicopters the only operational VTOL; is the helicopter the only viable answer to sustained hover mission requirements; what are the problems in subsystems and in system integration).
- Military mission effectiveness (trade-offs between VTOL and CTOL; what are the missions specifically demanding VTOL; considerations of quick reaction time; base vulnerability).

An expanded Round Table Discussion is planned, to permit maximum debate amongst advocates and critics, designers and users.

59th Panel Meeting/Symposium: **Combat Aircraft Manoeuvrability** (Classified)
5–9 October 1981, Florence, Italy

Current and recent technology developments have opened up a range of possibilities for major improvements in manoeuvrability of combat aircraft in the air-air and air-ground modes. There are now real prospects of exploiting a whole new regime of controlled flight, at angles of attack well beyond the normal stall limit, given the availability of automatic departure/spin prevention systems. There is, in addition, a range of new and not-so-new concepts capable of changing the traditional modes of control, of which thrust vectoring and direct lift and side-force generation are examples. All these concepts can be seen as improving combat manoeuvrability to some degree, but there is no simple way of assessing their usefulness, in terms of combat success rate, at the design stage. Most have reached the flight test stage, and a good deal of information must exist, at least in qualitative form, of their effect on combat manoeuvrability. A review of the situation is therefore planned, with the broad aim of relating technical possibilities to operational requirements. The meeting will be classified NATO-Confidential.

The main areas to be considered are:

- Operational requirements (desirable improvements in manoeuvrability; influence on tactics; relation to agility of weapons; etc.).
- Prospects for improvements in manoeuvrability (spin-resistant configurations; improved high angle of attack aerodynamics; new control degrees of freedom; control usage for departure prevention).
- Prediction methods of aircraft performance and manoeuvrability (state of the art and need for new methods or facilities).
- Assessment methods (combat simulation in computers, piloted simulators or flight; flight test techniques and instrumentation).

FLUID DYNAMICS PANEL

48th Panel Meeting/Symposium: **Aerodynamics of Power Plant Installation**
11 14 May 1981, Toulouse, France

Powerplant installations involve complex flows, strongly influenced by viscous effects and often with important aerodynamic interactions between the airframe and propulsion system. The introduction of new vehicle propulsion concepts, and new points of emphasis in aircraft and missile design requirements, provide an expanding range of aerodynamic problems which call for both experimental and theoretical study. It is the purpose of the symposium to survey the current and foreseeable aerodynamic problems in powerplant installation and to review recent work which has improved basic understanding or has enhanced prediction and design methods in this field.

49th Panel Meeting/Symposium: **Fluid Dynamics of Jets with Applications to V/STOL**
2 5 November 1981, Lisbon, Portugal

A number of major current aeronautical developments highlight the need for improvements in our understanding of the fluid dynamics of jets and the fundamentals of mixing. The most important of these developments are V/STOL aircraft and the associated use of thrust vectoring. In addition, there are other engineering applications of jets that call for a better understanding of their fluid dynamics.

The main areas of interest are: Jet mixing with and external flow to which it is inclined, effects of jets on the aerodynamic properties of neighbouring surfaces, interaction of multiple jets, wind tunnel simulation and ground plane effects, effects of nozzle geometry and initial conditions including highly curved ducts, ejectors, injectors and thrust augmentors, theoretical models and their assessment against experimental results.

GUIDANCE AND CONTROL PANEL

32nd Panel Meeting/Symposium: **The Impact of New Guidance and Control Systems on Military Aircraft Cockpit Design** (Classified)
4 8 May 1981, Stuttgart, Germany

In recent years, the role of the pilot, particularly in single-crew aircraft, has changed dramatically. The advances in flight control, weapon aiming systems, navigation and communication systems coupled with ECM and many other capabilities have presented a real challenge to the Aircraft System Designer and in particular to the design of a cockpit layout with controls and displays that maximize the overall aircraft capability while keeping the pilot's workload within bounds. The air-to-air and air-to-ground attack missions are becoming very demanding and the range of munitions, from free-fall bombs and guns to agile guided weapons, presents system integration problems which also reflect into cockpit design.

