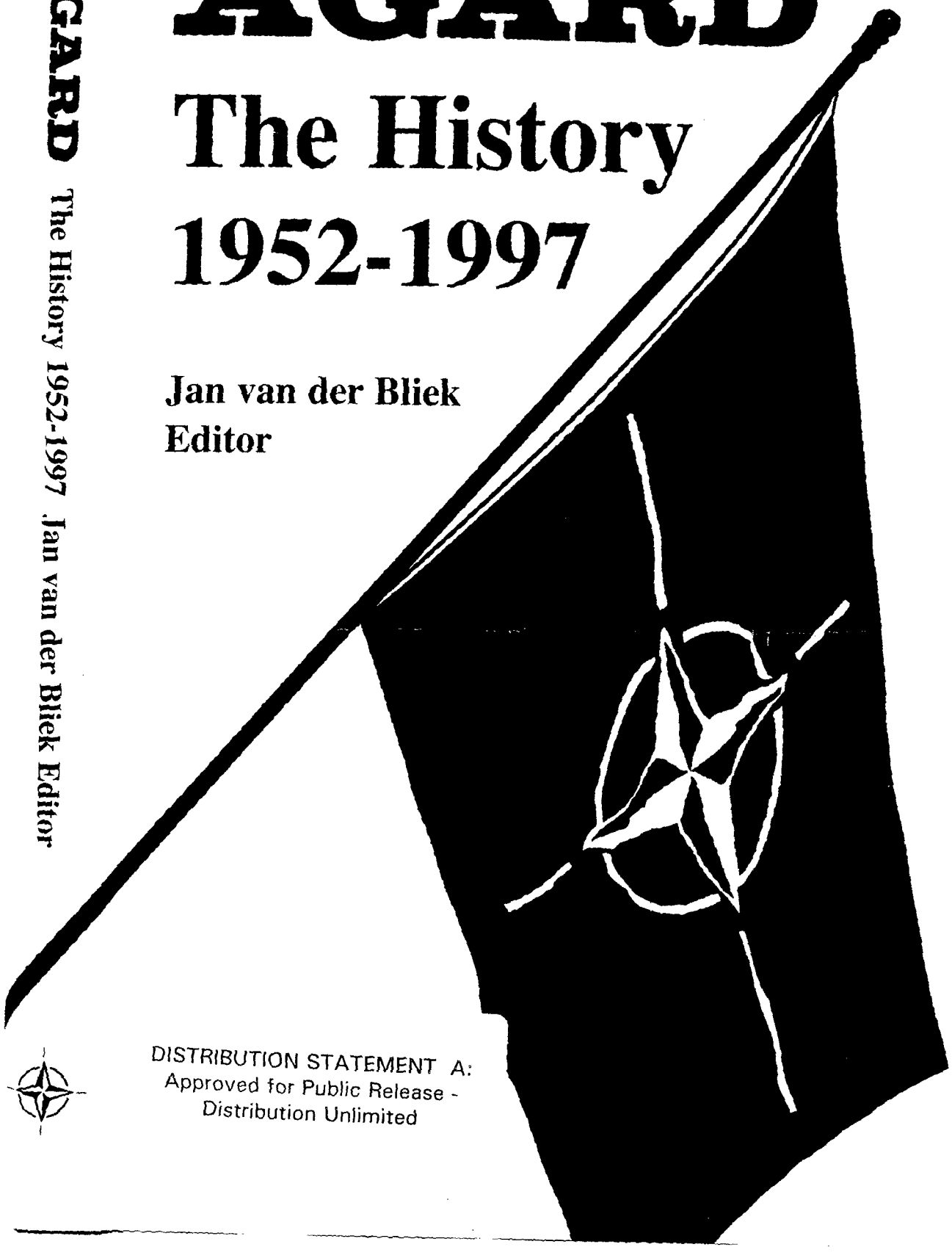
AGARD The History 1952-1997 Jan van der Bliek Editor

AGARD

The History 1952-1997

Jan van der Bliek
Editor



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The latest AGARD History has been distributed to all present members of the R&T Board, National Coordinators and all Panels (past and present) and a copy is enclosed herewith for your information.

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Thank you.

G.W. Hart

North Atlantic Treaty Organization

Research and Technology Agency

The AGARD History: 1952 – 1997

Copies of this History of AGARD, one of the forerunners of the NATO Research and Technology Organization (RTO), have been sent to all members of the Research and Technology Board and RTO Panels. Copies have also been sent to a number of former members of AGARD, but we have inevitably been unable to find addresses for all of them.

If you know someone who was a member of the AGARD National Delegates Board, a Technical Panel or a Committee, a National Coordinator, or closely associated with AGARD in some other way, who has not received a copy, please pass him this form.

Thank you very much.

Ernst A. van Hoek
Director, RTA

I should be interested in receiving a copy of the AGARD History, 1952 - 1997, if sufficient spares are available.

I was associated with AGARD in the following way (give your position and years of service):

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North Atlantic Treaty Organization

Research and Technology Agency

Errata

Please find overleaf an amended page of the contents list (page viii). It contains the following correction:

and the following additions:

We apologise for these errors.

THE
AGARD HISTORY
1952-1997

Dr Theodore von Kármán,
The Founder and first Chairman of AGARD

THE
AGARD HISTORY
1952-1997

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

Now amalgamated with the Defence Research Group of NATO into:

The NATO Research and Technology Organization, RTO

BP 25, 7 RUE ANCELLE, F-92201 NEUILLY-SUR-SEINE CEDEX, FRANCE

Spring 1999

THE MISSION OF AGARD

The Charter of AGARD stated its mission.

It was to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community;
- Providing scientific and technical advice and assistance to the Military Committee in the field of aerospace research and development (with particular regard to its military application);
- 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;
- Exchange of scientific and technical information;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- 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.

The highest authority within AGARD was the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD was carried out mainly through the Panels which were composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme.

During a period of 45 years the representatives of the NATO nations adhered to this mission. This mission is basically still valid in the new NATO Research and Technology Organization, RTO, but it is no longer limited to aerospace.

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* The sub-headings in chapters 3 and 4 are intended to indicate where a topic was first discussed. In many cases, further information is found in the reports of succeeding meetings.

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LIST OF ILLUSTRATIONS

FOREWORD TO THE FIRST EDITION – 1969

The Advisory Group for Aerospace Research and Development, AGARD, within the North Atlantic Treaty Organization, NATO, is both novel and unique. Novel because it was proposed, pursued to approval, developed and presided over by that much honoured, internationally renowned, aerospace scientist, Dr von Kármán, who, after twelve years of leadership, died as he would have wished – in harness. Unique because the Group is exclusively constituted by scientists employed nationally by a NATO Nation, who are free in their business meetings to form their own programmes of work and arrange their own publications, known as 'AGARDographs', without national supervision but with NATO financial assistance.

I was very interested to read that during the first Conference of Aeronautical Research Directors from the NATO Nations, which took place in Washington in February 1951 recommending the establishment of AGARD, the Delegates, (some of them are still on the AGARD National Delegates Board), unanimously adopted the following statement which still retains its full meaning today:

> *"All the Delegates agreed that in the present world situation, faced as they were with common problems of grave importance, there was an urgent need, as well as the existing potential, for working together in mobilising to mutual advantage the scientific and technical skill, manpower and facilities of all NATO Nations.*
>
> *All Delegates were of the opinion that, without affecting the principles of national policies, it is possible to accomplish much by the exchange of information, and by the fullest use of qualified manpower and existing research and development facilities to mutual advantage. At the same time, it should be profitable to coordinate the planning of future facilities with a view to their common use.*
>
> *Much will be gained by the acceleration of research and development projects by common efforts for the common good, and also by bringing together teams of leading scientists and engineers to consider and help in the solution of problems of common defence"*

Though basically a form of an international Learned Society serving NATO in a consultative capacity, AGARD is different from the well known national Learned Societies or Institutions in that is has developed, with the aid of NATO funding, a Consultant and Exchange Programme of its own for the benefit of its members.

Any history of AGARD would necessarily be a story of part of Dr von Kármán's life, and those who have worked closely with von Kármán know that it was his eminence as a scientist rather than AGARD as an organization which attracted as many eminent civil and military personalities to 'General Assemblies' and other gatherings of AGARD, no matter in which country of the NATO Nations they were held.

The first round of these General Assemblies in the fourteen nations of NATO was completed in twelve years at, approximately, intervals of ten months. Thus, the reader will find in this narrative many quotations from the speeches of welcome at Assemblies which, taken together, tend to duplication, but to those of the host nation attending each contribution was 'news' and, therefore, warrants a part in the narrative.

For the above reasons, I make no apology for the length of the document and I thank

all those who have contributed to the success of this novel and unique organization. In particular, I thank the Editorial Committee led by Dr Frank Wattendorf, AGARD Honorary Vice Chairman, assisted by Mr E.T.Jones, former Vice Chairman, Rolland A.Willaume, Director Plans and Programmes, Dr John Vannucci, Executive of the Technical Information Panel, Mr Patrick Greene, Scientific Publications Officer, and Miss Barbara Jacob, the able Secretary. They have spent much time in the preparation of this history which would not have been possible without their records and without their devotion to AGARD.

Every possible effort has been made by the Editorial Committee and by everyone else concerned to make the lists of members completely accurate and it is hoped that we have succeeded in including all those who have so generously contributed to the making of AGARD. However, with the lapse of time, it is always possible that some people may have been accidentally omitted, and to them we apologise for this omission and trust that they will not feel offended.

Finn Lied
Chairman

July 1969

FOREWORD TO THE FIFTH (AND FINAL) EDITION – 1999

AGARD was formed in 1952 at the personal initiative of Dr von Kármán with strong support of the USAF. This book is a tribute to his endeavours in international scientific cooperation and in particular to cooperation in aerospace research and development.

Von Kármán was a true international engineering scientist and his interests went far beyond aerospace engineering as is evident from his activities, his publications and lectures. It was not surprising then that in 1962 the National Delegates Board of AGARD – after ten years of successful operation – considered a proposal to broaden the activities of AGARD into a general research directorate for all of the NATO Military Authorities. For various reasons that proposal was never approved. Instead, in 1964, the Defence Research Group (DRG) was established separately under the NATO Conference of National Armament Directors (CNAD). While AGARD reported directly to the Military Committee of NATO and remained in Paris, DRG became responsible to the Assistant Secretary of Defence Support.

Fortunately the Directors of AGARD in Paris and the Heads of the DRG Support Group in Brussels realised from the beginning that coordination was essential, even though their mode of operation was different. So the two groups had intensive contacts and made sure that their activities were complementary and duplication of effort was avoided. Through this coordination several joint activities took place which led to very positive results for the NATO nations in the area of research and development. The joint conferences on subjects like the goals and the management of research often seemed not to reach any conclusion, but in the final analysis the contacts made during those conferences and the proceedings were important in developing a common understanding. Through those efforts the NATO community was continuously strengthened.

The political events of 1989 and the following years, during which the relations between the NATO countries and the (now former) Warsaw Pact countries rapidly improved, was a reason for the NATO Council to examine the structure of its organization. Elements of this process were the research and technology agencies and organizations of NATO. It seemed natural to join the AGARD organization and DRG into one organization, and in 1996 the two organizations were joined into the new NATO Research and Technology Organization (RTO).

In April 1997 the new RTO organised an AGARD Conference on "Future Aerospace Technology in the Service of the Alliance" at Paris. At the closing ceremony of that Conference the Secretary-General of NATO officially announced the absorption of AGARD into the new organization. Thus it is appropriate, after 45 years of activities, to publish the final history of AGARD.

Dr Michael I. Yarymovych
Chairman of AGARD, 1994-1997
Chairman of the NATO RTO, 1997-

PREFACE

This book basically follows the pattern established by Dr Wattendorf when he edited the first edition in 1969. He started with recording the activities of the National Delegates followed by the work of the Panels. This may give the impression that AGARD was basically a 'top-down' organisation. To some extent that was true in the early days. Von Kármán, assisted by Wattendorf, started the first AGARD Panels and during the first years he was actively involved in the Panels. He was more or less a 'Super Panel Chairman'. As the organisation attracted more experts from the NATO countries, this changed and the Panels became a 'bottom-up' type organisation. There were also the studies carried out at the instigation of the NATO military and the national authorities (the 'top-down' type studies) and they became of increasing importance. However, even these activities were inspired by national interests and a programme was proposed only after a consensus had been reached.

In charting the history of AGARD I make no apologies for following the pattern set by Dr Wattendorf; that is the way it evolved. Some who were involved in the Panel activities only – and that was the majority of the people who devoted so much of their time to AGARD, the 'AGARD family', the Trans-Atlantic scientific community – would probably write a different story. Perhaps rightly so, but it would require several volumes to write the history of each Panel and the AASC.

The history shows that the broadening of the scope was continuously debated by the National Delegates Board. The role of AGARD in the wider context of the NATO organisation was discussed several times. Von Kármán had a very wide scientific-technical interest. It was, however, not until after he died that the NDB decided to limit AGARD's activities to aerospace. Nevertheless, the success of AGARD stimulated others within the NATO community to initiate cooperative endeavours.

The aeronautical (and later, aerospace) community had the advantage that it was internationally oriented from the very beginning of aeronautics and that is was a relatively small and coherent community before World War II. International exchange of information was common from the beginning of this century, apart from the war periods. Technical-scientific information exchange was thus somewhat natural to aeronautics, it being concerned with an emerging science and with operations extending beyond national boundaries.

The AGARD story is a history of the mixture of military and civil authorities and their interests. AGARD was an Agency of the Military Committee, and the military played an important role in determining the programme. However, in many instances it was not clear initially whether the benefits of the cooperative efforts would be mostly in the military or the civilian area. That is inherent to research in a pre-application stage.

The initial preparation of this edition of the AGARD History was carried out by Brig. Gen. (FAF, retd) Gaston Alexis, then Chief of the Programmes Coordination Division of AGARD, assisted by many members of AGARD staff. Their assistance is gratefully acknowledged.

I should also like to acknowledge the contribution of Mr George Hart of the RTA staff, who was responsible for the final editing within RTA.

Jan A. van der Bliek, Editor
Spring 1999
Badhoevedorp, The Netherlands

THEODORE VON KÁRMÁN & FRANK L. WATTENDORF

AGARD was created and shaped by Dr von Kármán personally with the continuous assistance of his long-term companion and collaborator, Dr Wattendorf.

Prof. Theodore von Kármán (1881-1963), the man with the ideas, the man with the outstanding contributions to the aeronautical engineering sciences, managed to convince the authorities – military and civilian – of the importance of staying ahead in the aeronautical sciences and was prepared in his later years to spend much of his time to lead the aeronautical community to an effective form of international cooperation. There was an inherited basic philosophy that inspired him, and the referenced literature, [Ref. 1-8], bears witness to this and his enormously productive life.

In previous editions of this book, several excerpts of his unique biography, [Ref. 1], were reproduced. Von Kármán's life and work covered the whole area of the development of aerospace till he died in 1963. This is a most remarkable history.

Von Kármán was over 70 years old when AGARD was founded in 1952 and during more than ten years he personally guided and inspired all those who were associated with AGARD. He shared with them his rich scientific experience and imparted to them his philosophical wisdom.

In this final issue of the AGARD History it is appropriate to summarise his professional career. Clearly it does not do justice to his enormous scientific contributions and, above all, to his professional inspiration to those who were fortunate enough to encounter him.

Theodore von Kármán – Personal Data

Born: Budapest, Hungary, May 11, 1881, the son of Prof. Maurice von Kármán and Helene (Konn) Kármán

Sister: Dr Josephine de Kármán, who was his companion and supported him till she had a heart attack while von Kármán attended the dedication of the Arnold Engineering Center at Tullahoma, Tennessee in 1951. She died on 2 July 1951.

Never married

Citizenship: Naturalized, USA, 1936

Home: Pasadena, California

Died: Aachen, Germany, May 7, 1963, while Chairman of AGARD.

Education

M.E., Royal Technical University, Budapest, Hungary, 1902
PhD., University of Göttingen, Germany, 1908

Career

Research Engineer, Ganz and Company, Germany, 1903-1906
Assistant Professor, Royal Technical University, Budapest, Hungary, 1903-1906
Privat Dozent, University of Göttingen, Germany, 1909-1912
Director, The Aachen Aeronautical Institute, Germany, 1912-1929
Officer in the Austro-Hungarian Air Corps, 1914-1918
Consultant, Junkers Airplane Works, Germany, 1912-1928
Consultant, Luftschiffbau Zeppelin, Germany, 1924-1928

Consultant, Handley-Page Ltd., England, 1926-1930
Advisor and Consultant on Design of Guggenheim Aeronautical Laboratories, California Institute of Technology and of the 10-foot Wind Tunnel of the Laboratories, 1926-1927
Consultant, Kawanishi Airplane Company, Japan, 1927-1929
Research Associate, California Institute of Technology, 1928-1930
Designed Kobe Wind Tunnel, Japan, 1927
Director, Guggenheim Aeronautical Laboratories, California Institute of Technology, 1930-1949
Director, Guggenheim Airship Institute, Akron, Ohio, 1930-1935
Honorary Rouse Ball Lectureship, Royal Aeronautical Society, 1937
Director, Jet Propulsion Laboratory, California Institute of Technology, 1938-1945
Consultant, Army Air Corps and US Air Force, 1939-1963
Consultant, The Ballistic Research Laboratory (US Army), Aberdeen Proving Ground, 1938-1952
Consultant, General Electric Company, 1940-1960
Consultant on the committee investigating the collapse of Tacoma Narrows Bridge (Washington State), 1942
Consultant, Northrop Aircraft Company, California, 1941-1949
Consultant on High Speed Wind Tunnel, Boeing Aircraft Company, Seattle, Washington, 1941-1943
Consultant in development of Pumping Equipment for Metropolitan Water District of Southern California, 1934-1938
Consultant on the Grand Coulee Dam Project, 1939-1942
Consultant on the Smith-Putnam Wind Turbine for Development of Electricity, 1939-1941
Member of the Special Committee appointed by the US Navy to investigate the Akron and Macon dirigible disasters, 1933-1937
Consultant to the Army Air Corps on Design of the 20-foot Wind Tunnel, Wright Field, Dayton, Ohio, 1939-1941
Founder of the Aerojet Engineering Corporation (later Aerojet-General Corporation), 1942
Chairman, Scientific Advisory Board to the Chief of Staff US Air Force, 1944-1955
Consultant, Convair Division of General Dynamics Corporation, San Diego, California, 1955-1963
Consultant and Chairman of the Technical Advisory Committee, Allison Division of General Motors, 1958-1963
Director, NAS-ARDC Summer Study Groups, 1957-1958
Victor Emmanuel Visiting Professor for Engineering, Cornell University, 1959
Consultant and Member of the Board, of the Tool Research and Engineering Corporation, Los Angeles, California, 1960-1963
Member of the Board of The Washington Planetarium and Space Center, Washington, DC, 1961
Honorary Professor, Columbia University, from 1948
Professor Emeritus, California Institute of Technology, from 1949
President of Honor and Member of the International Union of the Theoretical and Applied Mechanics (IUTAM), 1951

Honorary President and Member of the International Council of the Aeronautical Sciences (ICAS), 1958
Honorary President, Institut du Transport Aérien, 1960
Chief Consultant and Chairman of the Technical Advisory Board of the Aerojet-General Corporation, Azusa, California, until 1963
Scientific Director and Honorary Chairman of the Board, General Applied Science Laboratories, Inc., Westbury, Long Island, New York (Formerly The Gruen Applied Science Laboratories, Inc), 1955-1963
Chairman, Board of Directors, Training Center for Experimental Aerodynamics, Rhode-Saint-Genèse, Belgium, now known as the von Kármán Institute for Fluid Dynamics, VKI, until 1963.
Director, International Academy of Astronautics of the IAF, Paris, France, until 1963
Editor in Chief of Astronautica Acta
Chairman, Astronautics Foundation, Inc., Washington, DC, until 1963
Chairman, Advisory Group for Aeronautical Research and Development (AGARD) of NATO, 1952-1963

Von Kármán published well over two hundred papers and books and lectured in a great many countries. During his career he received many Honorary Degrees, Awards and Titles, [Ref. 1]. Two of the honours must be mentioned here:

- In July 1962 the Chairman of the NATO Council, Mr D.U.Stikker, presented to von Kármán an engraved gold medal in recognition of his outstanding scientific achievements, inspiring leadership, and promotion of international scientific cooperation in the NATO Alliance.

- In February 1963 President Kennedy presented him at the White House with the first National Medal of Science, stating: *"I know of no one else who so completely represents all the areas involved in this medal – science, engineering and education."*

Dr Frank L.Wattendorf (1906-1986) was the second person who formed AGARD. When AGARD was started he became the first Director and as such he had to cope with the problems of getting the organization started. He was Director of AGARD during the period of 1952-1963. After von Kármán died in May 1963 he served as interim Chairman during the difficult period till a new Chairman was elected in September 1963. He then became Vice-Chairman of the National Delegates Board. The National Delegates Board constantly sought his council and drew on his wisdom and experience and it was not surprising that he was appointed Honorary Vice-Chairman in 1967. He stayed active in AGARD till shortly before he passed away.

We do not have available an autobiography of Frank Wattendorf but the testimonies given in the September 1986 issue of AGARD 'Highlights' [Ref. 6], and the tribute paid to him in September 1968 [Ref. 7 and 8] record some of his personal characteristics and his career.

Frank Wattendorf majored in Mathematics at Harvard University. After he received his bachelor's degree in 1926, at the age of 20, he enrolled at the Massachusetts Institute of Technology in the new curriculum in aeronautical engineering. There he met Dr von Kármán who was a visiting lecturer from the Technical University of Aachen. In his biography, [Ref. 1], von Kármán wrote:

"... a student in aeronautics came up to me and introduced himself. He said his name was Frank Wattendorf and he was greatly interested in my approach to the subject of aerodynamics. He also said that in America at that time there was only a very limited opportunity to learn basic aerodynamic theory, and he asked me to recommend a school abroad where he might complete his studies for a master's degree. I recommended Göttingen and Aachen, and added that while we had graduate students from many countries, we did not yet have an American, and would be glad to have one... Wattendorf came to Aachen in 1927 with his mother, and since that time I have considered him as a member of my family..."

In 1930, Wattendorf accompanied von Kármán as his assistant to the California Institute of Technology, where Wattendorf obtained his PhD degree. He stayed at CalTech up to 1936, lastly as chief research engineer. In the 1930s he published several papers on turbulent flow.

In 1936 he accepted a professorship in aeronautical engineering at Tsing Hua University, Beijing, China. Here he designed and built a 15 ft wind tunnel at Nanching. By the end of 1937 he left China because of the war with Japan. En route he was stricken by polio, but fortunately he could be treated in the USA.