The meeting will consist of five sessions: Overview requirements/technology, Displays, Controls/displays system integration, Automated systems/man-interface, Cockpit systems evaluation. It will be concluded by a round table discussion on the question: Are cockpit technology advances meeting operational requirements for military aircraft?

33rd Panel Meeting/Symposium: **Guidance and Control Technology for Highly-Integrated Systems** (Classified)
12 16 October, Athens (Agios Andreas), Greece

The highly integrated guidance and control system can be the key to high performance, economic and reliable systems. To attain high reliability conventional design employs large independent subsystems. This technique for several reasons cannot be treated as a practical design for the future. Several recent Guidance and Control Panel activities treating the impact of digital techniques have shown there is a rapid emergence of digital processor applications to guidance and control. These offer integration opportunities heretofore unavailable in analogue systems. Therefore, it was felt timely to organise a meeting assessing the impact of wholly integrated system concepts on the system elements and/or subsystems.

The meeting will consist of eight sessions: Operational requirements, Major operational evaluations, Cooperative system design considerations, Autonomous integrated weapons systems, Threat and target detection and identification, Affordability and survivability considerations, Panel discussions on affordability and survivability considerations.

PROPULSION AND ENERGETICS PANEL

57th Panel Meeting/Specialists' Meeting: **Helicopter Propulsion Systems**
11 15 May 1981, Toulouse, France

This meeting will be aimed at highlighting progress in propulsion systems of rotary-wing aircraft and will provide a forecast of technological developments for future applications. Many of today's successful helicopters are the result of continuous attention to propulsion systems, but a large share of the effort still is based on reaction to the operational environment of fielded units. As such, development activity has produced many lessons that now can be applied early in the design process. In particular, it will be valuable to review this history and survey the events that have led to today's status. In addition, factors to be addressed include: inlet protection from the dusty and sandy unprepared landing sites; component technology peculiar to engines, transmissions and drive trains; life-inhibiting environments; dynamic compatibility of the propulsion and airframe subsystems; and the impact of emerging technologies on future helicopters. This meeting will bring together those individuals who have made significant contributions to the field and will be held in parallel with a Fluid Dynamics Panel Symposium on 'Aerodynamics of Powerplant Installations'.

58th Panel Meeting/Symposium: **Ramjets and Ramrockets for Military Applications** (Classified)
26 30 October 1981, London, UK

With this Symposium the Panel turns its efforts especially to supersonic missile propulsion systems of highly military interest. The aim of the meeting will be to provide a forum for discussions to research scientists and development engineers and to furnish a comprehensive survey on modern ramjet and ramrocket technology and their possibilities in missile propulsion to application experts in government and military staffs.

Beginning with the military requirements and the requirements deducted by engine specific performance, the complete propulsion systems will be discussed including engine integration, dual mode engines, variable geometry engines, booster integration and boost phase transition. The aerodynamics of inlet diffusors and engine interactions will be emphasized. A lot of problems to be discussed are concerned with combustor and combustion, solid and liquid propellants, metal loaded propellants, slurries, hydrogen and fuel management. Testing methods, materials and manufacturing techniques will be further topics of the Symposium.

STRUCTURES AND MATERIALS PANEL

52nd Panel Meeting/Specialists' Meetings: **Aircraft Corrosion. Corrosion Fatigue**
5 10 April 1981, Çeşme, Turkey

Aircraft corrosion is a very expensive phenomenon in terms of cost, inspection, maintenance and repair man-power requirements, or decreased aircraft availability. This Meeting responds to the perception that improved communication between the corrosion R & D, the design and engineering, and the operating and maintenance communities should be helpful in anti-corrosion efforts. Presentations are scheduled from each of these communities and, together with scheduled discussion, are intended to improve the inter-community communication.

In the Corrosion Fatigue Meeting, three principal topics will be addressed:

Results will be presented of an AGARD-sponsored corrosion fatigue cooperative testing programme involving several laboratories, on both sides of the Atlantic, working to a carefully prepared and mutually agreed set of rules. An assessment will be made of the effectiveness of sharing between different laboratories an investigation of a size prohibitive for its execution at a single laboratory. At the same time, readily applicable information will be given on the performance of current protection schemes for aerospace aluminium alloys.