He started working again as soon as possible and began to consult with von Kármán on the design of the 20 ft, 40,000 HP, wind tunnel at Wright Field. He was asked by the US Army Air Corps to head the construction and subsequent operation. He stayed at Wright Field as the civilian director from 1939 to 1946.

In 1944, towards the end of World War II, Wattendorf became a member of a group of scientists and engineers – established by Gen. Arnold, see Chapter 1 – who, under the guidance of von Kármán, were to visit Europe and the Far East and advise the Army Air Force Corps on future action in the area of engineering development.

Dr James G. Mitchell recalled [Ref. 6] that while returning from a survey of German test facilities immediately after World War II, Dr Wattendorf wrote his famous 'Transatlantic Memo' (he wrote this on the airplane taking him back to the USA) which recommended the establishment of a new Air Force Test Center with advanced test capabilities. Eventually this became the Arnold Engineering Development Center near Tullahoma, Tennessee, [see Ref. 1]. For the initiation and later the implementation of these ideas Dr Wattendorf was awarded the Medal of Freedom in 1946.

During the period 1946 till 1952, when Dr Wattendorf became director of AGARD, he served in various planning and advisory functions in connection with the establishment of the Arnold Engineering Development Center.

Clearly, Wattendorf's early association, his own technical-scientific career and his many international contacts made him the ideal partner for von Kármán to undertake the task of organizing AGARD.

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CHAPTER 1 BACKGROUND

Introduction

AGARD, the Advisory Group for Aerospace Research and Development, represents a pioneering, successful experiment in scientific cooperation among NATO nations. The founder and first chairman of AGARD, Dr Theodore von Kármán, had dedicated his life to the enhancement of understanding and cooperation among scientists of different nations. Therefore, in order to give perspective to the History of AGARD, it is considered helpful to trace earlier events which show how the concept of AGARD progressively developed in the mind of its creator.

Dr von Kármán's lifelong mission of scientific cooperation was inherited from his father, Maurice von Kármán, a distinguished philosopher and educator at the University of Budapest, who at the beginning of this century predicted that in about fifty years, scientific understanding would transcend national boundaries and lead to international cooperative ventures. AGARD is, in a very general sense, a creation by the son bearing out the prediction of the father half a century earlier.

In order to set the stage for the origin of AGARD, we go back to the advent of World War II. Dr von Kármán, then Director of the Guggenheim Aeronautics Laboratory at the California Institute of Technology, was greatly saddened by the setback to international scientific cooperation, which he believed should eventually counter the irrationality of armed conflict. At the same time he was convinced that in times of world unrest, the United States and its allies should be backed by the most technically advanced military strength. For this reason, he gave unstintingly of his time and effort to help the US armed forces with their technical problems, including a new trend, originated by him, of providing special research and development indoctrination to young military officers. His statement, reproduced in the history of the USA Scientific Advisory Board:

> *"... scientific results cannot be used efficiently by soldiers who have no understanding of them, and scientists cannot produce results useful for warfare without an understanding of the operations."*

During this period, Dr von Kármán was especially impressed by the vision shown by General H.H.(Hap) Arnold, whom he had first known as Commander of the Air Base at March Field, California; later as Commanding General of the Army Air Corps, and its successor, the US Air Force.

The Scientific Advisory Group of the US Army Air Corps

In the Summer of 1944, General Arnold felt the need for a plan which looked far ahead, taking into account potential scientific advances, to ensure the best possible future Air Force. He believed that the war was being won more by sheer force and mass production than by technical superiority; this scientific deficiency should never be allowed to happen again. Military strength based on the latest technical advances should form the best deterrent against future aggression.

In September 1944, Gen. Arnold asked Dr von Kármán if he would assemble a small group of scientists to look forward twenty years or more into all phases of aviation that could affect the development of future air power. Dr von Kármán was pleased

to accept, and established the Army Air Corps Scientific Advisory Group (which later became the Air Force Scientific Advisory Board). This Group prepared the series of long term scientific studies known as 'Towards New Horizons'.

During the Spring of 1945, as the war approached its end, Dr von Kármán became extremely interested in knowing what had been happening scientifically in Europe during the war years, with the objective of planning how best to build for the future. Gen. Arnold had similar interests from the overall Air Force point of view, and it was natural that arrangements were made for a Scientific Advisory Group team to visit Europe, and later the Far East, on a mission of scientific assessment.

International Scientific Cooperation

The task of rebuilding and strengthening scientific cooperation and understanding among scientists of different nations with common interests and goals was a prime preoccupation of Dr von Kármán during the Summer and Fall of 1945, and it was helped by 'brain-storming' sessions with Dryden, Putt, Schairer and Wattendorf at Volkenrode in May 1945. He used his associates and scientist friends in different countries as sounding boards for mutual stimulation of ideas.

During this period, concepts were discussed in principle which, although premature at the time, eventually took tangible form. Examples of general concepts discussed at that time and names of organizations which eventually materialised are:

- A scientific advisory group to a group of nations with similar interests (AGARD);
- Stimulation of basic research in friendly nations (the European Office of Air Research);
- Initiation of cooperative development projects with friendly nations (the Mutual Weapons Development Programme, MWDP);
- Multi-national aeronautical research centre (the Training Centre for Experimental Aerodynamics, now the Von Kármán Institute, VKI);
- International Societies in aeronautics and allied fields [the International Council of the Aeronautical Sciences (ICAS); and the International Academy of Aeronautics (IAA)].

Another concrete move he made was to resume meetings of the International Congress of Applied Mechanics (ICM)[1], and he succeeded in having the first post-war meeting as early as 1946, in Paris. At this time the International Union for Theoretical and Applied Mechanics (IUTAM) was formed, with Dr von Kármán as Honorary President.

In 1947, Prof. Henri Laugier, Assistant Secretary General for Social Affairs of the newly created United Nations, asked Dr von Kármán for ideas on how scientists could assist the UN in maintaining world peace. Dr von Kármán writes in 'The Wind and Beyond':

> *"... I urged as a first step toward permanent peace the establishment of key international research centres, designed to attract learned men of all countries who*

1 The first congress was held at Delft in 1924. In his biography 'The Wind and Beyond' Von Kármán recalls that the delegates wore badges reading IMC, which stood for International Mechanics Congress, and it was also an apt expression for cooperation in several languages. As one delegate put it, IMC in German stands for "Ich muss cooperieren", in English, "I must cooperate", and in French, "Isolation me coûtera" (Isolation will cost me dearly).

would come to exchange ideas. I envisioned a return of the vagrants, or wandering scholars of the Middle Ages, who would, I felt, act as ambassadors to lay the foundations of international good will."

Following this, Dr von Kármán made contributions to the solution of soil erosion problems of the arid zones, and recommended an international study centre in fluid mechanics. Eventually, the United Nations Educational Scientific and Cultural Organization (UNESCO) set up an Arid Zone Research Program, but Dr von Kármán found the United Nations not entirely suitable as a possible framework for his proposed fluid dynamics centre.

CHAPTER 2 THE FOUNDATION OF AGARD, 1950 - 1952

Dr Theodore von Kármán and Dr Hugh L. Dryden, founding members and first US National Delegates

The Concept

The beginning of AGARD can best be described in Dr von Kármán's own words (see Ref.1 cited on page xviii):

> *"Then one day in April 1949, I read in the paper of the birth of NATO*[1]*. Here was a small and simply administered group of nations bound together by the needs of defense. For my purpose it looked ideal. Why not use NATO as a pilot plant to test out the feasibility of scientific cooperation? I had concluded back in Volkenrode in 1945 that progress in technology was so swift that only a pool of nations could properly utilize scientific advances for mutual protection. With such an effort, it seemed to me, the international character of science could grow. After that, my ideas began to firm up. Why not set up for NATO a scientific advisory board similar to the Scientific Advisory Board of the US Air Force? Such a board could ensure the NATO countries that they would always have the best technology at their command."*

Dr von Kármán's ideas were well received by the Chief of Staff of the US Air Force and by Robert A.Lovett, Deputy Secretary for Defense. With this encouragement Dr von Kármán went to Europe and undertook, in the Summer of 1950, a study of the state of aeronautical science in the member nations of NATO.

After his return, in September 1950, he wrote to Maj. Gen. Donald Putt, Deputy Chief of Staff for Research and Development, US Air Force:

> *"I came to the conclusion that the mobilization of science for research useful for defense is yet in a very rudimentary stage in most countries. It appears that the mobilization of scientific effort in Continental Europe can be effective only if the countries work in close collaboration with one another."*

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1 The North Atlantic Treaty was signed in Washington on 4 April 1949. It was ratified by the Parliaments of the first 12 nations within five months. Subsequently Greece and Turkey acceded in February 1952, the Federal Republic of Germany in May 1955, and Spain became formally a member on 30 May 1982.

In this same memorandum, Dr von Kármán recommended that the Scientific Advisory Board invite the directors of aeronautical research establishments of the NATO countries to a conference in the United States, in early 1951, to exchange views. It was his own opinion, based on discussions with Gen. Gruenther, Supreme Commander of the Allied Forces in Europe, that it would be wisest to initiate cooperation in specific scientific fields, and that such cooperation in the aeronautical sciences would be especially timely from the NATO viewpoint.

The above proposal was passed by Gen. Vandenberg to the Standing Group[2] of the NATO Military Committee, who agreed that the US Air Force as Executive Agent should convene such a conference. Dr von Kármán and Scientific Advisory Board associates started work as expressed in his own words:

'... In the next few days my associates and I made plans, and in February 1951 we invited the twelve NATO nations to a conference at the Pentagon. Representatives of eight nations showed up.'[3]

The names by country of the delegates attending the 1951 Conference were:

CANADA	Dr J.J.Green, Mr J.H.Parkin, Grp Capt. Truscott
DENMARK	Major P.N.Brandt-Moeller
FRANCE	Ing. Gen. J.Gerardin, Ing. Gen. J.E.Lafargue, Mr M.Roy
ITALY	Prof. L.Broglio, Mr F.Fiorio
NETHERLANDS	Prof. H.J. van der Maas, Mr C.Koning
UNITED KINGDOM	Mr E.T.Jones, Mr W.G.A. Perring
UNITED STATES	Dr H.L.Dryden, Dr T. von Kármán

The Recommendation

At the series of meetings, which occupied a full week, each delegate gave a résumé of the state of research, organization and facilities in the aeronautical sciences in his country. These contributions made clear that there were many common problems as well as gaps, so that the delegates became convinced of the desirability and usefulness of cooperation. In their own words:

"In the present world situation, faced as they were with common problems of grave importance, there was an urgent need, as well as the existing potential, for working together in mobilizing to mutual advantage the scientific and technical skill, manpower and facilities of all NATO nations."

The delegates were of the opinion that, without affecting the principles of national policies, it was possible to accomplish much by the exchange of information and by the fullest use of qualified manpower and existing research and development facilities to mutual advantage. They were convinced that it was both urgent and practicable to bring about cooperation in the field of aeronautics for the common good, and with immediate benefit to all nations concerned. The conference unanimously recommended:

(a) That an Advisory Group for Aeronautical Research and Development be established without delay within the existing NATO framework;

2 The Standing Group was essentially the Executive Committee of the NATO Military Committee.

3 Seven nations are listed; presumably one nation did not manage to attend. However all twelve nations (Luxembourg represented by Belgium) sent delegates to the inaugural meeting of AGARD in May 1952 (Chapter 3), representing all NATO nations at that point in time.

(b) That NATO consider the establishment of a Scientific Advisory Board covering the broad field of defence science to deal with broad policy questions, and reporting to the Defence Committee.

The report of the conference with the above recommendations was transmitted to the Standing Group on 15 February 1951, by Gen. Vandenberg, with the additional suggestion that NATO appoint the US Air Force as Executive Agent for implementation of the conference's recommendations.

Dr von Kármán's own remarks on the outcome of the 1951 meeting were:

"At the meeting, I explained the basic purposes of the scientific advisory board, and together we worked out a proposal to the high command of NATO. In essence the NATO Advisory Group for Aeronautical Research and Development, or AGARD, as we abbreviated it, would review advances in aeronautical science, exchange important information, and recommend how the scientific talents within NATO could best be employed in strengthening overall technical ability to solve mutual defence problems. We sent the proposal to the Standing Group, the team of four-star generals and admirals from the United States, United Kingdom and France who comprised the NATO General Staff. Each member of the Standing Group ... would forward our document to his nation's joint Chiefs of Staff. When we disbanded that night, we felt the exhilaration of success in setting up a new and exciting international organization."

Approval and Establishment of AGARD

The establishment of AGARD was finally approved by the Standing Group on 24 January 1952 but the second recommendation, for consideration of a Scientific Advisory Board covering the broad field of defence science, was not accepted for the time being. (However, NATO did recognise the broader need in 1957 when it established the Science Committee as a Council Committee.) The Standing Group accepted the US Air Force's offer to be executive agent but made it provisional for a two-year trial basis, after which time, if the experiment was successful, AGARD could be recommended for integration into NATO.

After obtaining Standing Group approval for AGARD, Dr von Kármán was appointed Chairman of the Group, and he started an intensive drive to get the nucleus of an organization in operation as quickly as possible. In April 1952 AGARD established an office in NATO Headquarters, Palais de Chaillot, Paris.

Dr von Kármán notified the Standing Group that he proposed to hold the first meeting of AGARD during the period 19 - 21 May in Paris and asked them to invite their governments to appoint representatives or national delegates. The Standing group on 3 April 1952 notified all members of the Military Committee of this proposed initial meeting of AGARD and invited all respective governments to appoint one or two scientific delegates as permanent members of AGARD.

Replies from the nations were expedited by intensive efforts involving personal contacts in the different countries by visit, telephone, cable or letter to assure appropriate attendance at the first meeting. Dr von Kármán remarked:

"... It wasn't until February 1952 that AGARD was approved, and I could throw myself into the job of setting up the organization. A task force led by Frank Wattendorf and consisting of Col. Paul Dane of JATO fame, Col. John J.Driscoll, and June

Merker, my personal assistant, went to Paris to set up the office, and in May 1952, with the help of Rolland Willaume, our able assistant in Paris, we organized the first General Assembly of AGARD, a meeting of the scientific representatives of twelve nations. I was personally thrilled to see the enthusiasm with which the entire scheme was being greeted. AGARD would be an important nucleus in the modern revival of the internationalism that my father had dreamed of a half century ago."

Dr Frank Wattendorf, the first Director of AGARD, and his close associate, M. Rolland Willaume, pictured in 1976. Mr Willaume was one of the first three recipients of the von Kármán Medal when it was instituted in 1972

CHAPTER 3 THE EARLY YEARS, 1952 – 1964

Professor Frederic C. Haus, a National Delegate from the first meeting in 1952 until 1984 when he was appointed Honorary Dean of AGARD

First General Assembly – Paris, 1952

The inaugural meeting of AGARD was held at the Musée de l'Homme, Palais de Chaillot in Paris, 19 – 21 May 1952, with the delegates of eleven nations as follows:

BELGIUM	Mr Max Fréson, Prof. F.Haus, Prof. J.Ducarme
CANADA	Dr J.J.Green, Mr J.H.Parkin
DENMARK	Major Brandt-Moeller
FRANCE	Mr Maurice Roy, Ing. Gén. J.Gerardin, Prof. J.Pérès
GREECE	Prof. D.Hondros
ITALY	Gen. Carlo Alippi, Prof. Giuseppe Gabrielli
NETHERLANDS	Prof. H.J.van der Maas, Mr C.Koning
NORWAY	Maj. E.Tuster
TURKEY	Lt-Col. Fuat Ulug, Maj. Juseyin Unsal
UNITED KINGDOM	Mr E.T.Jones, Prof. A.A.Hall
UNITED STATES	Dr Hugh L.Dryden

The main objective of this first meeting was to select the technical fields and the specific subjects within these fields on which the initial effort of AGARD should be concentrated. Suitable fields of aeronautical activity suggested by Dr von Kármán were:

1. Aerodynamics and Aircraft Design
2. Propulsion
3. Aircraft Materials
4. Electronics and Communications
5. Aeromedicine
6. Geophysics and Meteorology
7. Armament and Instrumentation

The three broad types of problems into which the activities of AGARD might be classified were:

1. Fundamental research problems
2. Applied research problems concerned with the mission of the Air Forces within NATO.
3. Coordination of means of research within NATO.

These three categories were further broken down into typical examples as follows:

Fundamental Research Problems:

a. The problems of combustion
b. Problems concerning shock waves
c. Aerothermodynamic problems of flow at very high Mach number
d. Unconventional lifting systems
e. Boundary layer control
f. Flutter in high speed aircraft
g. Aerodynamics of turbines and compressors
h. Modern problems in aircraft materials
i. Problems of physics of high altitude
j. Infra-red research

Applied Research Problems:

a. Methods of experimentation in flight
b. Aeromedicine – the human element in flight
c. Electronics in air defence
d. Meteorology of high altitudes and polar regions
e. Take-off and landing problems involved in operations in Europe and North Africa.
f. Aerodynamic problems in modern armament

Coordination of Means of Research:

a. Wind tunnels
b. Engine and rocket testing facilities
c. Experimental flight test facilities
d. Utilisation of missile ranges

At this inaugural meeting, in addition to discussions on general matters of policy, talks were given on the present status of selected items in typical areas for each of the proposed AGARD activities. Research on combustion was chosen as representative of Fundamental Research; flight testing techniques and aeromedicine provided two examples in Applied Research; and wind tunnels were considered important for Coordination of Means of Research. Dr von Kármán recommended that working groups or panels be established in these four areas to conduct studies and reviews culminating in specific recommendations for further action. The National Delegates agreed to these recommendations, and decided to establish an Executive Committee to plan the implementation during the interim period.

First Executive Committee Meeting

The members of the first Executive Committee were:

Dr Theodore von Kármán, Chairman
Mr Maurice Roy, France

Mr C.Koning, Netherlands
Mr E.T.Jones, UK
Dr Frank Wattendorf, ex officio

This Committee held its first meeting in London on 30 May 1952, when it finalised the resolutions in a form suitable for presentation to the NATO Standing Group, drew up a set of by-laws and operating procedures to supplement the Charter established by the Standing Group, and suggested initial activities for the four Panels recommended by the National Delegates as follows:

Combustion Panel *(Fundamental Research)*
1. Publication of a survey of the combustion problems in propulsion today (e.g. flame-holding problems at high velocity).
2. Preparation of a survey of the fundamental problems in combustion, emphasising their aerothermodynamic aspects.
3. Preparation of a roster of research scientists concerned with the problems of combustion.

Aeromedical Panel *(Applied Research)*
1. Aeromedical indoctrination of aviation personnel.
2. Survey of NATO aeromedical scientists and aeromedical research laboratories and facilities.
3. Publication of a bi-monthly information exchange bulletin.

Flight Test and Instrumentation Panel *(Applied Research)*
1. Evaluation of flight techniques and associated instrumentation used by the NATO nations, with a view towards preparing a NATO flight test manual.
2. Study of trends and desirable future requirements in flight test techniques and associated instrumentation.
3. Survey of flight test problems of primary interest to the NATO nations.
4. Exchange of instrumentation between NATO nations.

Wind Tunnel and Model Testing Panel *(Coordination of Means of Research)*
1. Publication of a wind tunnel design handbook incorporating high speed experience.
2. Exchange of instrumentation and calibration models between NATO nations.
3. Recommendations on expediting the common use of wind tunnel and model test facilities of the NATO nations for solving their important aerodynamic problems.

First Report to the Standing Group

It was Dr von Kármán's policy from the beginning to keep the Standing Group fully informed by personal contact, in the form of periodic briefings, as a complement to normal correspondence. To start this procedure, in June 1952, he went, accompanied by Dr Wattendorf and Col. Dane, to Washington, where he gave the Standing Group and the Military Committee a comprehensive briefing on the formation of AGARD, including the First General Assembly, and the course of action outlined by the Executive Committee. The Standing Group expressed complete satisfaction that the programme was well under way in such a short time, approved the planned approach, and agreed that the Research and Development Committee of the Standing Group would work with the AGARD staff wherever it would be helpful. Subsequently, Dr Wattendorf and Col. Dane met the Research and

Development Committee in the first of a series of periodic meetings.

Dr von Kármán told the Standing Group that conditions for research were more favourable in some countries than in others; however, he believed that conditions could and should be created in all NATO nations for participation in aeronautical research. This was important since no one nation could be self-sufficient. He visualised AGARD as the clearing house to consider how best to organise research and development for the mutual good of the NATO countries. He described the three different categories of problem listed above, and outlined the subject areas of the first four Panels. For initial activities, he said, these were fields in which there was an urgent need combined with a possibility of tangible accomplishments within the two-year trial period.

Coordination with the Standing Group was also discussed, including the mechanism of feeding-in technical problems raised by the Military Committee. It was decided that the best method would be to continue the procedure of periodic briefings of the Military Committee by the Chairman; and periodic staff meetings between the Research and Development Committee and the AGARD Director and senior staff.

During the Summer of 1952, effort was concentrated on establishing the four Panels as soon as possible, with nationally-appointed experts. Problems were selected which showed promise of tangible accomplishments in the two-year trial period. By the end of 1952, the first four Panels had been formed and all had started work. More detailed reports on individual Panel activities are given in Chapter 7.

Second General Assembly – Rome, 1952

The second General Assembly of AGARD was held in Rome, 12 – 19 December 1952. This was the first formal General Assembly in which each of the four newly-formed Technical Panels met concurrently for the first time. Most of the NATO nations sent delegations of military or civilian personnel, as well as their National Delegates; and several NATO Agencies were represented. In addition, the host country sent many scientific and technical personnel as observers to the technical panel meetings.

Dr von Kármán read to the Assembly the following memorandum received from the NATO Standing Group in Washington:

"1. The research and development potential of the North Atlantic Treaty Nations is one of the great resources of the West. Any feasible pooling of these resources should achieve a greater rate of technical progress than would each nation working alone. It is self-evident that any contribution to this rate of progress is a contribution of fundamental importance to NATO defence objectives.

2. AGARD is to be commended on its effort to exploit the aeronautical potential of NATO, and at the same time on its realistic approach to the problem: selecting a limited number of well defined fields to demonstrate the basic fact that a united approach to many of our aeronautical research problems can expedite their solutions as well as avoid the financial burden which can result from an excess of duplication.

3. The Standing Group wishes every success to AGARD in this, their Second Meeting."

Welcoming addresses were given by Prof. Gustavo Colonnetti on behalf of the Italian National Research Council, and by Prof. Enrico Pistolesi on behalf of the Italian Aerotechnical Association. Presentations were given by Gen. Aldo Urbani on 'The Contribution of Italian Scientists and Technicians to the Development of Aeronautics'; by Maj. Gen. James F.Phillips on 'The Role of University Research and Utilisation of Scientific Personnel by the US Air Force'; and by Prof. Gaetano Arturo Crocco on 'Aeronautical Research in Italy in the Past and in the Future'.

Dr von Kármán personally briefed each Panel group and invited them to work as a team, under the Chairman and Deputy Chairman of their own choice; and to arrange as far as possible and with the aid of National Delegates their own programmes based on knowledge of their respective countries' National Research Programmes.

AGARDographs instituted

A meeting of National Delegates approved the publication of "AGARDographs" to review or summarise the state of the art in specific fields on a NATO-wide basis, and the setting up of a Documentation Committee to study NATO problems of codification and cataloguing of aeronautical data and documentation, to advance the frontiers of documentation techniques, and to stimulate the preparation of AGARDographs.

Because of the great interest shown in the work of the technical panels, new ones were proposed: on Structures and Materials by Belgium and on Geophysics by Norway. The National Delegates postponed action on the first proposal until after the two-year trial period and decided to hold an exploratory symposium on the Polar Atmosphere before proceeding with the second.

Assistance to NATO

It became clear that there was much that AGARD could do to help NATO. In particular, opinion was unanimous that while the Technical Panels would in due course form the backbone of AGARD, National Delegates and panel members would provide a feed-back to national organisations; and conversely that the executive staff of AGARD, comprising the Director, Dr Wattendorf, and his four executive officers of the technical panels, could provide a technical feed into NATO Agencies as required.

To complement the work of the Technical Panels, it was decided at this Assembly that a catalogue of institutions willing to engage in an intra-NATO exchange of scientific personnel should be compiled; and it is appropriate here to record that the Consultant and Exchange Programme of AGARD, which was established later and became so vital a part of AGARD, was developed from this project.

Reviewing AGARD's accomplishments

In June 1953 the Chairman circulated a memorandum to all National Delegates announcing that the Standing Group would have to start considering the future of AGARD in the Fall of 1953. He proposed that the Third General Assembly be devoted to surveying AGARD's accomplishments in order to help provide information for the Standing Group. He asked each National Delegate to prepare a considered review of AGARD activities in his own country, especially pointing out

where beneficial results had been forthcoming from AGARD action. These papers would help the National Delegates arrive at their recommendations to the Standing Group.

Third General Assembly – London, 1953

The Third General Assembly of AGARD was held in London, 3–11 September 1953. The meeting was opened by Dr von Kármán, and welcomed by the Right Honourable George Ward, MP, Under-Secretary of State for Air, United Kingdom.

Presentations were made by Sir Harry Garner, KBE, CB, formerly Chief Scientist at the Ministry of Supply, United Kingdom, on the 'Role of Research and Development in Aviation during the last Ten Years', and by Dr.O.H.Wansbrough-Jones, CB, OBE, Chief Scientist, Ministry of Supply, on 'Some Tasks for AGARD'.

Dr von Kármán aptly summarised the motif of the meeting as follows:

"During the last session of the Third General Assembly, we plan to review the comments of all AGARD National Delegates, and to decide whether the concept of joint utilisation of scientific personnel and technical facilities is a sound one; to determine whether, through such an organization as AGARD, benefits can accrue to the entire NATO community. It will be interesting to see what all our 'care and feeding' has done for this sixteen-months-old off-spring of NATO.

The decision which the Standing Group of NATO has to make, concerning the continuation of AGARD's activities and its firmer incorporation into the NATO system, may be made easier by an apparent shift in the overall philosophy of the NATO concept. It is more and more recognised that the effort symbolised by NATO should be girded rather for the long haul, than for a short explosion of forces. And if there is time for thinking at all, I believe scientific thinking has its definite place in the planning.

In this sense, we are trying something of an innovation during this session. In addition to several technical topics of, I believe, great interest — as for example icing of aircraft, noise in aircraft, heat stresses in aircraft structures, and an exposé on forward-looking human engineering - a prominent British expert will give a review on the fundamentals of the 'Science of Operational Research."

Operational Research

Dr von Kármán's personal interest in operational research is shown by the fact that he himself gave a preliminary talk at the London General Assembly concluding with:

"This afternoon I would like to offer for your consideration two general conclusions which I believe are of fundamental importance to our AGARD operations.

First, it is apparent that much closer liaison is necessary between the aeronautical scientists and engineers engaged in technical research, and those persons, military and civilian, engaged in operational research, analysis, and planning.

Second, we must recognise that inter-NATO problems of operations analysis cannot be solved without the active cooperation of all NATO nations, particularly in view of the differences in fundamental data resulting from variations in such factors as geography, topography, economy and psychology – factors which cannot be changed on short notice by military directives."

The Consultant and Exchange Programme inaugurated

As a follow-up to the proposal to exchange scientific personnel made at the second General Assembly, Dr von Kármán had issued a circular letter to all National Delegates on this subject. Replies had been favourable and the results were reflected by two presentations to the Third General Assembly:

1. 'Examples of NATO Exchange of Scientific Personnel' by Prof. M.A.Brull.
2. 'A Tour of Western Europe: April 1953' by L.H.G.Sterne, which described a visit by British aeronautical scientists plus AGARD staff to several European aeronautical centres to stimulate an exchange of views. This tour had been arranged by Sir Arnold Hall, then Director of the Royal Aircraft Establishment.

These presentations led the National Delegates to agree that a continuing exchange activity within AGARD would be an important complement to the technical panels, and would provide flexibility in carrying out the AGARD mission. Thus the AGARD Consultant and Exchange Programme was born, and Mr Rolland A.Willaume was selected by Dr von Kármán to direct it. The activities of the Consultant and Exchange Programme are reviewed in Chapter 8.

A Review of the first two years

At a closed meeting of National Delegates on 11 September 1953, a resolution relative to the approaching completion of the two-year trial period of AGARD was unanimously adopted as follows:

1. The National Delegates of AGARD have critically reviewed the activities of AGARD since its inception.
2. The National Delegates agree that AGARD has achieved its preliminary objectives, and that its activities have led to valuable accomplishments in increasing the NATO research and development potential.
3. The National Delegates further believe that AGARD's continued activity will lead to increasingly greater benefits for the NATO community.
4. Therefore, recognising the need for AGARD's activities after the successful completion of the trial period, the National Delegates of AGARD, at the Third General Assembly in London, unanimously recommend to the Standing Group that the continuation of AGARD be assured.

Standing Group Approval

On 10 October 1953 Dr von Kármán sent a letter to the Standing Group with a Summary Report of the major accomplishments to date and the results of the comprehensive critique of AGARD activities during the Third General Assembly in London. He included the formal resolution, with appended copies of the individual national papers, and requested the Standing Group to take early action on the resolution so that National Delegates could be notified at the Fourth General Assembly, May 1954. Standing Group approval was given in December 1953, and this caused attention to be given to the need for international funding.

Search for Quarters

In October 1953, NATO told AGARD to move to new offices which had been

earmarked for the use of the Military Committee during its periodic meetings in Paris. AGARD replied that they could not suspend AGARD operations and vacate the offices every time the Military Committee had a major meeting in Paris. Two months later, the Standing Group requested AGARD to vacate the Palais de Chaillot by January 1954 or as soon thereafter as possible, but said that they were asking the French Ministry of Defence to help AGARD find space elsewhere. During 1954, the 'Space Problem' of AGARD became a major concern. AGARD was served with repeated eviction notices by NATO, but no alternative accommodation was available. During this period Rolland Willaume found some very promising solutions – but the financial arrangements were not approved by the Military Budget Committee. As an alternative, they proposed that AGARD, as a military agency, move to SHAPE. However, SHAPE had no surplus accommodation.

This controversy continued until the end of 1954, when the French Ministry of Defence made space available in the Passy wing of the Palais de Chaillot, which was under French control. AGARD had to work out use of the conference rooms with the Western European Union, which also occupied the Passy wing, since NATO had formally notified AGARD that no further NATO conference facilities would be available from 1955 onwards. In fact, AGARD remained in the Palais de Chaillot until Spring 1960 when it moved to rue de Varenne on the left Bank, opposite the Prime Minister's official residence. AGARD's next (and final) move took place at the end of 1967, to Neuilly-sur-Seine, midway between the Arc de Triomphe and the business quarter of La Défense.

Fourth General Assembly – Scheveningen, 1954

The Fourth General Assembly, which was held in Scheveningen, Netherlands, May 1954, marked the end of the two-year trial period, and a look toward the future now that approval for the continuation of AGARD had been given. The meeting was welcomed by His Royal Highness Prince Bernhard, who stated in his address:

> *"Exactly two years ago, AGARD held its first General Assembly in Paris. The initial trial period of two years for which AGARD had been established being over, it is very gratifying to learn that the Standing Group has meanwhile decided favourably on the unanimous proposal of the member countries to continue the work of AGARD on a more permanent basis. Two years is a relatively short time, but during this time some very important results have been reached. This is a noteworthy achievement which proves that the foundation of AGARD has been well laid and that the structure built on it is a sound one... AGARD has grown into something more substantial and important even than optimists originally thought."*

The General Assembly was greeted by Their Excellencies Jhr. F.L.K. van Vredenburch and Mr F.J.Kranenburg, on behalf of the Netherlands Government, and by Gen. Valluy of the Standing Group, who confirmed the approval of the Military Committee of the continuation of AGARD within NATO. Prof. van der Maas then gave a comprehensive review of Aeronautical Research in the Netherlands.

High Speed Flight

An outstanding feature of the meeting was a round table discussion on subjective experiences in high speed flight by the leading test pilots of NATO nations. The topic was 'Subjective Experiences and Reactions during Flight Testing in the

Transonic Region', and the participants were:

Dr von Kármán, Moderator
Cdr R.Carpentier, Chief Test Pilot, Centre d'Essais en Vol, France
Squadron Leader W.J.Potocki, Royal Aircraft Establishment, UK
Squadron Leader N.Duke, Chief Test Pilot, Hawker, UK
Maj. C.Yeager, US Air Force
Mr S.Crossfield, Research Pilot, National Advisory Committee for Aeronautics, US

Though bi-national discussions on the flight characteristics and testing techniques required to reveal the characteristics of transonic/supersonic aircraft had been staged previously, this discussion was probably the first ever to be held in front of representatives of all the nations of NATO; and the questions from the floor gave proof of the usefulness of this timely topic.

Finally, there were a number of technical presentations on subjects especially selected to stimulate interest in possible future AGARD activities, such as low temperature problems, airworthiness requirements, airborne electronic equipment, and laboratory management.

Integration into NATO

The period of transition from US Air Force to NATO funding, involving detailed defence of the AGARD budget before the Military Budget Committee, was extremely difficult. There was no precedent in NATO for a scientific organization such as AGARD. NATO Working Groups traditionally met in the NATO buildings, and issued reports as NATO documents through normal NATO machinery. AGARD, however, held scientific meetings in different countries, and published its own AGARDographs in book form. These basic differences led to a prolonged and involved period of mutual education on the part of the AGARD staff and the Military Budget Committee.

One item which led to considerable questioning by the Military Budget Committee was the AGARD principle of meeting in various NATO countries, and this prompted Dr von Kármán to seek Standing Group approval of the principle of rotation of General Assemblies. He pointed out that meeting in different countries enabled large numbers of the host nation scientists to meet their counterparts from other countries, thus stimulating long-term research development in each nation in turn and helping all to strengthen their role and contribution to NATO.

On 25 February 1955 the Standing Group confirmed its endorsement of the rotation of AGARD General Assemblies, but urged the practice of economy, noting that the final authority on financial implications was the Military Budget Committee. In other words, approval was given from the military viewpoint, subject to screening by the Military Budget Committee.

Fifth General Assembly – Ottawa, 1955

The Fifth General Assembly of AGARD was held in Ottawa, Canada, 10 – 17 June 1955. For the first time, representatives of the Federal Republic of Germany (West Germany), the most recent NATO participant, took part in AGARD meetings. They were Dr T.Benecke and Prof. A.W.Quick.

The Assembly was opened by the Honourable Ralph Osborne Campney, Minister of National Defence of Canada, and the participants were welcomed by Air Marshal C.R.Slemon, Chief of the Air Staff of the Royal Canadian Air Force.

A presentation on the History of Aeronautical Research and Development in Canada was given by Mr J.H.Parkin, Director, National Aeronautical Establishment, Canada, followed by technical papers presented by a number of speakers.

At this meeting, a Round Table Discussion was held on the theme 'Increasing the NATO Research and Development Potential'. Dr von Kármán served as moderator, and participants were:

Air Commodore Hugh Maxwell, RAF, Vice Air Deputy, SHAPE Hqs.
Dr H.P.Robertson, Scientific Adviser, SHAPE Hqs.
Dr G.E.Valley, Jr., Associate Director, Lincoln Laboratory, MIT, US
Mr L.P.Weicker, Assistant Secretary-General for Production and Logistics, NATO

A second Round Table, on the following day was devoted to the topic 'The Heat Barrier'. Sir Arnold A.Hall, Director, Royal Aircraft Establishment (RAE), served as moderator, and participants were:

Dr H.L.Dryden, Director, NACA (the forerunner of NASA), US
Prof. Maurice Roy, Director, ONERA, France
Dr P.B.Walker, Head of Structures Department, RAE, UK
Col. A.P.Gagge, US Air Force, Department of the Air Force, R&D
Prof. J.J.Broeze, Royal Dutch Shell Co.
Dr J.E.Duberg, NACA, Langley Field, US

This was the first General Assembly of AGARD as a fully integrated NATO agency; and it set a pattern for those to come. The programme was in three parts:

- Welcoming addresses, greetings and host country technical review, as in previous assemblies.
- Technical sessions on frontier scientific subjects, on the one hand, and on ways which AGARD could increase its contributions to NATO, on the other.
- Individual reports on panel activities by each Panel Chairman on the one hand, and report by the AGARD Director on extra-panel activities, especially the Consultant and Exchange Programme, and ad hoc assistance to the Standing Group and other elements of NATO, on the other.

This meeting also saw the setting up of a new Panel, the Structures and Materials Panel.

Concerning suggestions for further AGARD activities, Dr H.P.Robertson, Scientific Adviser to SACEUR said:

> *"In the field of operational research or systems engineering, it would be great for us to have assistance from a NATO body which can bring together the experience of all the national resources which would be represented, in order to give us sound technical evaluations for our military applications."*

In addition, Dr Valley, supported by Mr Finn Lied, Norwegian Delegate, recommended certain aspects of electronics for AGARD exploration.

Sixth General Assembly – Brussels, 1956

The Sixth General Assembly of AGARD was held in Brussels, Belgium 27-31 August 1956. M. Edouard Anseele, Minister of Communications of Belgium, gave the address of welcome, and greetings were expressed by Maj. Gen. F.J.Burniaux on behalf of the Belgian Air Force.

Following these greetings, Prof. J.Ducarme of the University of Liège gave a review of the evolution of aeronautics in Belgium.

International Cooperation in Scientific R & D

As a special feature of this assembly, Dr. von Kármán had invited senior representatives from NATO technical agencies to take part in a Round Table on International Cooperation in Scientific Research and Development.

The significance of this round table was that it brought together for the first time presentations and exchange of views among all the research and development activities within NATO at that time. Recalling that AGARD was the first scientific organization in NATO in 1952, the expansion of science within NATO had been remarkable within such a short time. Furthermore, it was evident that AGARD had played an important role in the creation or operation of many of these activities, as seen from the descriptions below.

Mutual Weapons Development Programme: Lt. Gen. (Ret.) T.B.Larkin, Director of the Programme, explained that it had arisen from an original suggestion by Dr von Kármán. Three of its projects had involved very close cooperation with AGARD: the SHAPE Air Defence Technical Centre at The Hague, the Training Centre for Experimental Aerodynamics in Brussels, and the NATO Light Weight Fighter Programme. The last was a project for the development of a light tactical fighter to operate primarily in close support of ground forces from unprepared fields close to the front line. AGARD had set up a committee and four specialised sub-committees in support of this project[1].

NATO's Military Agency for Standardization (MAS): AVM E.M.F.Grundy, Chairman of the Agency, said that its mission and that of AGARD were complementary to one another. He gave an example of a NATO Standardisation Agreement (STANAG), prescribing the minimum aeromedical training of flight personnel, which had been directly based on the work of the Aeromedical Panel.

Supreme Headquarters Allied Powers in Europe (SHAPE): Col. P.M.Gallois of SHAPE gave a presentation on the role of operational research in planning aerial defence, which served as a follow-up to Dr Robertson's talk at the previous meeting where he had invited AGARD's assistance in operational research techniques.

SHAPE Air Defence Technical Centre (later SHAPE Technical Centre – STC, and now part of NATO's C3 Agency – NC3A)**:** Prof. C.J.Sizoo reported on the programme of the Centre, which had been set up by SACEUR in 1954 as a result of a survey and study by Dr von Kármán's USAF Scientific Advisory Board.

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1 Several useful studies were carried out but as it turned out, AGARD was not the organization to initiate or manage industrial development of military aircraft. The 'D' of AGARD came to be understood as 'in support of development' rather than direct development by AGARD.

Training Centre for Experimental Aerodynamics (now the von Kármán Institute for Fluid Dynamics – VKI)**:** Prof. F.C.Haus described the Centre, the creation of which, at Rhode-Saint-Genèse, Belgium, had been suggested by Dr von Kármán to the Belgian authorities in June 1955 for the purpose of indoctrination in experimental aerodynamic techniques to selected personnel from the different NATO nations. After agreement by Belgium, the objectives and nature of the programme at the Centre were studied by a special AGARD group consisting of:

- Professor Haus, Belgium (Chairman)
- Professor Malavard, France
- Professor Zwikker, Netherlands
- Professor Young, United Kingdom
- Mr Willaume, AGARD Staff

The European Office of the US Air Force Air Research and Development Command: Brig. Gen. Don Flickinger, Director of this Office, described its support for research in Europe. The R & D Command was another body which had been set up as a result of a recommendation of the USAF Scientific Advisory Board under Dr von Kármán. It, too, had close relations with AGARD, which had served as a catalyst in identifying promising research sources, and the majority of the early research contracts placed by the European Office had been helped by AGARD initiatives of this kind.

AGARD's Role in NATO

During 1955 the integration of AGARD into NATO had resulted in bringing AGARD into the NATO spotlight. The Standing Group which, during the first two years, had given AGARD only broad guidelines, now had many questions to answer from the NATO civilian authorities, such as:

- What role does AGARD play in NATO?
- How does it relate to the Military Committee on the one hand and to the civilian authorities on the other hand?
- Is it best placed organisationally to do the greatest good for NATO?

These questions caused considerable concern within the Standing Group, and they were the subject of many conferences between the AGARD staff and the Standing Group. Finally, on 14 June 1956 the Standing Group issued revised terms of reference and a new organization chart for AGARD, including the addition of the Scientific Adviser to SACEUR as a member of the AGARD Executive Committee. This appointment naturally led the Executive Committee of AGARD to broaden the scope of its considerations, and matters such as operations research, avionics, and relationships with other NATO Agencies were discussed. These matters are referred to in greater detail in the next three sections.

NATO Operational Research Conference

Operational Research had been a growing ad hoc activity of AGARD, largely owing to the personal initiative of Dr von Kármán, and later of Dr Robertson, Scientific Adviser to SACEUR. AGARD, with the assistance of SHAPE, had organised missions to various countries by specialists who gave lectures and held subsequent working conferences on national problems. Where appropriate, special consultants and information exchange were provided, as for example to Turkey.

AGARD, with the cooperation of SHAPE, organised the first NATO-wide conference on Operational Research in Paris in April 1957. The objectives, as stated by Dr von Kármán in the Introduction were:

1. To increase the interest of high level executives in the many advantages to be gained through the proper use of Operational Research;
2. To demonstrate to scientists and technicians the application of some of the latest techniques and methods of Operational Research to specific problem areas.

The conference was well attended by the leading experts in NATO, and stimulated considerable interest. The proceedings were published as a book with a Preface by Gen. Norstad, SACEUR:

> *"Operational Research, by revealing methods for more effective utilisation of our manpower, our skills, our material and other resources, is making a significant contribution to the military potential of the Atlantic Alliance. This is of utmost importance, for our strength depends not alone on what we have but to a large extent on what we do with what we have. I am gratified, also, by the promise these new techniques offer for application in non-military fields. They should serve to stimulate and strengthen the economies of the NATO nations. As a military commander, and as a citizen of the Atlantic community, I welcome publication of this book."*

NATO Avionics Conference, May 1957

Another ad hoc activity of growing interest and importance was the field of aviation electronics. A NATO-wide Polar Atmospheric Symposium held in Oslo in 1955 (which had arisen out of discussions at the Second General Assembly) had led to the formation of an Ionospheric Research Committee. However, many believed that the time had come to consider broader avionics activities in AGARD. As a result, an ad hoc meeting was held of electronics experts within NATO and the member countries, in May 1957. The participants recommended unanimously the formation of an Avionics Panel within AGARD. In addition to having its own programme, the Panel would also serve as a source of electronic expertise for the other AGARD panels, and could coordinate avionics activities within AGARD, including those of the Ionospheric Research Committee. The National Delegates endorsed this recommendation the same month, and the Standing Group approved it in August.

Joint Working Group on the Coordination of AGARD Activities with NATO Civilian Agencies

NATO participation in the Operations Research Symposium in April 1957 and the Avionics Conference in May 1957 increased the interest of the NATO civilian authorities in AGARD affairs. In the Fall of 1957, a new NATO group was established entitled 'Joint Working Group on the Coordination of AGARD Activities with NATO Civilian Agencies'. The terms of reference of this Group included:

a. To study the best means of coordinating fully the activities of AGARD with NATO civilian bodies, and to give the activities of AGARD maximum effectiveness;
b. To make appropriate recommendations to the Secretary General.

The Chairman of this group was M.A.Moreau, Deputy Assistant Secretary General for Production and Logistics. Other members of the Group were three national members of the Defence Production Committee, Gen. de Porto, representing the Standing Group, and Dr Wattendorf.

Meetings of the Group were held from October 1957 to May 1958, and it recommended, with reservations by the Standing Group and AGARD, that AGARD be advisory both to the Standing Group and the North Atlantic Council. At about this time, the NATO Science Committee came into operation and it was assumed by the Joint Working Group that the Science Committee would take an interest in AGARD as an important part of the overall research and development activities in NATO.[2]

Seventh General Assembly – Washington DC, 1957

The Seventh General Assembly was held in Washington DC, USA, 25 – 26 November 1957. The meeting was opened by the reading of the following letter from the President of the United States:

November 25, 1957
"Dear Dr von Kármán,

As NATO's Advisory Group for Aeronautical Research and Development meets in Washington today to begin its Seventh General Assembly, I wish it were possible for me to greet you in person. Since I cannot, I hope you will convey my warm welcome to all who are participating.