Plans will be developed and discussed for a supplemental programme of a considerably wider scope, both as to the parameters to be investigated and to the conditions of testing.

In addition, papers will be presented stimulating thought on fundamentals of corrosion fatigue on the one hand, and of its combat for real structures on the other.

53rd Panel Meeting/Specialists' Meetings: **Dynamic Environment Qualification Techniques. Maintenance in Service of High Temperature Parts**
27 September – 2 October 1981, Noordwijkerhout, Netherlands

The first Meeting will review the state-of-the-art of dynamic qualification techniques and test methods for military aircraft with external stores, including consideration of the rationale and interpretation of existing standards. The determination of environmental inputs from various sources and their application to specific aircraft and store configurations, including helicopters, will be covered. Presentations will also be given on the development of vibration analysis techniques and the evaluation of possible improvements in prediction methods and establishment of criteria.

The Meeting on Maintenance in Service of High-Temperature Parts will examine, on a broad front, the interrelationship between materials science and technology, and maintenance problems, with a view to combatting the increasing cost of maintenance of engines by increasing the utilization of components. The areas to be covered will include protective schemes, monitoring of ageing, rejuvenation of materials, repair schemes and criteria to be adopted for component retirement.

TECHNICAL INFORMATION PANEL

34th Panel Meeting/Specialists' Meeting: **What Should Users Expect from Information Storage and Retrieval Systems of the 1980's?**
9 – 10 September 1981, Munich, Federal Republic of Germany

The Panel, following meetings in 1979 and 1980 which dealt with relatively basic aspects of aerospace and defence information work, but which nevertheless were directly responsive to the needs and interests of the NATO countries which hosted the meetings, is now anxious to look ahead to the nature and likely effects of new information practices, equipment, etc. To this end, for their 1981 Specialists' Meeting, in the Federal Republic of Germany, the Panel plans first to make a retrospective judgement of significant developments which have occurred in the field during the last two decades and, in particular, review problems which have not yet been solved, such as automatic indexing, fact retrieval, and input standardization.

The Meeting will then consider the context of the 1980s, in terms of relevant technical and social changes which can be expected, and try to assess what will be the impact of these changes upon the information services available in the late 80s. Topics of special interest to be discussed include the interfaces between technical information services, technical libraries, and on-line services and important fundamental technological questions such as the relative roles of mini-computers, microprocessors, and large centralized processors. The effect of the imposition of service charges upon information and library services will also be considered. The programme will conclude with a user-supplier dialogue in the form of a Forum Discussion.

LECTURE SERIES

Lecture Series No.113: **Microcomputer Applications in Power and Propulsion Systems** (with the Propulsion and Energetics Panel)
2 – 3 April 1981, London, UK
6 – 7 April 1981, Munich, Germany
9 – 10 April 1981, Genoa, Italy

The objective of the Lectures will be to familiarize the participants with microprocessor technology, design methods, and current applications in the aeronautical power and propulsion field. Topics proposed include: microprocessor characteristics by manufacturer, memory characteristics, software HI and LO level language tradeoffs, sensor and actuator interfacing, control logic design methods, redundancy managements, and a description of several current applications to engine control.

The Lecture Series Director will chair a round-table discussion at the end of the presentations during which comments and suggestions will be invited from participants.

Lecture Series Director: Prof. D.Powell, Dept of Aeronautics and Astronautics, Stanford University, Palo Alto, California, USA.

Lecture Series No.114: **Dynamic Stability Parameters** (with the Fluid Dynamics Panel)
2 5 March 1981, NASA Ames, Moffett Field, USA
16 19 March 1981, VKI, Brussels, Belgium

The proposed Lecture Series will review the impact of high-alpha aerodynamics on the dynamic stability characteristics of aircraft and missiles. A state-of-the-art survey of analytical, wind-tunnel and flight test techniques will be presented. Lectures will include the following topics:

Basic concepts.
Impact of high-alpha aerodynamics on dynamic stability parameters.
Forced oscillation, rotary, snaking, curved, rolling flow, and half-model techniques in wind-tunnel testing.
Determination of dynamic stability parameters from flight testing.
Analytical determination of dynamic stability parameters.
Control derivatives and aircraft motion sensitivity.
Applications to aircraft and missiles dynamics.