In conducting joint discussion and scientific exchange in aeronautical research and development, your organization is engaged in a work which becomes more important with each passing year to the safeguarding of peace and security. Moreover, it serves as a model for others in practical and productive cooperation for the benefit of the whole NATO community.

My best wishes to all for a highly successful meeting.

Sincerely,
(signed Dwight Eisenhower)"

General Piatte, Chairman of the Standing Group, NATO, made the following remarks on behalf of the parent group:

"AGARD has carried out its mission with respect to the aeronautical sciences. We know today that AGARD's organization is proved and its functions accepted by nations within NATO. For these reasons, we are not surprised that AGARD's scope of activities in the aeronautical field, of necessity, has broadened.

Recent events make it imperative that we unite our efforts towards greater cooperation in the utilisation of our combined scientific potential. The success of the Western World is irrevocably linked with the free exchange of ideas of growing importance in the area

2 The NATO Science Committee started its activities in 1958. As it turned out it covered a very broad field of the sciences and there was only a limited direct interest between its work and that of AGARD. The Assistant Secretary General for Scientific and Environmental Affairs attended the AGARD-NDB meetings and the AGARD Directors frequently had contacts with the Science Committee to assure proper coordination.

of sciences as the course of events of the past year has shown. Today's technological race presents NATO with the greatest challenge in history and it is imperative that NATO organizations participating in scientific endeavours accept this challenge. As a consequence it is probable that scientific cooperation, the urgency of which is apparent to us all, will open to AGARD new fields of activity. We are convinced that the defence of the Alliance depends on progress in science; technology and cultural exchanges among our fifteen nations; we cannot but encourage AGARD to perfect its work and its achievements."

The Honorable Donald A.Quarles, Deputy Secretary of Defense, encouraged the continuation of the efforts of scientific bodies such as AGARD, which had illustrated clearly what united effort can do; and greetings were presented by Lt. Gen. D.L.Putt on behalf of the US Air Force. Gen. N.F.Twining, Chairman of the Joint Chiefs of Staff, US, presented the keynote address, 'History of Air Power in the United States'.

Interest in Space

The Round Table discussion 'Towards Higher Altitude', presided by Dr H.L.Dryden, Director, National Advisory Committee for Aeronautics, was of particular scientific interest. Participants were:

Prof. W.Dieminger, Director, Max Planck Institut, Germany
Prof. G.N.Patterson, Director, Institute of Aerophysics, University of Toronto, Canada
Mr M.Florio, SEPR, France.
Col. P.A.Campbell, Air Force Office of Scientific Research, ARDC, USAF.
Mr H.M.Drake, NACA, US.

Although the first satellite had been launched into space barely two months before this Assembly, and at least one person attending the Assembly had reached an altitude of 22 miles and returned safely, the various speakers made it clear that many and various problems of high speed and high altitude flight still required intense study.

It was noted that as a follow-up to the NATO Operational Research Conference, a special conference for Northern countries was being planned, and that the considerable AGARD consultant activity in Turkey had led to the establishment of a Turkish Operational Research Group for the first time. Furthermore, ad hoc activities in the field of Guided Weapons had been in progress within AGARD during the past two years. In particular, two symposia had been organised, one in Munich which had reviewed for the first time the entire development of guided weapons in Germany; and a follow-up conference on techniques in Venice, Italy.

In February 1958, the Standing Group approved the subject of Ballistics[3] as a continuing field of AGARD activities.

Eighth General Assembly – Copenhagen, 1958

The Eighth General Assembly of AGARD was held in Copenhagen, 28 – 29 October 1958.

3 Ballistics did not become a separate element within AGARD but it was taken up periodically by the various Panels and the AASC.

The opening remarks were made by Dr Theodore von Kármán, and welcoming addresses were given by Mr P.Hansen, Minister of Defence and Lt. Gen. T.Andersen, Chief of the Royal Danish Air Force.

Maj. J.Foltmann, Secretary General of the Royal Danish Aero Club, presented a film celebrating the 50th Anniversary of the first flight of the Danish aviation pioneer, Ellehammer. Prof. T.Bjerge gave the host country technical review.

The theme of the Round Table discussion was 'Impact of Space Technology on Research and Development', with papers presented on propulsion, structures and materials, medical aspects, tracking and environment, by:

Prof. P.E.Muller, Astronomer, Observatory of Paris, France.
Prof. Dr E.Saenger, Forschungsinstitut für Physik der Strahlantriebe, Germany.
Mr R.V.Rhode, Assistant Director for Research, National Aeronautics and Space Administration, United States.
Mr A.W.Lines, Guided Weapons Division, Royal Aircraft Establishment, United Kingdom.
Dr W.R.Lovelace, II, Lovelace Clinic, United States.
Brig. Gen. Don Flickinger, Air Research and Development Command, US Air Force, United States.

In addition, a presentation on ballistic vehicles was given by Maj. Gen. B.A. Schriever, Commander of the Ballistic Missiles Division, US Air Force.

Liaison with the NATO Science Committee

The first NATO Science Adviser, Dr Norman F.Ramsey, addressed the General Assembly on behalf of the Secretary General, and said:

'At the heads of government meeting last December in Paris, one of the principal subjects of discussion and agreement was the importance to NATO of scientific collaboration among the members, and technical collaboration as well. But I think it is greatly to the credit of AGARD that it was six years ahead of the heads of government in actually both recognising the need for collaboration in technical and scientific fields, and also doing something about it. The actual practice of the activities of AGARD has, I think, in many respects been a model for the scientific activities that need to be extended into other fields.'

It is recalled that the early founders of AGARD in 1951 had recommended a high level Scientific Advisory Board for NATO. Although this had been considered premature at the time, the need came to the forefront during 1957, and a NATO Science Committee was formed, of which Dr Ramsey was the first Chairman. In order to ensure full coordination of AGARD activities with overall scientific interests of NATO, the NATO Science Adviser was added to the AGARD Executive Committee as ex-officio member, as was done previously with the Scientific Adviser to SACEUR. Cooperation between AGARD and the Science Committee had already started in areas such as:

Long range detection of high, fast-moving bodies.
Chemistry of rocket propellants.
Materials.
Technical information interchange.

Ninth General Assembly – Aachen, 1959

Dr Theodore von Kármán with the first two German National Delegates, Professor A.W. Quick (on his right) and Dr T. Benecke, at the first AGARD meeting to be held in Germany (in Aachen, where Dr von Kármán had lived for many years). Dr Benecke became Chairman from 1970 to 1973

The Ninth General Assembly of AGARD was held in Aachen, Germany, 24 – 25 September 1959. The meeting was opened by Dr Theodore von Kármán, who expressed pleasure that it was being held in the University where he had himself been a professor for many years before World War II. Greetings were presented by Prof. H.Winterhager, Rector, Technische Hochschule, Aachen, Lord Mayor H.Heusch, on behalf of the City of Aachen, and Adm. F.Ruge, on behalf of the Minister of Defence, Federal Republic of Germany.

Prof. A.W.Quick, Technische Hochschule, Aachen, made a comprehensive host country presentation, 'Review of Aeronautical Research in Germany'. In closing he said:

> *'All German members of AGARD, i.e. national delegates, panel members, and observers, are unanimously of the opinion that AGARD with its meetings and its organization has rendered a very great service to German aeronautical research. For German aeronautical scientists it was most difficult to make a new start after a complete interruption lasting for more than 10 years'.*

Space Research

The subject of the Round Table discussion was 'Space Research Techniques and Recent Experimental Data'. Experts from different NATO nations were invited to comment on a survey paper on this subject prepared by the National Aeronautics and Space Administration of the United States; and to exchange information on present knowledge of the space sciences, the techniques which are being used, recent experimental data, and promising directions for future research. Dr von Kármán served as moderator, and participants were:

Gen. Schriever, Commander, Air Research and Development Command, USAF.
Dr M.Fréson, Secretary General of the National Science Foundation, Belgium

Prof. Maurice Roy, Director of ONERA, France.
Dr Dieminger, Director of the Max Planck Institut for Aeronomy at Linden, Germany.
Prof. Enzo Cambi, Professor of Mathematics, Physics and Radar at Rome University, Italy.
Prof. H.C.Van de Hulst, Professor of Astronomy at Leyden University, Netherlands and Chairman of COSPAR.
Dr F.R.Scrimshaw, Director of Scientific Research for Electronics at the Ministry of Supply, UK.
Dr H.L.Dryden, Deputy Administrator of NASA, US.

This was the first General Assembly since the release of actual experimental data from the first space experiments; which served as an incentive for aerospace interests of all AGARD Panel and Consultant activities. It was also the first General Assembly since the Defence Research Directors had held their initial meeting in December 1958, providing a forum for all defence research problems within NATO.

Military Requirements

In 1959, a major theme in NATO was cooperation in research development and production, and the NATO Basic Military Requirements (NBMR) procedure was initiated. AGARD had been asked to propose a role for itself with respect to this procedure, and this was discussed at a meeting between the Standing Group deputies and AGARD on 11 December 1959. The proposed AGARD role was as follows:

a. To make state-of-the-art surveys to see where the potential improvement lies;
b. To give advice to the military in the formulation of a NATO basic military requirement;
c. To arrange participation by AGARD experts on mixed working groups on NBMR;
d. To advise on the technical aspects of specifications when required;
e. To advise on test techniques during the assessment phase.

It was noted that owing to the increasing need of the NATO Military Authorities for technical advice of a more continuing nature, a new post of Special Projects Officer had been established in the AGARD staff.

At the National Delegates meeting, Mr E.T.Jones, UK was unanimously elected Vice-Chairman of AGARD.

Tenth General Assembly – Istanbul, 1960

The Tenth General Assembly was held in Istanbul, Turkey, 3 –8 October 1960. Gen. Cemal Gursel, Chief of State of the Republic of Turkey, gave the opening address. The following are excerpts from his speech:

"You all have had to travel over great distances to be here and participate in this meeting, which, we are convinced, will help pave the way towards a personal friendship among the scientists and research engineers of NATO and Turkey. This will subsequently lead toward fruitful cooperation in the scientific support of common Defense.

It is our conviction that rendering effective decisions at responsible levels can only be

made possible through the application of systematic analysis of the kind which can be realised in cooperation with scientists and scholars.

I am sure that the Advisory Group for Aeronautical Research and Development will look upon us, within the framework of our Great Alliance, as reliable and sincere friends, and will extend to us the scientific assistance which we can then apply to the support of our many NATO programs."

At the opening session, greetings were extended by Maj. Gen. Tulga, Governor of the City of Istanbul and Gen. Ozdilek, Minister of Defence, Turkey.

A Closer Relationship with the Military Committee

Gen. Beaufré, Chairman of the Standing Group, announced the new NATO emphasis on long term planning, and the Standing Group's intention to utilise AGARD for making long term scientific studies as a background for future possible military applications. This was the start of a new phase of much closer working relationships between AGARD and the NATO Military Authorities. The importance of Gen. Beaufré's speech can best be shown by the following excerpts:

'Military strength is needed to guard liberty, but that strength depends on scientific progress. The work of AGARD has been of value not only to us but also the ad hoc working group responsible for this important task of cooperation in NATO. If we look to the future, we see that we shall continue to have a requirement for scientific advice and I would like to take this opportunity to give you an outline of certain aspects of our future tasks in which we believe that AGARD can be of great help to us.

Last December, during the Ministerial Meeting of the Council, the United States Secretary of State, Mr Christian Herter, emphasised the fact that we should give our attention to long range planning in NATO. These long range plans should be developed in common within NATO and should include several vital fields among which, of course, are to be included the military and scientific.

It is the task of the Standing Group to study the military plans which the Alliance will require in the future and to study them in the light of foreseeable scientific and technical progress and the military applications which may be made.

In order to fulfil this important and difficult duty, the Standing Group must first receive advice from the most competent technical and scientific authorities in all fields and in particular from those authorities which, though specialising in scientific research, are nevertheless familiar with production capabilities from the technical and economic point of view. I believe that AGARD is in a particularly favourable position to satisfy a great part of the Standing Group's requirements. It is my intention to bring this question up during the meeting of your National Delegates.

I shall close by emphasising the great respect and admiration that my colleagues and I have for the scientific work that you have done for NATO. May I add that we are showing the faith that we have in your organization when we assign you the task of which I have just spoken.'

R & D in Turkey

A survey paper on Research and Development in Turkey was given by Gen. Fuat Ulug, AGARD National Delegate. The paper reviewed in a comprehensive manner

the considerable effort of AGARD in giving assistance to this developing country, either directly or as a catalyst. The examples given were:

- Formation of a Scientific Advisory Board to the Turkish General Staff;
- Advice on completion of the Ankara Wind Tunnel;
- Information exchange leading to the establishment of a Defence Documentation Service;
- Indoctrination of Turkish Engineers at the Training Centre for Experimental Aerodynamics;
- Initiating Operations Research competence in Turkey through the Consultant and Exchange Programme;
- Recommendation of Turkish Research Projects for support through the European Office of the Air Research and Development Command;
- Establishment of a Radio and Optical Observatory at Ankara, in cooperation with the Mutual Weapons Development Programme;
- Soil Stabilisation;
- Fatigue Testing;
- Anthropometric Survey to assist in selection of Air Force Personnel.

The theme chosen for the Round Table discussion was 'Ballistics and Aeronautics'. Mr E.T.Jones, AGARD Vice Chairman, served as moderator, and participants were:

Mr H.Davies, Deputy Director of the Royal Aircraft Establishment, UK
Mr Benjamin F.Ruffner, Boeing Airplane Co., US
Mr P.Contensou, Directeur Technique Adjoint de l'ONERA, France
Dr Ing. R.E.Kutterer, Institut Franco-Allemand de Recherches de St Louis, France
Prof. D M.Santur, Istanbul Technical University, Turkey.

Long-Term Scientific Studies

At the Tenth General Assembly, Gen. Beaufré had told the National Delegates that the Standing Group intended to assign to AGARD the task of making long term scientific studies, across-the-board. However, it proved difficult to do this immediately, because the AGARD charter was limited to 'aeronautical' activities; and time would be involved in changing the charter with full approval by the nations. Because of the urgent need for long term studies, the Standing Group decided to assign the task to Dr von Kármán in his personal capacity; at the same time authorising him to make full use of the AGARD staff, framework and funds for carrying out the studies. The directive was issued in November 1960, and the so-called 'Von Kármán Committee' of five defence research directors, was formed soon after. This consisted of:

Dr Theodore von Kármán, Chairman
Dr George S.Field, Canada
Gen. J.M.H.Guerin (succeeded by Prof. Lucien Malavard), France
Dr Karl Fischer, Germany
Sir Solly Zuckerman, UK
Dr H.P.Robertson (succeeded by Mr Jack Macauley), US

The von Kármán Committee had its initial planning meeting with the Standing Group in Washington in January 1961. Since the Standing Group required a preliminary progress report by April 1961, a 'crash programme' was necessary. It was decided to review the state of the art in fourteen technical areas and study trends over

the next 10 – 15 year period.

These initial studies were carried out by multi-national expert groups at AFSOUTH, Naples, in March 1961 over a three week period. Each nation represented on the Committee, and several other nations, sent experts to Naples; and they met in fourteen study groups according to the subjects listed. The Vice Chairman, E.T.Jones, and practically the entire AGARD staff, provided technical, administrative and executive support, supplemented by consultants and by Sergeant Vince Rungo, contributed by the US Air Force. Fourteen group reports were written at Naples; and the von Kármán Committee issued an interim report based thereon. All reports were delivered to the Standing Group by the April 1961 deadline.

The next step was to integrate these projections of the state of the art into eight military mission areas. For this purpose the nations were invited to nominate three different types of experts:

a. Scientific-Technical
b. Military-Operational
c. Operations Research-Systems Analysis

The resulting experts were convened for a two week study exercise at NATO Headquarters during June 1961. They were organised in groups according to the mission areas mentioned above; and each group produced a report.

On the basis of both the March reports and the June reports, the von Kármán Committee wrote a final summary report for the Standing Group. In addition to utilisation by the nations, there were several general results from the report, namely:

a. Four new long-term studies were initiated to fill gaps evidenced by the present series.
b. The continuing need of scientific advice to the Military Authorities was brought to the general attention of NATO; this was eventually responsible for the formation of the Committee of Defence Research Directors [now the Defence Research Group (DRG)].

Eleventh General Assembly – Oslo, 1961

The Eleventh General Assembly of AGARD was held in Oslo, Norway, 27-28 July 1961. A welcoming address was given by Hon. H.Sivertsen, acting Minister of Defence, who said:

'Realising the importance of very rapid communications, it has been one of the major aims of AGARD to bring scientific workers together, on a formal as well as informal basis. This, to a large extent, is being achieved through scientific meetings, varying in size from small specialists' meetings to the greater Assemblies like the one here in Oslo. The value of personal contact should not be underestimated. Particularly for the small countries, it is of great importance that their scientists are well acquainted with their contemporaries abroad and informed about the work going on in the more extended areas of their interests. They may save valuable time, and ensure that other efforts are not unnecessarily duplicated'.

Air Chief Marshal Sir George H.Mills spoke on behalf of the Standing Group, as follows:

'I would like to tell you how tremendously valuable we in the Standing Group and the Military Committee, whom we must never forget because they are the people who

direct us, how valuable we know we are going to find the Special Study which was undertaken by Dr von Kármán and with the backing of the AGARD organization. This was a look into the shape of things to come in the military field, the effects of the advances in science on military science and weapons in the future – in the near future, the 10-15 year future. I know there were some who wondered whether it was worth doing. I think by the time the reports have been digested, and people can appreciate what is in them, there will be none who will not say: Why did we not do this sooner? I know this is going to have a tremendously important effect on our military thinking, on our military preparations, even, perhaps, on our military strategy'.

A welcome on behalf of the University of Oslo was given by Prof. L.Harang, and Mr M.J.Truelle spoke for the Assistant Secretary General for Scientific Affairs, NATO on 'Internationalism and Science'. Director Robert Major gave the host country presentation 'Research and Development in Norway'.

At a Round Table discussion on 'Scientific Aspects of Space Technology' attention was given to the medical aspects involved, to the interests of physical scientists, and to one challenging application of the many potential ones in space – that of communication satellites.

Director Finn Lied served as moderator, and participants were:
Space Physics: Dr H.Friedman, Naval Research Laboratory, US
Space Medicine: Dr W.R.Lovelace II, Lovelace Foundation, US
Space Communications: Dr S.R.Dauncey, Hawker-Siddeley Ltd, UK
Communication Satellites: Dr W.F.Hilton, Hawker-Siddeley Ltd, UK
Space Communications: 'Framing the Window', Mr A.G.Haley, International Astronautical Federation.

The AGARD Director reported a Standing Group assignment to AGARD of a new task, namely to prepare a report on the requirements, as seen by AGARD, for education in, prosecution of, and coordination of, Operations Research in NATO from a military view point. This resulted in the formation of an Operations Research Committee and the setting up of a new post of Operations Research Officer in AGARD.

Proposals for broadening the AGARD Charter

In October 1961 there were informal discussions within NATO on whether AGARD should be put under the aegis of the Assistant Secretary General for Scientific Affairs with broadened terms of reference to cover applied research. Dr von Kármán expressed his opinion to the Standing Group informally that AGARD should continue to report to the Standing Group, but that the Standing Group should consider broadening the AGARD Charter to applied research and development. This would help to regularise AGARD's heavy involvement in the von Kármán Long-Term Studies, as well as Operations Research. The AGARD Chairman was invited by the Standing Group to prepare a new Charter, and as a result he suggested the name be broadened to Advisory Group for *Applied* Research and Development.

At a briefing of the Standing Group principals on 23 May 1962, Dr von Kármán reiterated his willingness to broaden the scope of AGARD to applied research and development, provided its nature did not change and would remain concerned with

scientific rather than hardware problems. The Standing Group said that the process of obtaining approvals for charter changes was a slow one, but advised the AGARD Chairman to continue broadening scientific activities in fields such as ballistics and hydrodynamics, and to continue ad hoc activities such as the Long-Term Scientific Studies and Operational Research, under the assumption that the Charter would be revised. This left the AGARD staff in a very difficult position because, although the broader activities caused a greatly increased work load, the Military Budget Committee would not consider additional funding or personnel until the Charter was changed.[4]

Twelfth General Assembly – Paris, 1962

The Twelfth General Assembly was held in the NATO Headquarters in Paris, 11 – 12 July 1962. The meeting was honoured by the presence of the NATO Secretary General, Mr Dirk U.Stikker, the NATO Supreme Commander, Gen. Lauris Norstad, and the Chairman of the Standing Group, NATO, Adm. Max Douguet, each of whom made a short introductory speech.

Commemoration of the Tenth Anniversary of AGARD

The presentation by Mr Stikker of an engraved gold medal[5] to Dr Theodore von Kármán, Chairman of AGARD, in recognition of his outstanding scientific achievement, inspiring leadership, and promotion of international scientific cooperation in the NATO Alliance, was a highlight of the opening ceremony.

Talks marking the occasion of the Tenth Anniversary of AGARD were given by:
Gen. Gaston Lavaud, Délégué Ministeriel à l'Armement, France
Sir Solly Zuckermann, Chief Scientist, Ministry of Defence, United Kingdom
Lt. Gen. James Ferguson, Deputy Chief of Staff, Research and Technology, US Air Force, United States
Gen. Bernard A.Schriever, Commander, Air Force Systems Command, United States.

A presentation was made by Dr Theodore von Kármán on the 'Origin and Goals of AGARD', and was followed by talks illustrating the 'Historical Review of AGARD' given by the following leading NATO personalities:
Prof. M.Roy (France)
Prof. G.Gabrielli (Italy)
Lt. Gen. D.L.Putt (US)
Prof. M.Anastassiades (Greece)
Dr T.Benecke (Germany)
Lt. Gen. L.C.Craigie (US).

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4 This is how Dr. Frank L. Wattendorf summarised the discussions in the first edition of this book. The Science Committee had already been established and the formation of DRG was under consideration (it was founded in 1964). As is clear from the summaries of the records of the initial NDB meetings, Dr. Von Kármán was a great supporter of broadening the scope of AGARD. However, because of his US Air Force background, his main support came from the Air Forces, although his interests were much wider in scope. He did not have the same relations with the other armed forces. With the new NATO-RTO organization set up in 1998, this 'problem' should finally be resolved.

5 Ten years later, the AGARD-NDB instituted the Von Kármán Medal, a silver copy of this medal, to be awarded to individuals who had rendered exceptional services to the AGARD community, see Annex 2.