Lecture Series Director: Dr K.J.Orlick-Rückemann, National Aeronautical Establishment, National Research Council, Montreal Road, Ottawa, Ontario K1A OR6, Canada.

Lecture Series No.115: **Personal Visual Aids for Aircrew** (with the Aerospace Medical Panel)
22 23 June 1981, Paris, France
25 26 June 1981, Fürstenfeldbruck, Germany

The purpose of this Lecture Series will be to review:

The various conventional modes of optical correction required either by ametropias or by normal or pathological drops in visual acuity;
The various optical correction by means of contact visual aids.
The individual brilliance enhancement systems for night flights conditions.
The harmful effects, on the ocular apparatus, of various radiations (ultraviolet, infrared, visible spectrum, ionizing radiations, laser, nuclear weapons);
Protective means against these various aggressions.

A round-table discussion will close the Lecture Series during which the participants will be invited to present their comments or short papers.

Lecture Series Director: Medecin en Chef J.Chevaleraud, Ecole d'Application du Service de Santé pour l'Armée de l'Air, Paris Armées, France.

Lecture Series No.116: **Electromagnetic Compatibility** (with the Avionics Panel)
31 August 1 September 1980, Bölkesjo, Norway
3 4 September 1981, Munich, Germany
7 8 September 1981, Rome, Italy

This Lecture Series will describe methodology for the prediction analysis, and test of electromagnetic interference. Current EMC practices and procedures to achieve electromagnetic compatibility within complex weapon systems will be discussed. Topics for discussion include electric current distribution, antenna-to-antenna coupling, intermodulation effects, and spurious responses. Existing data bases for EMC analysis and design, design techniques, and design tools will also be described.

A round-table discussion will close the Lecture Series and participants will be invited to make comments or present suggestions for future work.

Lecture Series Director: Mr John F.Spina, Rome Air Development Center (RBCT), Griffiss Air Force Base, USA.

Lecture Series No.117: **Multi-Variable Analysis and Design Techniques** (with the Guidance and Control Panel)
1 2 October 1981, Bölkesjo, Norway
5 6 October 1981, Delft, Netherlands
8 9 October 1981, Ankara, Turkey

The Lecture Series is intended to provide the basic theories and concepts involved in the design of advanced guidance and control systems employing state-space and multi variable design methods. An intricate part of this Lecture Series will be computer aided and graphical techniques that can be employed in preliminary design and related analysis methods. This will provide one document which covers the necessary design background and state-of-the-art involved in the application of advancing technologies.

Among the main topics, will be reviewed:

Analysis and Synthesis Techniques.
Application of Observer and Estimation Principles.
Computer-Aided Design and Analysis Methods.
System Simulation Techniques.
Test Evaluation and Validation.

The Lecture Series Director will chair a round-table discussion at the end of the presentations during which comments and suggestions will be expected from participants.

Lecture Series Director: Dr R.E.Pope, Section Chief, Honeywell Systems and Research Center, Minneapolis, USA.

Lecture Series No.118: **Fatigue Test Methodology** (with the Structures and Materials Panel)
19–20 October 1981, Copenhagen, Denmark
22–23 October 1981, Lisbon, Portugal
26–27 October 1981, Athens, Greece

This Lecture Series will concentrate on fatigue testing of specimens and small components rather than full scale structures.

Among the main topics covered by the Lecture Series are:

Tests under variable amplitude loading, including the use of standard sequences such as FALSTAFF and TWIST.
Testing under simulated varying environmental conditions.
Specimen design.
Possibilities of and problems with computerized control,
Practical examples will be given of various real cases, problems and techniques used.

A round-table discussion will be organized during which the participants will have an opportunity to obtain answers on specific questions.

Lecture Series Director: Dr P.R.Edwards, Structures Dept, Royal Aircraft Establishment, Farnborough, UK.

SPECIAL COURSES 1981

FMP **Special Course on Flight Test Instrumentation**
11–22 May, 1981, Delft University of Technology, Netherlands

In 1975 the Flight Mechanics Panel sponsored a Course on Flight Test Instrumentation at Cranfield Institute of Technology, UK. The aim of the Course was to provide flight test instrumentation engineers with both the theory and practical application of instrumentation techniques; classroom instruction was enhanced by flight experiences in the CIT laboratory aircraft.

The Course was repeated in 1977 at DFVLR Braunschweig, with the support of the CIT aircraft and staff, and again at Cranfield in 1979. The participants' comments on the value of the instruction received appear to justify a further Course in 1981. On this occasion the Netherlands National Delegates have extended an invitation to hold the Course at Delft University of Technology; CIT aircraft and staff would again participate. Funding from the AGARD Consultant and Exchange Programme will support the contributions of around four lecturers from DFVLR and other NATO nations; the remaining costs will be met by a Course Fee paid by each participant.

Course Director: Mr L.Lucassen, National Aerospace Laboratory (NLR), Amsterdam, The Netherlands.

FDP/SMP **Special Course on Modern Data Analysis Techniques in Noise and Vibration Problems with Particular Emphasis on Aero-acoustic Applications**
7–11 December 1981, VKI, Brussels, Belgium

Scope, Content: After a brief review of classical methods, the principles and general theorems and domains of application of modern methods of data analysis will be presented. This will be followed by details of the instrumentation requirements for the implementation of these methods and of the practical problems which arise. Finally, applications to noise and vibration problems will be considered, with reference to particular examples, many of which are chosen to illustrate the intimate connection between acoustics and vibrations in aeroacoustics.

Course Director: Mr Mario Perulli, ONERA, Châtillon-sous-Bagneux, France.

MILITARY COMMITTEE STUDIES

20th Meeting of the **Aerospace Applications Studies Committee** (Classified)
18 20 May 1981, London, UK

The Committee will hold the initial review of AAS-14, "Mission Applications for V/STOL Combat Aircraft" and the final review of AAS-13, "Signature Reduction". Terms of reference for AAS-15 and AAS-16 will be finalized and the organization of the AAS-15 Study Group will be established.

21st Meeting of the **Aerospace Applications Studies Committee** (Classified)
16 18 November 1981, Washington, D.C., USA

The final review of AAS-14 "Mission Applications for V/STOL Combat Aircraft" and the initial review of AAS-15 will be accomplished. Proposals for new Aerospace Applications Studies will be reviewed and their terms of reference refined as required. The organization for the AAS-16 Study Group will be established. Terms of Reference for AAS-16 will be finalized.

Any other business....

HAPPY OCCASION. A memento from friends on the AGARD National Delegates Board is handed to retiring AGARD Director of Plans and Programmes Rolland Willaume at an informal dinner at the Hotel des Indes in The Hague in October last year

PANEL CHAIRMEN'S MEETING. Discussion ahead of the Meeting between Dr K.J. Orlik-Rückemann (Fluid Dynamics Panel Chairman) and Panel colleague, Prof. Dr Ir. J.A. Steketee of The Netherlands. Dr Orlik-Rückemann is presently Chairman of Panel Chairmen.

BREAK-TIME INFORMALITY at the top table in the course of the NDB meeting in The Hague between (left to right) Major General Cavendish of the International Military Staff at NATO Headquarters, Brussels, who is a member of the AGARD Steering Committee, the AGARD Director Jack Burnham, John Walsh, until recently the Assistant Secretary General, Defence Support Division, NATO, and AGARD Chairman Dr Alan Lovelace.

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DOUBLE CONGRATULATIONS to former UK National Delegate to AGARD, John Charnley, who is the Controller of R&D Establishments and Research at the Ministry of Defence (Procurement Executive) in London. In the Queen's New Years Honours List he received a knighthood and among the 1980 Royal Aeronautical Society Awards, Sir John was awarded a RAeS Gold Medal for his leadership in research and development organisation and management.

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