The technical theme of the meeting was 'Manned Flight Systems, Past, Present and Future'. In the development of this challenging theme, each AGARD Panel was represented through a presentation given by a senior member. Particularly interesting was the presentation by Maj. Rushworth, a test pilot of the X-15 research plane, who gave the benefit of his personal experience in flight testing the most advanced manned aircraft to date. The programme also included the NASA filmed record of Col. John Glenn's orbital flight of early 1962, presented by Dr Walter Williams of NASA.

As a further indication of AGARD's growing interest in space, it was decided to invite each Panel to designate a member with the responsibility of keeping abreast of information about aspects of space research which would be of interest to the rest of the Panel. These members met periodically as the Space Information Group.[6]

AGARD and Defence Research

During the year 1962, the whole subject of Coordination of Research, Development and Production in NATO was subject to high level review, by the North Atlantic Council, the International Staff, and by the Standing Group. It was agreed that the existing NATO Basic Military Requirement procedure needed revision; and the activities of all NATO research, development, and production organisations, including AGARD, were subject to intensive review. An important potential development from AGARD's point of view was a proposal drafted by the Standing Group staff for the broadening of AGARD's charter and a transformation of AGARD into a defence research directorate for the NATO Military Authorities. However, this proposal never received approval. Instead, the Defence Research Group (DRG) was formed two years later.

End of an Era

On 7 May 1963, four days before his 83rd birthday, Theodore von Kármán passed on 'to view the earth from the other side of space', to use his own expression.

Thus ended a long and successful career devoted to international scientific cooperation, with tangible outgrowths in flourishing creations such as AGARD.

Now the big problem was how to ensure the continued growth of such organizations in an environment without the presence of their great founder. On 8 May 1963 Dr Wattendorf was appointed Acting Chairman of AGARD. He went to the Standing Group in Washington, where it was agreed that the election of a new Chairman should be the first order of business. They also agreed that AGARD should proceed with the planned Thirteenth General Assembly at Athens, and make no change in plans, programmes or policies for the time being.

In June 1963 the Acting Chairman of AGARD and the heads of all the NATO Military Technical Agencies were called to Washington by the Standing Group to meet the high level Exploratory Group, appointed by the Secretary General of NATO to review the whole question of military scientific advice and defence research and development in NATO. At this meeting many possible solutions were

6 During the following years, the formation of a separate Space Technology Panel was discussed. Finally it was decided that space should not be handled as a separate discipline and that the various Panels should incorporate specific space problems in their programmes.

discussed which could vitally affect the future of AGARD.

From the viewpoint of the Military Committee, it was preferable to have scientific advice from within the military-technical structure. Two possibilities predominated:

a. To have AGARD act as the defence directorate for the NATO Military Authorities, coordinating the other technical agencies, such as SHAPE Technical Centre, SACLANT Centre, etc.
b. To have the heads of the Military Technical Agencies, including AGARD and the Scientific Adviser to SACEUR, act as a Scientific Advisory Committee to the Standing Group and the Military Committee.

On the civilian side, possibilities were:

c. To transfer AGARD to the Science Committee.
d. To transfer AGARD to the proposed Committee of Defence Research Directors, as part of a mechanism of providing scientific advice to the Military Authorities.
e. To utilise AGARD as a nucleus for the proposed NATO Air Force Advisory Group under the Production and Logistics Division.

The Standing Group position was that AGARD should maintain its 'status quo'.

Thirteenth General Assembly – Athens, 1963

The Thirteenth General Assembly was held in Athens, Greece, 10 – 12 July 1963. After twelve consecutive General Assemblies under the Chairmanship of the creator of AGARD, Dr von Kármán, this was the first Assembly without his physical presence. The meetings were chaired by Dr Wattendorf as Acting Chairman. The address of welcome was given by His Excellency Phillipos Dragoumis, Minister of National Defence, who said:

"Greece, on her way in industrial development and growth, is happy to mention that she has had the advantage of receiving most important assistance from AGARD in the form of technical advice, exchange of scientific information, and acquaintance with aeronautical development. Significant in particular has been AGARD's help in promoting the project of setting up at Suda Bay, Crete, a purely Training Installation, a project which AGARD first started to study in 1957. Moreover, thanks to AGARD's efforts, the Greek National Defence Research Centre has been enriched with an aerodynamic tunnel and the Royal Hellenic Air Force provided with an aviation medical centre."

Greetings from the host country were presented by Prof. K.Pezopoulos, Rector of the National Technical University of Athens, Adm. A.Spanides, Chairman, Greek Atomic Energy Commission, and by the Greek National Delegates, Prof. M.Anastassiades and Gen. N.G.Platis.

The Eulogy for Theodore von Kármán was pronounced by Dr Hugh L.Dryden, US National Delegate and long time associate of von Kármán. Gen. J.M.Guerin spoke on behalf of the Standing Group.

Admiral James S.Russell, Commander-in-Chief Allied Forces Southern Europe, gave an informative talk on his Command, which includes Greece, Italy, and Turkey.

The theme of the technical session at this Assembly was 'The Design, Construction, and Operation of Missile Ranges'. This was selected in view of the fact that Greece

was the host country for the NATO Missile Firing Installation (NAMFI), on the island of Crete, the only NATO missile range. Reports on the principal national missile ranges within NATO were given by distinguished experts from France, Italy, the United Kingdom and the United States. Gen. Xenos, Hellenic National Defence General Staff, gave an exposé on NAMFI.

A new Chairman

At the meeting of the National Delegates, Prof. Courtland D.Perkins, Vice Chairman of the US Air Force Scientific Advisory Board, was presented as US National Delegate, replacing Dr von Kármán. Prof. Perkins had been associated with AGARD since the early days. He had initiated work on the Flight Test Manual and contributed actively to many activities. Previous to this meeting, all National Delegates had been requested to make nominations for the AGARD Chairmanship. Prof. Perkins, the US nomination, was unanimously elected, subject to national confirmations.

Professor Courtland D. Perkins, the first Chairman of AGARD after the death of Dr von Kármán and one of the first recipients of the von Kármán Medal in 1972

Considering the Future

At a special meeting of National Delegates in Paris, September 1963, Prof. Perkins took over the Chairmanship of AGARD. The meeting was devoted to a discussion of how best to conduct AGARD affairs in a von Kármán-less environment. It was agreed that the National Delegates would function as a Board, and be so designated. Furthermore, reorientation and streamlining of AGARD was called for in view of recent organisational studies in NATO. One pertinent study had been conducted by a high-level Exploratory Group chaired by Dr B.T.Price of the UK.

In brief, the Exploratory Group had agreed:

- That AGARD could remain organisationally attached to the Military Committee 'for the time being';
- However, it recommended against extending the terms of reference across-the-board, but would not object if the broadening were limited to aerospace;
- The group disapproved of AGARD's involvement in such broad fields as Operational Research, Long Term Scientific Studies, and other ad hoc studies for the Standing Group in subjects which they considered beyond aerospace.

The Standing Group meanwhile had dropped its proposal to change the word 'Aeronautical' in the AGARD charter to 'Applied', and left the future course for the National Delegates to consider.

Against the background of the above high-level policy changes and concepts, the National Delegates, now acting as a Board[7], came to the following decisions:

- to prepare a new charter changing 'Aeronautical' to 'Aerospace', but not broadening the role further;
- to terminate the Long Term Studies during 1963;

- to discontinue Operations Research after the completion of current studies for the Standing Group, to dissolve the Operations Research Committee, and to abolish the staff post of Operations Research Officer;
- to discontinue the AGARD Inter-Panel Space Information Group;
- to phase out AGARD participation in the NATO Missile Firing Installation;
- to hold the Fourteenth General Assembly in Portugal, but change to more limited Annual Meetings thereafter;
- to elect Dr Wattendorf as Vice Chairman;
- to approve Colonel Munroe as Acting Director.

The reversal of the pendulum swing, which for the past three years had been toward a broadened charter and increasingly close relations with the Military Authorities, naturally involved a long transition phase. The AGARD staff prepared a new charter and terms of reference based on aerospace activities, and handled the phasing-out of the ad hoc activities, including the Long Term Studies and Operational Research, in less than a year.

Fourteenth General Assembly – Lisbon, 1964

The Fourteenth General Assembly took place in Lisbon, Portugal, 16-17 September 1964. The Assembly concluded the cycle of holding one General Assembly on the territory of each of the NATO nations participating in AGARD. It also was the first General Meeting of AGARD with the new team of Prof. Courtland D.Perkins, Chairman, and Dr W.P.Jones, Director. The Opening Remarks by Professor Perkins paid tribute to the Founder and Chairman, the late Dr Theodore von Kármán. To continue successfully in a von Kármán-less environment, the greatest need would be AGARD's remarkable and powerful Board of National Delegates.

Dr W. P. Jones, the first Director of AGARD after Dr Wattendorf, also one of the first recipients of the von Kármán Medal in 1972

The address of welcome was given by the Minister of National Defence of Portugal, General Manuel Gomes de Araújo.

Greetings were presented by the Chief of Staff, Portuguese Air Force, General Corte-Real. He looked forward to increasing cooperation with AGARD, and mentioned that in the past Portuguese participation in AGARD affairs had been handicapped by the fact that even the Portuguese Air Force had to send their engineers abroad for aeronautical training. Now, with the help of the AGARD Consultant and Exchange Programme, a course in Aeronautical Engineering had been established at the Lisbon

7 The expression 'now acting as a Board' is that of Dr Wattendorf in the first edition of this book. Now, 35 years later, it may be interpreted as meaning that until the death of Dr Von Kármán, the National Delegates had acted more as board of consultants than as a Managing Board. Indeed, the first decade of AGARD with Dr Von Kármán as Chairman and Dr Wattendorf as Director was largely dominated by their ideas. In retrospect: AGARD could not have had a better team to integrate the aerospace research activities of 16 different nation.

Technical Institute, under Air Force sponsorship, and with support from the Ministry of Education.

The host country technical presentation was made by Prof. Ferreira, Vice President of the Portuguese Academy of Science, who gave a comprehensive review of Scientific Research in Portugal.

Gen. Sir Michael West presented a message from the Standing Group in which he paid tribute to the accomplishments of Prof. Perkins in redrafting the basic documents of AGARD and obtaining Standing Group approval thereof, of broadening the national representation in the AGARD staff, and successfully bringing together the Research Directors of France, Germany and the United States in person for a round table discussion. Sir Michael West also pointed out that this might well be the last General Assembly of this particular kind, and that in the future it was planned to streamline the meetings. Finally, he underlined the fact that it was the first General Assembly to be held under the new nomenclature: AEROSPACE.

An outstanding feature of this General Assembly was the discussion on the role of Science in Defence. The speakers were:

Dr Harold Brown, Director of Defense Research and Engineering, Department of Defense, US

Professeur Lucien Malavard, Directeur des Recherches et Moyens d'Essais, Ministère des Armées, France

Dr.-Ing. Karl Fischer, Direktor der Abteilung Wehrtechnik, Bundesministerium der Verteidigung, Bonn.

The Technical Theme of the Assembly was 'Man-Machine Relationships'; the topics and speakers were:

Man-Machine Synergy, by Wing CDr T.C.D.Whiteside, UK

Adaptation of Man to the Machine, by Col. J.M.Quashnock, US

The Role of the Pilot in the Mercury and X-15 Flights, by Dr W.C.Williams, US

Some Aspects of High-Speed Manned Flight at Low Altitude, by Lt. Gen. J.Ferguson, US

Man-Machine Problems in VTOL Aircraft, by Dr T.Benecke, FRG

Le Transport Supersonique 'Concorde' envisagé du Point de Vue des Relations de l'Homme et de la Machine, by Mr R.Blanchet, France

A new 'Look' for AGARD

At this meeting, two changes were made. First, a new system of rotation of Executive Committee members was started. Secondly, whereas previously Panel Chairmen had reported in person at the General Assemblies of AGARD, the Director gave a summary report of events since the last General Assembly based on individual reports by the Panel Chairmen which had previously been distributed to all National Delegates.

The cycle of formal General Assemblies held in each participating country concluded with the Fourteenth General Assembly. The form of the next and future Annual Meetings of AGARD was discussed. It was decided that the next meeting would be conducted on a much smaller scale, with attendance limited to National Delegates, Panel officials and AGARD staff, and selected observers. Particular attention was given to the report by the Sub-Committee chaired by Mr Nicholson of the UK

which resulted in proposals for AGARD's future structure and functions.

It was indeed the end of an era; von Kármán started AGARD with his very personal involvement in the Panel activities and in general the General Assemblies had had a high technical-scientific content. The NDB did continue this over the years in a different manner, for example by technical presentations by Panels on a rotating basis and through presentation of the proposed technical programmes at the Spring meetings by the Panels.

CHAPTER 4 THE NATIONAL DELEGATES BOARD 1965 – 1997 A SUMMARY OF THE DELIBERATIONS AND ACTIONS

As is clear from Chapter 3, the years under the Chairmanship of Dr von Kármán were the formative years. AGARD was the first technical-scientific organization under the NATO umbrella, starting with specific aeronautical problem areas which led to the establishment of the first four Technical Panels. As experience was gained, the number of Panels was increased.

The pattern of meetings established for Meetings of the AGARD National Delegates Board and described at the end of Chapter 3, continued through the years. Each year the Board met twice, in the Spring and Fall, and meetings of the Steering Committee and the Panel Chairmen were held at the same time. The Spring meetings were generally held in Paris and were mainly concerned with a detailed review of the technical programme and budget for the following year.

The Fall meetings, were known as AGARD Annual Meetings. They were somewhat broader in scope, and were organised in rotation by member nations, the host nation being offered an opportunity to present reviews of its own aerospace research and development programmes. This arrangement served to stimulate national research and development, and to enable the range of AGARD contacts to be widened. In addition, every three years the Fall meeting accepted nominations for the next Chairman of the Board and Director of AGARD. In most cases, they were selected at the same meeting, subject to ratification as necessary. They both took office the following year, the Chairman immediately after the Spring meeting and the Director on 1 July.

As is evident from Chapter 3, the 14 General Assembly Meetings, all but the last two chaired by Dr van Kármán, generally had a high technical content and often the relations with the military and their needs were discussed in great detail. From 1965, the direct interaction of the NDB members with the Technical Panels was maintained through detailed discussions of the Panel Programmes on the occasions of the budget approval at the Spring meetings and through technical presentations of the Panel Chairmen. The Directors, the AASC Chairmen and members gave regular briefings on their activities and the results to the NATO Military Committee and its subordinate bodies. At each meeting AGARD invited leading NATO military and civilian authorities to address the NDB and others attending the NDB meetings. This, together with the visits to national institutions and industries at the Fall meetings, ensured a broad contact between the NDB and the NATO defence community.

In the following record of the years 1965 to 1975, the headings are limited to the Annual meetings, but some of the events and discussions reported took place at the Spring meeting in Paris of the same year. From 1976 on, however, the Spring meetings are reported separately, because of the increasing importance of the topics covered.

First AGARD Annual Meeting, Paris, September 1965

The first of the new round of AGARD Annual Meetings took place in Paris on 13 and 14 September 1965. The first day was spent at ONERA and the meeting was opened by the Director of ONERA, Prof. Paul Germain, and Ingénieur Général

Legendre, Technical Director, who described the activities of ONERA in detail. The afternoon was devoted to tours of the ONERA laboratories.

On 14 September the meeting was opened in the NATO Headquarters building by the Chairman of the Standing Group, Gen. Jean Houssay. Gen. Houssay expressed satisfaction at the way that AGARD was working, stressing particularly the importance of flexibility and cooperation with other NATO bodies such as the Committee of Defence Research Directors.

A typical meeting of the National Delegates Board in the 1960s

Dr John McLucas, Assistant Secretary General for Scientific Affairs, NATO, emphasised the important role of AGARD in NATO and further clarified his own position as Assistant Secretary General for Scientific Affairs, which he saw as being a coordinator to help in avoiding unnecessary redundancy, but still allowing enough flexibility to allow for the diversity approach. He believed that with reasonable but not over-rigid control the present system would work well and he looked forward to working with AGARD as it fulfilled its role as the principal scientific body dealing with the aerospace problems of NATO.

The Chairman, Prof. Perkins, reviewed the creation of the Steering Committee which had been approved in Lisbon (see Chapter 5). They had met in June, considered a number of important military topics, and chosen four for attention during the coming year, namely: helicopter developments, multi-purpose combat aircraft, gas turbines and hypersonic aircraft.

This meeting marked the end of the two-year term of Prof. Perkins as provided in the new AGARD Charter. The National Delegates Board unanimously elected him as Chairman for another year.

Second AGARD Annual Meeting, Delft, September 1966

This meeting was held in Delft, The Netherlands. Delegates were welcomed by His Excellency Gen.(rtd) H.Schaper, the Netherlands Secretary of State for Air. Prof. van der Maas, one of the original AGARD National Delegates and Head of the Aerospace Department of the Technical University, and his fellow National Delegate, Mr A.J.Marx, Director of the Netherlands National Aerospace Laboratory, gave a comprehensive review of aerospace activities in the Netherlands. Visits were made to the Aerospace Department of Delft Technical University and the National Aerospace Laboratory in Amsterdam. A stimulating lecture, entitled 'The By-Products of Space Research and Development', was given by Prof. R.L.Bisplinghoff of the Department of Astronautics and Aeronautics at the Massachusetts Institute of Technology. He showed that there are many by-products ranging over a broad sweep of activities, including education, science, hardware, engineering and elementary social needs.

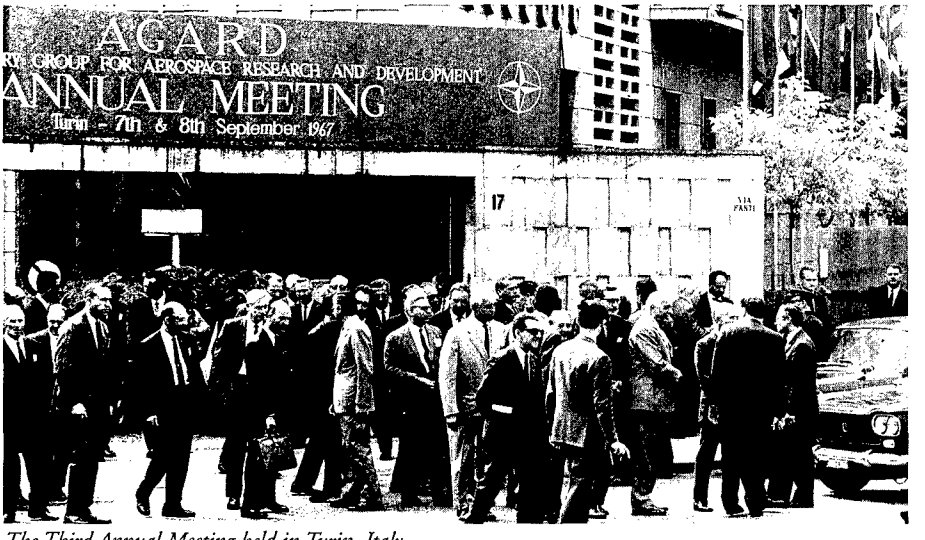
A notable feature of this meeting was the first address by a Chairman of the Military Committee of NATO, at that time Gen. Baron de Cumont. Previously, AGARD meetings had been traditionally addressed by the Chairman of the Standing Group or his representative. From now on, however, the Chairman of the Military Committee addressed the Board on a number of occasions, thus underlining the continuing importance of AGARD to the Military Committee. This was the first meeting since the abolition of the Standing Group during the reorganisation of NATO HQ following its relocation to Brussels. All Military Agencies previously reporting to the Military Committee through the Standing Group now reported directly to the Military Committee.[1]

A major topic of discussion was the general subject of AGARD's future role and position in NATO. The Director, Dr Jones, reviewed the new structure of the research, development and production cycle under NATO's Division for Production, Logistics and Infrastructure, including the Conference of National Armaments Directors and its subsidiary groups, the NATO Air Force, Army, and Naval Armaments Groups and the Defence Research Group. He added that there were two important study groups on the reorganisation of NATO defence science activities: a working party of four set up by the Defence Research Directors Committee; and an exploratory group of six formed by the Science Committee. Gen. de Cumont, Chairman of the Military Committee, expressed the view that the relation of AGARD to the Military Committee should remain unchanged and stressed the importance of having statements from the National Delegates to the Military Committee with their views.

The Chairman then set up an AGARD 'Committee of Four' consisting of Mr Handel Davies, UK, Director Finn Lied, Norway, Prof. Paul Germain, France and Dr Frank Wattendorf, to formulate a resolution expressing the points agreed on by the Delegates. The resulting resolution, which recommended continuation of the mission and method of work of AGARD under the aegis of the Military Committee,

1 As described in chapter 2, the 'Military Committee of NATO' consisting of the Chiefs-of-Staff had an Executive Committee composed of representatives of France, the United Kingdom and the United States, known as the 'Standing Group', to which AGARD was directly responsible. When France withdrew from the integrated military command structure of NATO in 1966, the Standing Group was abolished and from then on AGARD reported directly to the Military Committee in Permanent Session. Daily contacts were maintained between the AGARD staff and the International Military Staff of the Military Committee.

was unanimously approved and submitted to the Military Committee on 12 September 1966. When the Military Committee forwarded this resolution with their endorsement to the North Atlantic Council, it had a strong stabilizing influence on the position of AGARD during a period of NATO reorganization.



The Third Annual Meeting held in Turin, Italy

Third AGARD Annual Meeting, Turin, September 1967

At this meeting, held in Italy, AGARD was especially honoured by the presence of His Excellency the Honourable Manlio Brosio, Secretary General of NATO. He stressed the importance of maintaining technological superiority within NATO and spoke favourably of the important role of AGARD in this respect. In addition, welcoming addresses were given by Gen. Columba and Prof. Gabrielli, and aspects of scientific research in Italy were reviewed by Prof. Cacciapuoti and Prof. Ciampolini, the Chairman of the Flight Mechanics Panel. Technical visits were made to research and testing facilities in the Turin area.

This meeting was marked by changes in the appointments of Chairman and Director of AGARD. Director Finn Lied, Norway's active Delegate to AGARD for many years, the driving force and first Chairman of the AGARD Ionospheric Committee, replaced Prof. Perkins as Chairman; and Franklin J.Ross, Deputy Assistant Secretary of the US Air Force for Research and Development (which position kept him closely in touch with AGARD), replaced Dr W.P.Jones as Director.

Once again, the meeting was also addressed by the Chairman of the Military Committee, Gen. Baron de Cumont, who spoke of the new direct relationships between AGARD and the Military Committee and the functioning of the AGARD Steering Committee. He stressed the fact that coordination of research activities in NATO benefited from the fact that the new Chairman, Director Lied, headed both the Defence Research Group and the AGARD National Delegates Board.

Two technical papers were also given: one by Air Commodore F.R.Banks of Hawker Siddeley Aviation Ltd on Problems of International Cooperation in Aircraft Design and Construction; the second by Dr Royal Weller, Deputy Director of the

SACLANT Centre at La Spezia, who reviewed the anti-submarine warfare research programme at SACLANT Centre.

Fourth AGARD Annual Meeting, Cambridge, UK, September 1968

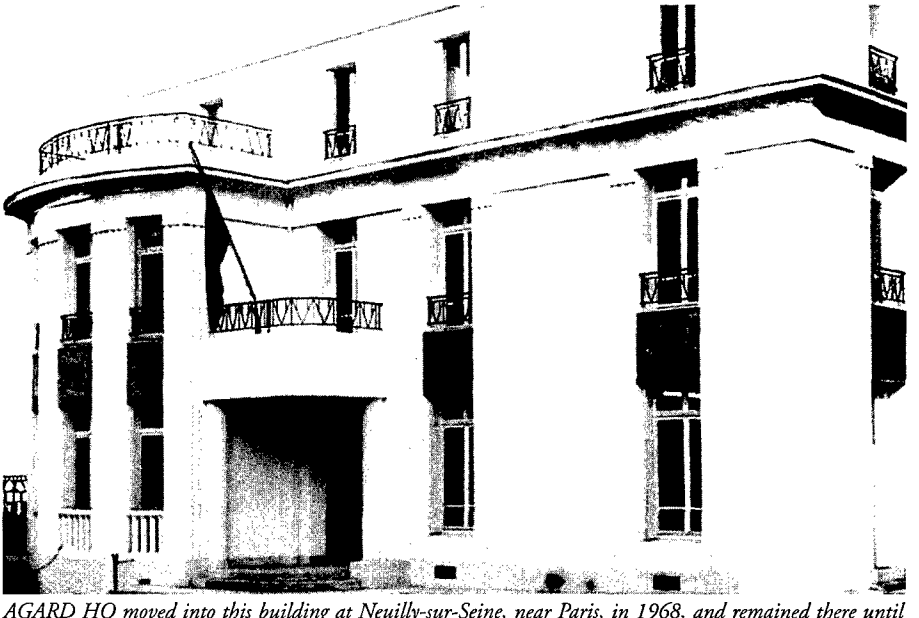
Mr J.P.W. Mallalieu, Minister of State in the UK Ministry of Technology, spoke of the valuable services which had been provided by AGARD since its formation and gave assurance of the United Kingdom's continued support. Gen. Baron Charles de Cumont, who was making one of his last official appearances before retiring from the chairmanship of the NATO Military Committee, gave his wholehearted endorsement, both personally and on behalf of the Military Committee, to the activities of AGARD.

Dr H.M.Agnew, Scientific Adviser to SACEUR spoke of the necessity for further development of V/STOL and automatic take-off and landing to overcome not merely a number of military problems but also those of civil aviation.

A new feature at this meeting was an address on the von Kármán Institute, given by Prof. A.D.Young, Queen Mary College, University of London (Chairman of the Board of the VKI) and Mr R.O.Dietz, Director of the VKI. This was followed by a Forum on Technical Institutes for Education and Research in which the speakers were joined by Prof. K.Refslund (National Delegate, Denmark), Dr Robert Seamans Jr (National Delegate, USA). Mr Anton Marx (National Delegate, Netherlands) and Dr Rudolf Schrader (National Coordinator, Germany).

As host country, the United Kingdom provided an overall picture of the current state of aeronautical research. This survey was broken down into three main topics:

- Research in Universities,
- The Function of Government Establishments,
- The Organization of Aircraft Engine Research in the United Kingdom.



AGARD HQ moved into this building at Neuilly-sur-Seine, near Paris, in 1968, and remained there until the end of AGARD, nearly 30 years later

The speakers were respectively: Prof. W.A.Mair, Professor of Aeronautical Engineering at Cambridge University; Mr P.A.Hufton, Deputy Director (A), Royal Aircraft Establishment (who was also an AGARD National Delegate); and Mr R.Hills, Chief Executive, Aircraft Research Association Ltd and Mr L.S.Dawson, Director of Advanced Engineering, Rolls Royce Ltd.

A visit was paid to the Royal Aircraft Establishment at Bedford.

Advantage was taken of the presence of most of AGARD's principal personalities to make a presentation to Dr Frank Wattendorf, who after serving with AGARD in many capacities since its foundation, had retired from the vice-chairmanship during the year. The presentation was made by Prof. van der Maas (AGARD National Delegate, Netherlands) as the doyen of the National Delegates Board. Dr Wattendorf had been voted Honorary Vice-Chairman by the Board at its previous meeting in Spring 1968.

Fifth AGARD Annual Meeting, Bad Godesberg, FRG, September 1969

This meeting in the Federal Republic of Germany was in the twentieth anniversary year of NATO. The delegates were welcomed by State Secretary, K.G. von Hase and by Dr Theodor Benecke, National Delegate of the host country. Briefings on scientific and technological development in the Federal Republic were given by Dr Benecke (as a Member of the Board of Managing Directors of the German Research Establishment for Aerospace (DFVLR)), Prof.Dr K.H.Doetsch, Chief of the Institute for Guidance and Control of DFVLR, and Dipl-Ing. Julius Henrici, Director of the Astronautics Division of Messerschmitt-Bölkow-Blohm GmbH.

There were three guest speakers: Lt. Gen. T.R.Milton, Vice Director of the NATO International Military Staff, who spoke of developments in the V/STOL field and in the area of air-to-air ordnance; Dr Gunnar Randers, NATO Assistant Secretary General for Scientific Affairs, who outlined the work of the Scientific Division of NATO Headquarters; and Mr Chester M.Lee, the Apollo Mission Director of NASA, who described the Apollo 11 mission which had been successfully completed during the summer.

At this meeting the National Delegates approved revisions of the AGARD Charter and By-Laws. The former Executive Committee was replaced by a new Advisory Committee[2] with the following terms of reference:

- The Advisory Committee shall meet at the request of the Chairman of AGARD and give its assistance and advice to the Chairman for preliminary or informal consultation between meetings of the National Delegates Board.
- The Director of AGARD, and the members of the permanent staff specially designated, shall normally attend all meetings.

These changes were forwarded through the NATO Military Committee to the NATO Council for approval.

The National Delegates also agreed at this meeting that full Panel status should be accorded to what was then the Electromagnetic Wave Propagation Committee.

2 The Advisory Committee consisted of one National Delegate from each country and it was to deal with urgent business arising in the intervals between two annual meetings of the full Board. As it turned out it did not have to meet. Occasionally it was consulted by letter or telephone.

Sixth AGARD Annual Meeting, Washington DC, October 1970

This meeting was hosted by the United States Air Force, supported by NASA and the US Department of State. The President of the United States sent his good wishes for a successful meeting and the welcoming address was delivered by the Honorable U.Alexis Johnson, Under Secretary of State for Political Affairs. The Honorable R.C.Seamans, Jr, Secretary of the USAF, was the keynote speaker, and the Honorable R.Ellsworth, US Permanent Representative to the North Atlantic Council, and Lt. Gen. T.R.Milton, Deputy Chairman of the NATO Military Committee, also delivered addresses.

The meeting was chaired by Dr T.Benecke of the Federal Republic of Germany, who had been appointed by the National Delegates at their March 1970 meeting. Dr Michael I.Yarymovych was present as the newly-appointed Director of AGARD; he had succeeded Mr Franklin J.Ross in July.

Presentations were given by the Department of Defense and NASA on the US Aerospace-related R&D Program. The key speakers were the Honorable J.S.Foster, Jr, Director of Defense Research and Engineering, Mr M.B.Ames, Jr, Director of Space Vehicle Research and Technology, NASA, and Lt. Gen. O.J.Glasser, Deputy Chief of Staff for R&D, USAF.

The National Delegates stressed the need to incorporate military inputs in the planning of the Panel programmes. Also during this meeting an important discussion took place concerning procedures to deal with activities on subjects of importance to the NATO Military Committee which might not fit into the area of responsibility of one or even several Panels. The original suggestion was that a new Panel should be formed to deal with such matters, but it was finally decided that what was needed was a machinery for formalizing the ad hoc groups of which AGARD had made frequent use in the past.

Seventh AGARD Annual Meeting, Nord-Torpa, Norway, September, 1971

The welcoming address was delivered by Lt. Gen. Tufte Johnsen, Commander, Allied Forces South Norway, representing the Norwegian Defence Minister. The theme of the First Plenary Session was 'Norwegian Industrial and Defence Research Development'. The three speakers for this session were: Mr Robert Major, Director, Royal Norwegian Council for Scientific and Industrial Research; Dr Henrik Nødtvedt, Head, Division for Underwater Warfare, Norwegian Defence Research Establishment; and Mr Bjarne Hurlen, Director, Kongsberg Våpenfabrikk.

The second plenary session was opened by Gen. Johannes Steinhoff, Chairman, North Atlantic Military Committee. The theme for this session was 'Status and Trends in International Aerospace Cooperation'. Speakers for this session were Mr R.Chevalier, Directeur Technique Central, Aérospatiale, France; Mr D.M.Davies, Anglo-French Collaboration Manager, Westland Helicopters Ltd, United Kingdom; Mr J.K.Quill, British Aircraft Corporation Ltd, United Kingdom; Messrs K.H.Heilmann and H.Ambos, Ministry of Defence, Federal Republic of Germany; and Mr H.G.R.Robinson, Director General, Aerospace Assessment and Research, Department of Trade and Industry, United Kingdom.

At this meeting the National Delegates received the first reports of the activities of

the Aerospace Applications Studies Committee. This Committee had been established at the previous March meeting as a result of the proposal for the creation of a mechanism to deal with requests for studies on subjects of importance to the NATO Military Committee, mentioned above. This topic is discussed further in Chapter 6.

The National Delegates also approved the creation of the von Kármán Medal to be awarded for outstanding contributions to aerospace science and technology and to the enhancement of progress in scientific and technological cooperation among NATO Member Nations. The von Kármán Medal Committee[3] was created to recommend to the Board the names of suitable recipients. The recipients of the von Kármán Medal are listed in Annex 2.

AGARD Eighth Annual Meeting, Brussels, September 1972

This meeting, hosted by the Belgian Government, had additional significance as it also celebrated the twentieth anniversary of the formation of AGARD. One session was devoted primarily to Belgian Research and Development activities and included a welcoming address by the Belgian Minister of Defence, Mr P.Vanden Boeynants, and an address by Lt. Gen. A.Debeche, Chief of Staff, Belgian Air Force. The Chairman of AGARD, Dr Theodore Benecke, briefly sketched the history of AGARD, thus providing perspective to the commemoration of the Twentieth Anniversary.

Highlighting the Belgian Research and Development programmes was a series of technical presentations, as follows:

- Some Belgian Contributions to Aerospace Techniques: Energy and Propulsion, by Prof. A.Jaumotte;
- Structures and Materials Research in Belgium in Relation to AGARD Activities, by Prof. B.Fraeijs de Veubeke;
- Fluid Dynamic Research in Belgium and the Role of AGARD, by Prof. J.J.Smolderen.

A second session included an address by the Chairman of the North Atlantic Military Committee, Gen. Johannes Steinhoff, followed by a presentation entitled 'Souvenirs of Dr von Kármán', which was given by Prof. Giuseppe Gabrielli, a former student and close associate of von Kármán.

A major technical highlight of this meeting was the von Kármán Lecture which had been specifically established for this anniversary meeting. This lecture on 'Lessons Learned and Future Directions in the Management of Technical Programs' was given by the Honorable Robert C.Seamans, Jr, Secretary of the United States Air Force, who had had a long and distinguished career in the aerospace field and had been at one time a United States National Delegate to AGARD.

The final address was given by the Secretary General of NATO, Mr Joseph Luns, who also presented the first three von Kármán Medals to be awarded by AGARD. The recipients were Mr E.T.Jones, United Kingdom, Prof. Courtland D.Perkins, United States, and Mr Rolland A.Willaume, NATO AGARD Staff, France.

3 When in 1989 two more Awards were instituted the name was changed to the AGARD Awards Committee.

This meeting was attended by most of the NATO Ambassadors, the Permanent Representatives to the Military Committee, a number of high ranking Belgian dignitaries, a group of AGARDians who had been invited by the current AGARD National Delegates, and distinguished guests from the Aerospace Community in the NATO nations.

During the Board meeting it was agreed that an Engineering Study of various concepts for a high Reynolds Number transonic wind tunnel should be undertaken by a consulting engineering firm to follow up the work of the Large Windtunnels (LaWs) Group, a Working Group of the Fluid Dynamics Panel. AGARD would issue the contract for this study but it would be financed by the participating nations. This was done in close cooperation with the 'AEROTEST Group' of the NATO Defence Research Group, DRG.[4]

Ninth AGARD Annual Meeting – Athens, September 1973

This meeting was chaired by Dr Alexander Flax, who had been appointed Chairman at the previous meeting, and the new Director was Mr Olav E.Blichner of Norway. Welcoming addresses were delivered by Gen. D.Zagorianakos, Commander-in-Chief of the Hellenic Armed Forces and Gen. T.Mitsanas, Commander of the Hellenic Air Force.

Dr Alexander (Al) H. Flax, long time National Delegate and Chairman, 1973-76, who was appointed Honorary Vice-Chairman in 1987

Three speakers gave presentations on 'Research and Development Activities in Greece': Maj. Gen. S.N.Moraitis, the Greek National Delegate and Director of Technical Inspection of the Greek Air Force; Prof. M.Anastassiades, Professor of Electronics at the University of Athens; and Prof. Alexopoulos, Professor of Physics at the University of Athens. These presentations were followed by a session on 'Using Science and Technology to meet Military Requirements at Reduced Costs'. Six speakers from five countries gave short talks describing the applications of various innovative techniques that had resulted in military cost savings within their countries' defence industries. They were: Mr P.Chevalier, Directeur Technique Centrale, Aérospatiale, Paris; Prof. T.van Oosterom, National Aerospace Laboratory, Amsterdam; Dr J.Seddon, Director-General Research (Air), Ministry of Defence, London; Dr-Ing. R.Barth, Ministry of Defence, Bonn; Mr P.Bohn, Directeur Technique Adjoint, Avions Marcel Dassault Breguet Aviation, St. Cloud, France; and Col. J.E.Brooke, Deputy Director of Laboratories, United States Air Force Systems Command.

4 The AEROTEST Group was established by DRG to consider the need for future aerospace tests facilities and explore the possibilities of international cooperation. This Group worked very closely with the AGARD LaWs Group. It was a perfect example of cooperation of AGARD and DRG. A major result of this cooperation was the design and construction of the ETW, the European high Reynolds Number transonic wind tunnel, undertaken by four NATO nations.

The National Delegates recommended to the Director that efforts be made to encourage the various military agencies to propose new Aerospace Applications Studies related to their current problems. The Board also agreed to emphasize the importance of three topics – economy, energetics and scientific and technical standardization – and recommended that these should be borne in mind by the AGARD Panels when preparing their future technical programmes.

Tenth AGARD Annual Meeting, Paris, September 1974

This meeting had been scheduled for Portugal, but due to political events there it was transferred to Paris at short notice. The theme was 'The Energy Problem: Impacts on Military Research and Development'. Six speakers presented papers: Prof. J.E.Dubois, Director, Direction des Recherches et Moyens d'Essais, Paris; Dr Michael I.Yarymovych, former Director of AGARD, Chief Scientist, United States Air Force; Mr I.Irving Pinkel, Consultant, Fairview Park, Ohio, USA; Mr F.Jaarsma, National Aerospace Laboratory (NLR) Amsterdam, The Netherlands; Prof. Dr-Ing. X.Hafer, Institut für Flugtechnik, Technische Hochschule, Darmstadt, Germany; and Mr M.C.Neale, Deputy Director Research and Development, National Gas Turbine Establishment, UK.

During the previous Board Meeting in the Spring of 1974, also in Paris, Prof. Courtland D.Perkins and Lt. Gen. Otto G.Glasser, USAF, gave addresses at a special session on 'The Impact of Research and Development on the United States Air Force'[5].

Eleventh AGARD Annual Meeting, Ottawa, September 1975

Dr L.J.L'Heureux, Chairman, Canadian Defence Research Board, welcomed Delegates to Ottawa. Addresses on various aspects of Canadian military aerospace research and development were given by Lt. Gen. W.K.Carr, Commander Air Command, Maj. Gen. D.W.Goss, Chief of Engineering and Maintenance and Mr E.J.Bobyn, Chief of Research and Development, Department of National Defence. Dr J.D.Keys, Vice-President (Programs) of the National Research Council of Canada talked on Canadian research and development policies in general, while Dr J.P.Uffen of De Havilland Aircraft of Canada Limited and Mr F.C.Black of the STOL Project Office, Ministry of Transport, spoke on STOL[6] developments and the Canadian STOL demonstration. The Plenary Sessions concluded with presentations on aerospace medicine by Dr R.Lowry, Chief of the Defence and Civil Institute of Aviation Medicine, and by Dr Jacques Gilbert of the Defence Research Establishment Valcartier on the development and application of the transversely-excited atmospheric CO_2 laser.

The National Delegates approved proposals concerning methods by which AGARD might contribute to a study of interest to NATO Headquarters on Alliance Defence Industry and Technology (ADIT), by assisting in the development of an ideal tactical missiles model; this effort was related to an early AASC study on Small Tactical Missiles for the 1980s and Beyond. The NATO Military Committee had proposed that AGARD should undertake a long-range technological forecast on developments in the aerospace field, and the National Delegates asked the staff to review approaches

5 This presentation and many others given to Board meetings were published in AGARD Highlights.

6 STOL = Short Take Off and Landing

for organizing such a study and to make a presentation to the board at its next meeting in the Spring of 1976. Delegates also devoted attention to the subject of cooperative projects and the ways in which AGARD Panels could effectively assist the nations in planning and coordinating research efforts in various fields.

March 1976 Meeting, Paris

The Meeting was devoted entirely to presentations and discussions concerning the proposed technological forecast for the year 2000 (later known as Project 2000) which the Military Committee had asked AGARD to consider at the previous meeting.

The keynote address was made by the Chairman of the North Atlantic Military Committee, Adm. of the Fleet Sir Peter Hill-Norton, who spoke on 'The Need for Scientific and Technological Forecasting for NATO'. Ing. Gen. J.Carpentier, France, presented a paper on 'Possible Ways to Cover the Military Aerospace Domain in the Horizon 2000'; and Dr L.Roberts, NASA, spoke on 'Outlook for Aeronautics 1980 -2000'.

The Delegates were asked to comment on the feasibility and desirability of Project 2000. It was agreed that the scope should be well defined, and that the Nations' support be clearly itemized in terms of manpower and money. The NDB emphasized that a Central Control or Study Group, composed of very senior people with broad scientific outlook and experience in technological forecasting, should be established in order to define the terms of the study. The Aerospace Applications Studies Committee (AASC) could provide guidance to the technical panels. Finally, it was agreed that AGARD should be involved only with aerospace, that the interrelationship of this project with regular Aerospace Application Studies should be examined, and that Project 2000 should be decoupled from ongoing AGARD activities. Moreover, the Board decided that the ADIT Project (see the previous meeting) was not appropriate for AGARD participation.

The Board elected Mr F.R.Thurston, National Delegate to Canada, as its new Chairman, and Dr R.H.Korkegi was appointed as the new Director.

Twelfth AGARD Annual Meeting, Istanbul, September 1976

Welcome addresses were presented by the Turkish Minister of National Defence, Mr F.Melen, and the Chief of Staff of the Turkish Air Force, Gen. E.Ayan. A paper 'Overview of Research and Development in Turkey', was presented by Prof. H.Doğrusöz of the Turkish National Scientific and Technical Research Organization. A paper on the 'Space Shuttle' was presented by Mr W.C.Schneider, Deputy Associate Administrator for Space Flight, NASA, and this was followed by a presentation on 'The European Space Laboratory', by Dr D.Shapland, of the European Space Agency. A technical visit was paid to the Marmara Scientific and Industrial Research Institute.

March 1977 Meeting, Paris

After the discussions on the AGARD Technical Programme and the Budget for the year, the Chairman commented that the Panel Chairmen should conduct their meetings so that all members had an opportunity to speak their minds without

restraint, as was the AGARD tradition. The Board examined the Terms of Reference of the Panels, and discussed the document 'Panels Topics List' which had recently been published.[7]

A report on the progress of Project 2000 was given by the Chief of Military Committee Studies, Col. G.H.Dimon, and Maj. Gen. Lawson of the International Military Staff presented a status report on the military input to Project 2000 called 'Long-Term Technological Appreciation'. Ing. Gén. J.Carpentier, Chairman of the AGARD Project 2000 Steering Group, summarized the status of work, including the Steering Group's report to the National Delegates Board on the results of Project 2000 Phase I. The Board concluded that the Phase I Report established a sufficient technological basis from which to proceed; and the National Delegates approved in principle the continuation of the project into Phase II.

Thirteenth AGARD Annual Meeting, Copenhagen, September 1977

The Honourable O.Møller, Danish Minister of Defence, gave a welcoming address to the audience, and was thanked by the Chairman, who endorsed his plea for cooperation among member states. Contributions from Danish scientists were: 'New Emphasis on Battlefield Visibility Control – The Dynamics of Smoke Clouds', by Mr S.Christensen and Mr E.L.Petersen; and 'Project Greenland' by Prof. P.Gudmandsen.

A paper on 'The Contribution of Science and Technology to the North Atlantic Treaty Organization' was presented by Prof. N.Ozdas, NATO Assistant Secretary General for Scientific and Environmental Affairs, and Mr K.Muller, Director of Armaments and Defence Research at NATO Headquarters. The Board also discussed two main topics: 'Cooperation in Research with Smaller Nations'; and 'Reduction in Cost in Various Aerospace Fields', the latter being based on the view that new technologies could provide answers, and the Panels were asked to consider both topics.

Gen. Z.Gundersen, Chairman of the North Atlantic Military Committee, addressed the Delegates on the status of Project 2000. He reviewed the efforts of the Alliance in setting up high level task forces to carry out new initiatives in nine selected long term priority programmes, and mentioned other important Committees with whom AGARD should cooperate within its terms of reference, especially with regard to Project 2000. Because of this project, the Board agreed not to approve any further activities of the Aerospace Applications Studies Committee for the time being.

March 1978 Meeting, Paris

It was reported that an R&D capability had been established within the Hellenic Air Force with the assistance of AGARD Consultants. Air Commodore J.N.C.Cooke, Deputy Chairman of the Aerospace Medical Panel, gave a presentation on 'The Technology of Human Adaptation'. In addition, Brig. Gen. F-J.Queiroz de Azevedo e Bourbon, National Delegate from Portugal, presented a paper on 'Research and

7 Although some experts were Panel member for 10 years or more, many stayed only 2-4 years on the Panels. This made clear Terms of Reference and Topic Lists important instruments both in identifying prospective Panel members and as a guideline for the Panels in designing their programmes. The NDB and the Director frequently used these documents when reviewing the topics proposed by the Panels.

Development Involving Smaller Countries'.

A status report on Project 2000 was given, and an extensive discussion took place concerning the participation of nations in Project 2000 Working Groups, the usefulness of comparative cost value analysis, back-up information needed from nations, the methodology used, and the lessons to be learned from the exercise.

Fourteenth Annual Meeting, Lisbon, September 1978

This meeting was opened by the Vice Chief of Staff of the Portuguese Air Force, Gen. J.M.B.Miranda. Brig. Gen. F-J.Queiroz de Azevedo e Bourbon then presented a paper on 'The Relationship of AGARD and Portugal'. Two technical reviews were also given: 'Scientific Research in Portugal', by Dr H.J.Gomes Carvalhinhos; and 'Research in Applied Thermodynamics and Fluid Dynamics in the Lisbon Universities', by Prof. A.F.de O.Falcao. Three technical visits were arranged: to the Nuclear Energy Centre; the Air Force Maintenance Facility at Alverea; and the LISNAVE (Ship Construction and Repair Facility).

The Chairman reminded the Board that one of AGARD's principal tasks was to recommend effective ways for the Member Nations to use their R&D capabilities for the common benefit of the NATO Community; and an important way of putting that into practice was by assisting smaller nations when requested. Nations should encourage maximum participation of their Panel Members in Panel Meetings; and time should be allotted in Panel Meetings to discuss potential ways to assist the less industrially advanced nations.

One of the topics discussed by the Board was the level of effort of AGARD versus financial commitments, and a further comprehensive review of Project 2000 was made, with respect to cost, methodology, schedule, and management. Prof. Winterfeld, Chairman of the Propulsion and Energetics Panel, gave a presentation entitled 'Future Prospects of Propulsion'.

March 1979 Meeting, Paris

The Chairman was pleased to welcome the participation of Gen. G.Schmuckle, Deputy, Supreme Allied Commander Europe. The role of the Panels in other AGARD programmes was underlined, especially in consultant missions. Although good coordination between AGARD and other NATO groups existed in the aerospace disciplines, Panel Chairmen were asked to be aware of all pertinent information.

Mr J.B.Scott-Wilson, Chairman of the Project 2000 Review Board, reported on the progress of the work and said that it was intended to produce the report in early 1980. Mr Seymour Deitchman was appointed Project 2000 Studies Coordinator, replacing Mr E.Paxson who had died a few months previously. The Board agreed to start approving new Aerospace Applications Studies again.

The proposed Support to Nations Programme was discussed. It was agreed that giving assistance to Panel Members of smaller nations would be helpful, but should be limited to a fixed budget ceiling.

Dr A.Lovelace was elected as the new AGARD Chairman. Mr J.Burnham had previously been appointed AGARD Director, to serve from July 1979.

Fifteenth Annual Meeting, Florence, September 1979

The Meeting was chaired by Dr A.Lovelace. Gen. U.Fabi, Italian National Delegate, introduced the Italian guests, the Honourable Dr Giovanni Del Rio, Under Secretary of Defence; and Gen. A.Mettimano, Chief of Staff, Italian Air Force. Gen. Cottone, Commandant of the Scuola di Guerra Aerea was the host for the meeting.

The Director of AGARD presented a request received from the International Military Staff, NATO, concerning potential assistance to Southern Flank Nations. As noted above, this subject had been discussed before, and of course during the previous years much attention had been paid to the specific needs of Greece, Portugal and Turkey, particularly through the Consultant and Exchange Programme. However, the Military Committee was now asking for a proposal for a more formal programme. After consideration by the Board, the Director was requested to present a working paper at the 1980 March meeting.

The Board discussed the updating of 'The AGARD History' and its usefulness to AGARD Members and Delegates. A decision in principle was made to update the History, and plan for further updating at five-year intervals.[8]

During the Italian National Day, Gen. L.Broglio, Italian National Delegate, made a presentation on 'The Role of Italy in Aerospace Cooperation', followed by a paper on 'The Philosophy of the Development Programs in the Aeronautical Sector for Defence Modernization'. Dr Ing. A.Valerini, Spacelab Programme Director from Aeritalia, Soc. Aerospaziali then presented a review called 'Space Lab – A Reality of Today Projected in the Future'.

March 1980 Meeting, Paris

A welcome was given to the announcement that Iceland had asked to take part in the AGARD Board and other activities.

In the new initiative concept, the item 'Collaborative Research Programme' was reviewed in detail. In discussion on the Director's paper, it was agreed that the Technical Panels should be involved in filtering proposals associated with the Programme of Support to Greece, Portugal and Turkey. Topics presented by these nations and approved by the Board at the Fall Meeting were reviewed. The proposed budget for this new programme was discussed, but approval was postponed to the Fall meeting. A proposed Fellowship Programme was also discussed in detail, but referred to the Fall meeting for decision.

Sixteenth AGARD Annual Meeting, The Hague, September 1980

The AGARD Director reported on the completion of Project 2000, with the exception of the methodology report, which was still in its draft stage. He also reported on the status of the Multilingual Aeronautical Dictionary, successor to the Aeronautical Multilingual Dictionary of 1960, and on the proposed distribution within nations, and on potential sales. The dissemination of AGARD documents

8 As it turned out that period was not exactly 5 years:
1st Edition 1952-1968; 2nd Edition 1952-1975; 3rd Edition 1952-1981;
4th Edition 1952-1987; 5th Edition 1952-1997

was reviewed, and it was agreed that the AGARD position should be reported to the NATO Military Committee.

The budget for the Programme of Support to Greece, Portugal and Turkey was agreed by the Board, subject to appropriate funding by the NATO Military Committee. The potential Fellowship Programme was again discussed, but decision was further postponed until the following March.

As a result of deliberations during the Panel Chairmen's Meeting, an intensive discussion took place concerning the role of the Panels in inter-disciplinary areas. The implications of Project 2000 with regard to Panel programmes was also discussed, and the Panels were told that they should take full advantage of pertinent results of Project 2000 studies.

Dr Lovelace suggested the creation of a small group to re-examine AGARD accomplishments, and to consider future goals and how best they should be approached. The proposal was accepted. The Board also agreed that the thirty years of AGARD's existence should be commemorated by having a Memoir on Dr Theodore von Kármán in the updated version of the AGARD History.[9]

The National Day was opened by the Netherlands Secretary of State for Defence, Mr W.F.van Eekelen. Gen. W.J.W.Wijting, Chief of Defence Staff in the Netherlands, made the introductory presentation. This was followed by two papers on 'Aerospace in the Netherlands' presented by Ir. J.A.van der Bliek, General Director of the National Aerospace Laboratory, NLR, and by Lt. Gen. (ret.) A.B.Wolff, Chairman of the Board of of the Netherlands Agency for Aerospace Programmes, NIVR. Tours of the Netherlands aerospace facilities and the Delta Works were arranged.

March 1981 Meeting, Paris

The meeting was chaired by Mr F.R.Thurston in the absence of Dr.Lovelace. Mr Thurston welcomed Ambassador H.Bjornsson, Permanent Representative to the North Atlantic Council from Iceland, who was acting as National Delegate for Iceland.

The first exchange of views was on the 'Programme of Additional Support to Greece, Portugal and Turkey'. The Director made a status report on the on-going programmes in each nation, and the Board agreed that the Director should proceed. Concerning the proposed AGARD Fellowship Programme, the Board decided that these so-called Study Grants should be part of the additional support to Greece, Portugal and Turkey.

Concerning Project 2000, the Steering Committee approved the Methodology Report with minor corrections. Problems regarding the future of the von Kármán Institute[10] were discussed by the NATO Financial Comptroller, Mr J.Ceulemans,

9 In the third and in the fourth edition of this book a 35 page excerpt of von Kármán's biography 'The Wind and Beyond' (Reference 1 cited before Chapter 1 of the present book), was included.

10 The NATO nations contributed financially to the Von Kármán Institute for Fluid Dynamics (VKI) through an 'ad hoc' Committee on Finance. Over the years, since its foundation at the instigation of Dr von Kármán in 1956, several attempts failed to include even part of the budget in the general NATO budget. Although the great majority of the nations contributed to this budget, it was never possible to reach full agreement of the 16 NATO nations on this subject. ('Ad hoc' in this case means that each year the contributing nations determine their financial share in a special NATO finance committee)

who was chairing a NATO Working Group on this subject, and who also reported to the NATO Science Committee.

The proposed Study Group on 'AGARD in the 1980s and Beyond' was the subject of an extensive exchange of views with regard to content and timing. The Chairman of AGARD invited the comments of the Delegates in order to proceed with the organizational and operational aspects of the Study.

Seventeenth AGARD Annual Meeting, Oxford, September 1981

Dr E.W.E.Rogers, UK National Delegate, made the welcoming address to the AGARD Delegates. The Board had a further long discussion on the financing of 'Additional Support to Greece, Portugal and Turkey'; and selected programmes for approval from lists proposed by the nations. The Director was given flexibility in financing portions of the programme within broad limits set by the Board. A new look at the transfer of surplus equipment from one nation to another was proposed.

The UK National Delegates arranged a full day visit to British Aerospace, Warton. Technical papers were presented covering an 'Outline of Overall System of Management, Funding and Execution of Aeronautical Research in the UK', by Mr D.J.Harper, UK National Delegate; and an 'Outline of General Scope of Aeronautical Research in the UK' by Dr E.W.E.Rogers, UK National Delegate. Seven technical papers were also presented by British Aerospace Warton staff members. Technical visits to the Warton Division were also arranged.

During the closed session of the Board, Professor J.B. Walsh, formerly Assistant Secretary General of NATO for Defence Support and now the US nominee for the Study Group, presented the proposed Terms of Reference for the Study Group on 'AGARD in the 1980s and Beyond', as well as a tentative schedule of work and procedures. The Board agreed the Terms of Reference of the Study, and approved the nomination of Prof.Walsh as the Chairman of the Study Group.

The National Delegates Board elected Prof. O.H.Gerlach of the Netherlands as Chairman of AGARD, and selected R.Adm (retd) R.K.Geiger as Director, to succeed Mr J.Burnham on 1 July 1982.

March 1982 Meeting, Paris

In discussing the Panel Chairmen's report, the Board stressed the importance of inter-Panel coordination in the preparation of Panel programmes and asked that, henceforward, this work be completed and formally documented in advance of the presentation to the Board of the Panels' proposed future programmes.

It was agreed that the existing programmes entitled 'Support to Nations' and 'Additional Support to Greece, Portugal and Turkey' should be consolidated into a single budget line-item in the future, this to be called 'Support to Greece, Portugal and Turkey'. A review by the Director, and an assessment of the effectiveness and value of this programme was also called for.

A further lengthy discussion took place in the Board's closed session concerning the financial affairs of the von Kármán Institute for Fluid Dynamics (VKI), again introduced by Mr J.Ceulemans, the NATO Financial Controller. The possible role of AGARD in assuming partial management responsibility for VKI was discussed. A

NATO cost-sharing formula would reduce the cost for some of the supporting nations.

Eighteenth AGARD Annual Meeting, Washington DC, September 1982

Prof. O.H.Gerlach, the Chairman, read a letter he had received from the President of the USA, Mr Ronald Reagan, welcoming the Delegates and congratulating AGARD on attaining its 30th Anniversary. The Chairman extended a special welcome to Spain (represented by Col J.S.Rocha) which had become a member Nation of the Alliance in June 1982.

In his welcoming speech, the senior US National Delegate, Dr A.G.Keel Jr, invited all Delegates to a dinner to celebrate AGARD's 30th Anniversary, to be held in the US National Air and Space Museum on 16 September.

Following discussion of the Aerospace Applications Studies programme at its March meeting, the Board received a report by the Director concerning presentations of the results to NATO HQ and requesting nations. In some cases more requests for presentations or briefings were received than could be handled, both due to limited funds and the availability of the experts concerned. The Director was asked to prepare procedures, rules, and funding requirements for such presentations, and to report back to the next meeting.

It was agreed that the Director should draft an improved definition of the objectives and goals of the programme for AGARD Support to Greece, Portugal, and Turkey, for approval by the Board. Concerning the VKI financial status and management issue, the Director was requested to prepare a proposal for mechanisms under which AGARD could exercise oversight of the VKI international programme.

In closed session, the Board, together with AGARD Panel Officers, heard a comprehensive report from Prof. John B.Walsh, Chairman of the Study Group on AGARD in the 1980s and Beyond, whose written report was to be published by the end of 1982. A lengthy discussion followed, it being finally decided that the published report would be reviewed and discussed by the Board at its next meeting.

The US National Delegates arranged a full-day visit to the Kennedy Space Center at Cape Canaveral, Florida, where Delegates were given a series of briefings concerning the US Space Program, followed by an extensive tour of the facility.

March 1983 Meeting, Paris

The recent death, on AGARD duty at a Lecture Series in the USA, of Col J.-C.de Buretel de Chassey (French Air Force), Deputy, Plans and Programmes, was reported, and one minute's silence was observed.

Following a report presented by the Director, and a very comprehensive discussion of the policy behind the Programme of Support to Greece, Portugal and Turkey, the Board agreed that the Director should have increased flexibility (in regard, for example, to the commitment of funds) in his management of the programme, subject to his reporting upon the status of the programme at each Board meeting.

After the presentations of proposed Panel programmes, criticism again arose concerning the paucity of inter-Panel coordination information appearing in the

presentations. The Director explained that much of this activity took place at the Panel Chairmen's meeting on the day prior to the NDB meeting, and so it was essentially a problem of timing. The matter would be reviewed.[11]

In closed session, the formal report of the Study Group on AGARD in the 1980s and Beyond was reviewed. The Board requested the Director to prepare for their consideration comments and recommendations on the proposals contained in the report. They also thanked Prof. Walsh and the members of the Study Group for their efforts and decided that the Group should now be disbanded.

The Board accepted in principle a proposal to establish an Advisory Panel to periodically assess the utility to NATO of the VKI International Programme, and asked the Director to prepare a detailed proposal.

Nineteenth AGARD Annual Meeting, Munich, September 1983

The Senior National Delegate from the FRG, Dr Meisel, warmly welcomed Delegates to this meeting. The Fall Address to the National Delegates Board was given by Gen. Richard E.Lawson, USAF.

During the German National Day, a series of technical presentations was given, followed in the afternoon by visits to a variety of companies and military installations in the Munich area.

In closed session the Board returned to the subject of the VKI and was informed that the creation of an Advisory Panel[12], proposed by AGARD, had been accepted by the NATO Council and that a request to set up the Panel could now be expected. The Panel would comprise NDB members, or their designated experts, nominated by those Nations who had chosen to participate in the VKI's affairs. The full Board would not be involved.

The NATO Financial Controller told the meeting that it was intended to delegate a measure of financial authority from his office to AGARD, in Paris. The Chairman said that the total AGARD budget proposed for 1984 was some FF 19 million, including 9 million for the Technical Programme, of which 4 million was earmarked for Panel programmes, including technical publications, 2 million for the Consultant and Exchange programme and 2 million for Support to Greece, Portugal and Turkey.

In further discussion of the report on AGARD in the 1980s and Beyond, the Board concluded that the essence of the report was to say that AGARD was doing an effective job: proceed as before. The Board decided that it did not need to involve itself in detailed deliberations concerning the numerous conclusions and

11 This problem was never fully resolved because Panels met at different places at different times and so much of the preliminary coordination between Panels could only be carried out between their Executives in AGARD Headquarters. Once it had been agreed that a particular activity was feasible and worthwhile, the final coordination was carried out between the Panel Chairmen during their meetings, sometimes 6 months before the Spring Board meeting at which the proposed programme would be reviewed, but sometimes only the day beforehand. Panel Chairmen (and the members) were all 'volunteers', often having available only a limited time for further consultations. Nevertheless, the Panels did remarkably well to avoid duplications and to work with other Panels and elements of NATO when this was appropriate.

12 This Advisory Panel has proved to be extremely useful to VKI to this day. It is composed of leading personalities in the area of fluid dynamics of the NATO nations.

recommendations contained in the report, but that it approved the contents of the report as a constructive guide to the future conduct of AGARD's affairs.

March 1984 Meeting, Paris

The venue was the Paris Headquarters of the Western European Union, and the Chairman had the pleasure of warmly welcoming the Deputy Secretary-General of the WEU, Mr Hinterman. He also announced that Gen. Cornelius de Jager, RNLA, new Chairman of the Military Committee, would be attending the Meeting later and had kindly consented to address the Board.

Presenting his report on the conduct of the 1983 Programme, the AGARD Director said that it had been both trouble-free and successful. On specific issues, he reported that 34 tasks had been completed under the Support Programme to Greece, Portugal and Turkey, and that a start had been made on the automation programme at AGARD Headquarters, first priority being the Budget and Finance area.

In regard to the Support Programme to Greece, Portugal and Turkey, a number of issues were discussed. Concern was expressed on the continuity of Panel members from those countries, whose participation at Panel meetings was funded by the Programme, and it was stressed that continuity of attendance was important to enable them to become actively involved in Panel affairs. Finally, there was a lengthy discussion of an Issue Paper about the funding of direct labour and overhead costs incurred under this Programme. The matter was not resolved and the Director was asked to explore the matter further and report back to the Board.

In the closed session, the policy and past practice in respect of procedures to be followed in regard to the selection and appointment of AGARD Chairmen and Directors were reviewed. The US Delegation indicated that, if asked, it would be prepared to offer candidates for the post of Director at the forthcoming Fall Meeting of the Board. (This suggestion was unusual in that the present incumbent was also of US nationality and hitherto it had been the practice for North American representation to alternate between the posts of Chairman and Director, the other post for the same period being filled by someone from Europe).

Twentieth AGARD Annual Meeting, Oslo, September 1984

The Fall Address to the Board was presented by Lt. Gen. James Abrahamson, USAF, on the subject of the 'United States Strategic Defense Initiative', then popularly known as 'Star Wars'.

Prof. Haus of Belgium was appointed as Honorary Dean of the National Delegates Board, in recognition of his outstanding contributions to AGARD since his attendance as a National Delegate at the first NDB meeting in 1952.

The payment of labour and overhead costs on tasks in the Support Programme for Greece, Portugal and Turkey was the subject of intensive discussion. The Board decided not to deviate from its previously-agreed policy that such funding could not be provided under this Programme. However, the Director was asked to continue his efforts to try to find a mechanism, external to the Programme, by which such costs might be met.

On Norwegian National Day, the meeting was honoured by the presence of the

Norwegian Minister of Defence, Mr Anders C.Sjaastad, and Mr Erik Klippenberg, former Director of the SHAPE Technical Centre, and presently Director of the Norwegian Defence Research Establishment. A presentation by Mr H.K.Johansen, Norwegian National Delegate, was followed by a visit to the Kongsberg Våpenfabrikk.

The National Delegates Board unanimously elected Prof. Gero Madelung, Federal Republic of Germany, to be the next Chairman, in succession to Prof. Gerlach. Dr Irving C.Statler, USA, was selected as AGARD Director-designate.

March 1985 Meeting, Paris

The Chairman, in opening this meeting, thanked the French Authorities for their continued generous support of AGARD in providing facilities for these Spring NDB meetings in Paris.

In the Director's report, he made reference to the difficult security situation being experienced in the Paris region, due to terrorist activities, and described the steps being taken to re-enforce existing precautions at AGARD Headquarters.

On other matters, further experiments in the use of audio-visual aids in support of Lecture Series were authorised. One proposal was to record the presentation at one site and then use the recording to present the same Lecture Series elsewhere[13].

Means for exercising quality control, and receiving appropriate feedback, in respect of tasks conducted under the Support Programme for Greece, Portugal and Turkey were again discussed. It was agreed that the existing rules be continued. These required a final report to the Director in respect of all tasks; a publication to be prepared and published when this was considered appropriate; and constant monitoring of expenditure and progress to be maintained.

Miss Nancy Wildgoose, the first lady to chair an AGARD Panel (TIP), presenting the report of the Panel Chairmen's meeting to the Board in Fall 1985

In closed session the Board reviewed the roles of the Aerospace Applications Studies Committee (AASC) and the Steering Committee, and particularly their relationship with the Military Authorities. It was considered that a clear role existed for both bodies but, upon the proposal of the Director, the Board agreed to receive suggestions as to how inputs from the Steering Committee to the NDB might be made more effective, particularly in regard to their timing.

Twenty-first AGARD Annual Meeting, Brussels, September 1985

The welcoming address was given by Gen. H.Robyns de Schneidauer, National Delegate from Belgium. Opening the meeting, the

13 In the event, this proved to be unsatisfactory, both because of the poor quality of the results, unless the filming was carried out professionally (at a substantial cost, thereby defeating one of the objects of the exercise), and because it was not possible for the audience to put questions to the lecturers.

Chairman, Prof. G.Madelung, reported that the Secretary-General of NATO, Lord Peter Carrington, had visited AGARD Headquarters earlier in the month and had been briefed by the Director and members of the staff.

The NDB Fall Address, given by the Deputy Chairman of the NATO Military Committee, Lt. Gen. Paul S.Williams Jr (US Army), and titled 'A Critical Analysis of AGARD's Support to the Military Committee', evoked considerable discussion. This centred upon the nature and effectiveness of the ties between AGARD and the Military Committee, and in particular the scale and timeliness of response of AGARD studies undertaken on behalf of the Committee.[14]

Reporting on the Technical Programme, the Director remarked upon the growth in activity in the Support Programme to Greece, Portugal, and Turkey, with all nine Technical Panels now involved in 68 active R&D projects. In the final session of the NDB Meeting, Dr A.Flax gave a wide-ranging review of AGARD's position in relation to the emerging technologies of the next decade and, in particular, suggested an updating of technical perspectives which the AGARD Technical Panels might undertake in this context. Subsequent discussion revealed some divergence of opinion on this issue and the Director was asked to try to capture a consensus of the views expressed and provide a paper for review at the next Meeting.

Lord Carrington, then Secretary General of NATO, visited AGARD Headquarters in September 1985. He is seen here, directly under the photograph of von Kármán, with the Director, Dr Statler

His Excellency Freddy Vreven, Belgian Minister of Defence, gave the opening address on the occasion of Belgian National Day. A series of technical presentations on aspects of Belgian aerospace activities followed, and Delegates were then offered visits to the von Kármán Institute for Fluid Dynamics, the Belgian Institute for Space Aeronomy, and four aerospace-related companies.

March 1986 Meeting, Paris

The Chairman informed members that this was the 60th National Delegates Board Meeting. The Director announced the setting up in AGARD Headquarters of a Contracts Processing Office and confirmed that, with only minor exceptions,

14 The lecture of Gen. Williams was a good illustration of the importance of inviting to NDB meetings key-note speakers from the NATO military. His lecture was published in AGARD Highlights 86/1 and it became known as 'Gen. Williams frustrations'. He highlighted the problem of the mismatch between trying to find answers to the problems at hand and the longer term view often taken by the Panels. He also pointed out that many of the military did not understand how AGARD could work effectively – but were surprised that it did somehow – in the complicated network as presented in the organigrams of NATO. His speech – and those of others – kept AGARD vigilant.

AGARD had been awarded financial autonomy by the NATO Financial Controller.

In the light of the critical analysis of AGARD's role in supporting the NATO Military Committee given by Gen.Williams at the previous NDB meeting there had been a lengthy meeting of the Steering Committee in order that the General's comments, and those subsequently expressed by members of the Board, might be fully considered. The NDB Chairman, who was also Chairman of the Steering Committee, reported on the outcome. Delegates were reminded that the Steering Committee was given total responsibility by the NDB for the organization of Aerospace Applications Studies when the AASC was originally formed. It was noted also that the AASC reported to the Steering Committee, and only through the Steering Committee to the National Delegates Board.

Following a discussion which included consideration of the effectiveness of existing procedures and methods concerning AGARD relations with the military authorities, the Board gave authority to the Steering Committee to approve up to two Aerospace Applications Studies and their associated Terms of Reference annually. Such authorization would require a majority of the AGARD members of the Steering Committee to be present and voting. The Board also concurred with the recommendation of the Steering Committee that the AASC should expressly consider the time-elements of each study cycle and provide a report to the Steering Committee on how the studies could most expeditiously be managed.

Maj. Gen. Randolph Peat, USAF, ACOS Ops at SHAPE, presented a report on SHAPE's Conceptual Military Framework (CMF). In discussion, the Director expressed the hope that arrangements could be made to provide a similar briefing to the Panel Chairmen and Executives.

The matter of Document Classification was raised and the Board approved the proposals put forward by the Director to protect the classified material contained in certain AGARD publications.

Twenty-second AGARD Annual Meeting, Athens, September 1986

Gen. Apostolakis, Chief of Staff of the Hellenic Air Force, attended as a Special Guest, and the Welcoming Address was presented by Gen. P.Kontodios, National Delegate for Greece. The Chairman announced, with solemn regret, the death of Dr Frank Wattendorf, AGARD Honorary Vice-Chairman, on 11 June 1986.

The Fall Address, entitled 'The Value of AGARD to NATO', was given by Ambassador Marcello Guidi, of Italy, Deputy Secretary-General of NATO. His presentation, which was warmly received by the Delegates, contained specific proposals as to how AGARD's contribution to the Alliance might be made even more effective. He remarked that several recent NATO initiatives – the Conceptual Military Framework (concerning long-term planning activities), the improvement in armaments cooperation, and the long-term exploitation of emerging technologies – all had important implications for AGARD's work, and commended them to the Board for their further attention.

The Board approved the revised selection procedure for Aerospace Applications Studies which the Steering Committee had proposed, together with changes in arrangements concerning the timing of reports to be furnished by the Committee to

the NDB. Measures affecting the authorization, and conduct by the AGARD Panels, of Technology Studies referred to them by the Military Committee, were also approved. The Board also agreed Guidelines for Technical Panel Briefings to the Military Committee that had been drafted by the Director.

The Director then sought, and received, NDB support in responding to questions raised by the NATO Auditors concerning the size of the AGARD publications programme, the number of copies distributed, and the possibility of charging for copies provided.

In 1986 AGARD began to review ways in which it could be responsive to the NATO Conceptual Military Framework (CMF). As part of the response, the Board authorized the use of up to five percent of the Consultant and Exchange budget on a one-year-trial basis to fund consultants to other NATO Bodies. Requests for these consultants would come from the Military Committee and be approved by the Director of AGARD bearing in mind the funding available. The Director would consult with the National Delegates, and members of the Technical Panels and AASC as appropriate, to identify these consultants. Coordination of the programme would be conducted by the Chief, MCS Division.

Ms Nancy Wildgoose, the first lady to chair an AGARD Panel (TIP), gave a presentation on the value of scientific and technical information as an integral part of the R & D process.

The Greek National Day was marked by a series of technical presentations, followed by visits to the Hellenic Aerospace Industry, the National Research Foundation, and KETA, the Air Force Technology Research Centre.

March 1987 Meeting, Paris

The opening announcements from the Chair gave news of the death of Prof. van der Maas, of The Netherlands, one of the founding fathers of AGARD, who had represented his country as an NDB Member from 1952 to 1971. The Board was also informed that Dr A.H.Flax, US National Delegate, had resigned after 18 years of service, including a term of office as chairman. Belgium then proposed, and France seconded, that Dr Flax be appointed Honorary Vice-Chairman of AGARD, a move which received unanimous support.

In his report on recent activities, the Director said that a high level of interest in AGARD's technical meetings had been maintained, mentioning in particular the FDP Short Course on 'Fundamentals of Fighter Aircraft Design', and an FMP Symposium dealing with improvements in the combat effectiveness of existing and future aircraft. On the subject of support to Greece, Portugal, and Turkey it was reported that AGARD's programme now comprised 87 projects.

In the context of a report presented by the Steering Committee, the Board agreed that the Director should present topics proposed for Technology Studies to the relevant Panels for their consideration and subsequently report back to the Steering Committee on actions taken in respect of these Studies. Other procedural proposals, regarding AGARD's response to requests for consultants by other NATO bodies, and the selection and review of presentations to be made to the Military Committee, were also approved.

The Director reviewed with the Board arrangements under which AGARD publications were printed and distributed. The 5-year printing contract was due to go out for international bidding, and subsequent renewal, later in the year. However, he had received two proposals from commercial companies for printing and distributing AGARD publications as technical books, and he suggested that this approach might with advantage be adopted on this occasion. After discussion, the Board decided it needed more information before a decision could be reached and asked the Director to arrange a one-year extension to the current contract, if possible, to allow adequate time for the Board to consider the various options which had been proposed.

Twenty-third AGARD Annual Meeting, Ottawa, September 1987

Following the welcoming address to Delegates from the Canadian Associate Minister of Defence, the Honourable Paul Dick, the Chairman introduced the several Special Guests present, including US Deputy Secretary of Defense, the Honorable William H.Taft IV, whom he called upon to present the Fall Address to the Board. This was titled 'Cooperative Research and Development in NATO', an appropriate topic in the week when the United States Air Force was celebrating its 40th Anniversary. The address gave rise to a lengthy and wide-ranging discussion covering the continuing need for common defence, the increasing competitive strength of European industry, the large disparity between the size of the US and aggregate European defence industries and the scale of R&D expenditure on defence in the two areas (roughly, 3.5 to 1). Mr Taft's message was one of confidence in the future of the Alliance, to a degree one of satisfaction, and one of challenge.

The Director informed the Board that nearly the entire Military Committee, including the Chairman, Gen. Altenburg, had recently visited AGARD Headquarters, and that, in celebration of AGARD's 35th Anniversary, an extensive poster display of the Agency's work and achievements had been set up at NATO Headquarters in Brussels.

The Board considered proposals from the Director in response to comments made in the Fall Address the previous year by the Deputy Secretary-General of NATO, and a survey conducted by the NATO Defence Research Group of its own activities and effectiveness, the two matters being similar in many respects. Following discussion, the Board decided that AGARD must continue to pursue a dialogue with military planners, and to stimulate multi-lateral national cooperations. In particular, the Technical Panels should address military potential and risks, when appropriate.

Regarding the printing of AGARD publications, the Director said that, as requested, he had arranged a one-year extension to the present printing contract. In the light of further discussions which had taken place in the meantime, he now proposed that the style and format of AGARD publications would continue unchanged, but that a few publications each year would probably be given more durable covers (laminated with plastic film or even hard back). The Board agreed to these proposals[15].

Developments in the administration, conduct, and financing of projects under the Support Programme for Greece, Portugal and Turkey brought this subject to the agenda once again. A series of measures, relating to the purchasing, use, and disposal

15 In fact, the use of laminated covers was adopted for all publications two years later (except for the few with hard backs).

of hardware and software, was approved, in addition to further cost controls and limitations.

In closed session the Board reviewed certain difficulties inherent in AGARD budget arrangements, relating to exchange rate movements, prosecution of the publications programme, etc. The reporting to the Board of business conducted during Panel Chairmen's Meetings was also discussed. Previously, the Chairmen had produced full minutes of their meetings, for distribution to the Board the following day. In future, the Board agreed, only a short summary of the salient points would be required.

The nomination by the United States delegation of Radm.(retd) R.K.Geiger (who had been Director, 1982-1985) for the position of AGARD Chairman received the Board's unanimous approval. The Board agreed to recommend the appointment of Ir. J.A. van der Bliek of the Netherlands as AGARD Director in succession to Dr Statler whose term of office would end in June 1988.

The Canadian Deputy Minister of National Defence presided over a dinner for the Board and addressed them on Canada's defence policy and its R & D programme. During National Day, visits were made to Pratt & Whitney, Canadair, CAE Electronics, and to the about-to-be-opened National Aviation Museum.

March 1988 Meeting, Paris

This was the last Board Meeting to be chaired by Prof. G.Madelung. Gen. E.Eimler, Deputy SACEUR, presented the Address. It was noted that in the future, development of NATO's Air Forces would strongly depend on their concept of the employment and utilisation of advanced technology and the increasing involvement of NATO Commanders in the planning process. Advice from AGARD would become even more valuable.

The Director, reporting on current activities, noted the AVP Meeting on 'Electro-optical Systems and image Analysis for Airborne Application' as a positive demonstration of a quick response by a Panel to a request from the Military Authorities. Similarly the FMP and GCP joint Symposium on 'The Man-Machine Interface in Tactical Aircraft Design and Combat Automation' had been a response to NATO Military Committee interest, as was the proposed Technology Study on 'Systems Concept / Requirements for Knowledge-Based Expert Systems on Board Future Tactical Fighters'.

The Board requested that at each March Meeting the Director report only on all hardware and software purchases for the Support Programme to Greece, Portugal and Turkey that he had approved during the preceding year for which the cost exceeded 10,000 FF for a single Project.

The Board also discussed the Consultant and Exchange Programme, and in particular the part related to consultants for other NATO bodies for which AGARD had reserved up to 5% of the relevant budget. The Board suggested that the Director should request an increase in this part of the budget.

Twenty-fourth AGARD Annual Meeting, Madrid, September 1988

Following a welcoming address to Delegates by the Spanish Secretary of State for Defence, Mr De La Cruz, the Chairman, Radm. Geiger, introduced several special

Guests present including the US Ambassador to NATO, the Honourable Alton G.Keel, former US National AGARD Delegate (1981-1982).

The Chairman said that he had received a letter from one of the National Delegates who had recently attended three Panel symposia. He had found the symposia to be excellent and constructive, and had commented on good points and on points he felt needed improvement. The Chairman suggested that, if time was available, each of the National Delegates should visit AGARD events to judge the quality and the timeliness of the presentations.

One of the Panels had recently held a 'poster session', without asking permission from the Board, and had printed the papers as a second volume of its published proceedings, thus making them unusually large (and costly). An extensive discussion took place about this, and since such sessions were new to AGARD the Director was asked to prepare a paper on this subject for the March 1989 meeting.

The Board took note of the Director's statement that there was a renewed interest in Hypersonic and Space Vehicle Mechanics. The conclusion was that insofar as some Nations had expressed an interest in this domain it was a responsibility for the AGARD staff to ensure that the proposals made by the Panels were detailed enough to allow the Delegates to judge the value of their proposals.

A backlog of printing valuable publications, due to lack of funds, was noted. Efforts (ultimately successful) were being made to obtain extra funds in order to reduce the backlog. The Board decided that the Consultants Programme to other NATO Bodies should be a formal AGARD programme forming part of the Consultant and Exchange Programme.

In connection with the proposed restructuring of the Structures and Materials Panel the question of the maximum number of Panel members was raised. The number of 85 Panel members per Panel was agreed as a guideline. A report would be presented – in about one year – indicating the effect of this measure.

In the closed session, the Board reviewed the contributions which could be made to the countries with Less Developed Defence Industries (LDDI). They also discussed a paper on possible limitations to the distribution of AGARD unclassified publications, and agreed that no changes should be made in the procedures for their distribution, but that the Director should prepare an issue paper on the subject.

Concerning the response to the question posed by the Military Committee to AGARD on improving the industrial participation of Greece, Portugal and Turkey in the development of Weapons Systems or Sub-Systems, it was felt that AGARD should not extend itself beyond its expertise, that is the scientific and technology base. The Support programme was related to that aspect.

The Board also agreed to the creation of two more awards, in addition to the von Kármán Medal: a Scientific Achievement Award and a Staff Award.

During Spanish National Day, presentations were made by Mr Quinteiro of the Ministry of Defence on Aerospace Research and Development in Spain, Mr P. Perez del Notario of INTA (National Institute of Aerospace Technology), Mr J.Alvarez

Vara of CASA on R&D in the Spanish Aerospace Industry, and Mr J. A. Perez-Nievas on the Spanish Electronics Industry and National Defence. The presentations were followed by visits to INTA, CASA and INISEL.

March 1989 Meeting, Paris

IGA M.Benichou, Director responsible for Armament Programmes of the General Directorate for Armament (DGA) of the French Ministry of Defence presented the Address.

The matter of Poster Sessions was discussed again. The Chairman concluded in summary that the Panels should experiment with poster sessions using the recommendations made as guidelines, and that they should review the technical merits of the papers presented. It was still an experiment within AGARD, and the Panels should report to the Board on their experiences and make recommendations for the future.

The Director presented an issue paper on possible limitations on the distribution of AGARD unclassified material. For a long time it had been AGARD policy not to distribute AGARD publications outside NATO countries but he noted that unclassified ones could be purchased from Sales Agencies in US, UK and France.[16]

He said that if we did not want AGARD publications to go outside NATO countries they should be marked at least NATO Unclassified, with a clear statement limiting distribution to NATO, the governments of NATO nations, and their contractors. The Board agreed with this proposal. The Board also asked Panels to take every care to ensure that publications were correctly classified, if necessary at a higher level than any of the material included.

In the closed session, the Board discussed proposals for the improvement of the Support Programme and agreed the following actions:

- Stimulate participation of LDDI nations (see previous meeting) in Panel activities.
- Periodically select projects concerning development of an industrial R&D base and solicit funding from the Science for Stability Programme.
- Through the IMS, coordinate the AGARD Support Programme with NATO LDDI initiatives (MAREQS, Science for Stability, CNAD proposals, etc.)
- Organise a Travelling Seminar with a series of lectures on aeronautical Research and Development structures, long-term planning and organisation, for government officials and managers in aeronautics and related areas in Greece, Portugal and Turkey.

Twenty-fifth AGARD Annual Meeting, Ankara, September 1989

Special guests were His Excellency Safa Giray, the Turkish Minister of National Defence, Gen. Tastan, Deputy Commander of the Turkish Air Force, Lt. Gen. Çelikay, Under Secretary of National Defence and Maj. Gen. Canova, Deputy Under Secretary for Economic and Technical Affairs, National Defence.

16 It was known that many unclassified AGARD publications found their way to interested parties outside NATO. Indeed, there were no restrictions on the sale by the three Sales Agencies of AGARD publications that were not classified or marked NATO Unclassified.

The Chairman thanked Col. D. Kaya, the Turkish National Delegate, for his dedicated work for AGARD over the previous sixteen years and for all his efforts in assisting the AGARD Staff.

In response to a request made at the previous meeting, by Ministerialdirektor Dipl-Ing. P.Runge, National Delegate of the Federal Republic of Germany, the Director presented proposals for AGARD to assist in alleviating the problems of noise due to low-level high speed flying training in FRG. The AASC was proposing a workshop primarily oriented towards the role of simulation to be held in October 1989, and the PEP and the FDP Panels proposed to establish relevant Working Groups in March 1990. After an intensive discussion the Chairman concluded that the Board agreed with these proposals and asked the Director to ensure that the comments and recommendations were acted upon. He added that the NDB wished to have a status report on this subject at the following meeting.

The Director reported that the quality of the Support Programme was being improved further, especially because of the increased interest of the Panels. Many new contacts had been established through the Programme and he thought it would be interesting some day to make an inventory of the effect of the Programme. The Travelling Seminar on Aeronautical Research and Development would be held in Ankara, Athens and Lisbon in April the following year.

During National Day, an overview of Turkish aviation activities was presented by Prof. C.Çiray of Middle East Technical University (METU) and a member of FDP, and Col. D.Kaya, Director of the R&D Department of the Ministry of National Defence and a National Delegate. This was followed by visits to the Turkish Aerospace Industries (TAI), the military electronics industry ASELSAN and METU.

In the closed session, Maj. Gen. Melo Correia gave a briefing on the NATO Conventional Armaments Planning System (CAPS).

A discussion paper on The Challenges of the 1990s was presented by the Director. He noted that the review which was carried out in 1981-1982 had not considered it necessary to change the AGARD charter and organisation. AGARD was a unique transatlantic forum for the aerospace community, including civil aviation technology. There would be many more opportunities in the future for transatlantic cooperation. Greater cooperation in the early phases of research and development of defence systems and sub-systems would be desirable in view of the expected pressure on defence budgets.

After the discussion, the Chairman proposed that each nation submit the name of a person to participate in an informal Group to think about the future of AGARD during the next ten years, including considerations of those external developments over which AGARD had no control. This Group, which later became known as the Senior Advisors Group, would report a year later.

March 1990 Meeting, Toulouse

Because the normal meeting site in Paris was not available, the French National Delegates had decided to hold this meeting in Toulouse, rather than Paris. This gave them the opportunity to hold a 'National Day', as the other host nations did, in which they could present some of their aerospace capabilities in the Toulouse region.

The Chairman thanked IGA M.Lamy, the new French National Delegate, for this initiative and introduced IGA J.Ferrandon, the Director of the École Nationale Supérieure de l'Aéronautique et de l'Espace, ENSTA, who gave a Welcome Address.

The Board decided that the Director should continue to monitor funds for Consultants to other NATO Bodies, but no longer needed to report on them to the NDB. The annual amount should not exceed FF.150,000 but any funds not used under this item could be transferred to the remainder of the Consultant Programme.

During the French National Day the participants paid visits to either Aérospatiale and CEAT, or CNES and ONERA-CFM (Centre le Faugat-Mauzac of ONERA).

During the Executive Session, Prof. G. Madelung, Chairman of the Senior Advisors Group, reported. Since the previous meeting, there had been many new developments. Earlier, new developments such as "Europe 1992", and the "Vienna Disarmament Talks" had been in the foreground. Now with the fall of the Berlin Wall, the borders to the East were opening up and the continuation of the Warsaw Pact was doubtful. The possible effects on the operation of NATO and AGARD were being discussed. The Board agreed that the Group, which consisted of Prof. Madelung (Chairman), Brig. Gen. Argyros, Mr. Armstrong, IGA El Gammal, Dr. Flax, Prof. Gerlach, Dr. Marsters, the Chairman and the Director, should continue studying the developments and report to the NDB.

Twenty-sixth AGARD Annual Meeting, Elsinore, Denmark, September 1990

Vice Adm. H.Garde, the Danish Chief of Defence Staff, gave the welcoming address, and Lt. Gen. C.P.Otsott, the Deputy Chairman of the NATO Military Committee gave the Fall address.

A paper had been prepared by AGARD HQ with numerical information on the various AGARD activities, with estimates of the direct cost to the participating nations. The 'core' of AGARD consisted of about 600 people (NDB Members, National Coordinators, Panel members (about 500), the AASC, and AGARD HQ staff). A total of 1,300 people contributed annually as lecturers, working group members, consultants, study team members, etc. Their work resulted annually in 60-80 publications with 700-800 individual papers; and each year some 3000-4000 people attended symposia, specialist meetings, lecture series, and courses, or took part in consultant missions. The time spent and the cost involved were estimated as effectively 300 man-years at a cost of US $ 50 million, including travel, per diem, cost of organizing meetings, etc. The AGARD budget was about 10 % of this, including the cost of publications, consultants fees and the support programme.

The Board noted that, although this information on the 'collective' effort did not provide a direct answer to the question: 'What is the value of AGARD to the nations?', it was an important part of the answer. In some nations, attempts had been made to answer that question and to determine the 'multiplier effect' of attending meetings and distributing documents and although some very positive effects had been reported, no overall conclusive information was available.

In connection with the recently held Travelling Seminar on Aeronautical Research and Development, the National Delegates of Greece, Portugal and Turkey reported

on the positive effects of the Support Programme.

During National Day, the participants visited either Alcatel-Kirin, Nea-Lindberg Ltd and Disa Systems Group, Elekronikcentralen or the Danish Technical University.

During the Executive Session, the Senior AGARD Advisors reported on their activities. The Group had been briefed at NATO Headquarters on 'Political Implications of a changing Europe', on 'The NATO Strategy Review', on 'Arms Control and its impact on Military Requirements' and on 'the Changing Risk to NATO Security'. The Group concluded that consideration must be given to new contacts with NATO. Various options for AGARD were discussed without identifying a clear preference. Among them were closer links with other NATO bodies such as DRG, SHAPE Technical Centre, and SACLANT Centre.

After a discussion the Chairman asked the Group to continue its deliberations and propose a direction for AGARD to respond to the new NATO as it was emerging after the London Declaration of July 1990[17]. With respect to the question of inviting specialists from the former Warsaw Pact countries to attend AGARD meetings, it was concluded that AGARD had to wait for further steps by the Military Committee and the Council.

During this session the Board elected Mr J.B.Scott-Wilson (UK) as the AGARD Chairman and selected Dr A.J.Wennerstrom (US) as the next AGARD Director.

April 1991 Meeting, Paris

In the report of the Steering Committee, it was mentioned that Maj. Gen. E.Brandes, Deputy Assistant Chief of Staff, Operation Division, SHAPE had given a report listing the needs for improving technology in support of the SHAPE mission and which could be incorporated in the Panel Programmes. Maj. Gen. E.Stai gave a status report to the Board from the NATO Military Committee. He presented a first indication of the requirements of the Emerging Future Force Structure in peacetime, crisis and war, and the possible implications for the AGARD and DRG technical programmes.

The Board decided to limit the number of Working Groups of the Panels to 24 at any one time so as to maintain a constant level of effort by the nations.

During the report of the AGARD Technical Advisory Committee on the von Kármán Institute (established in 1983) it was noted that only nine countries were represented on this Committee. The other countries were encouraged to participate in its work, which was highly valued by the Board and the Director of VKI and by the NATO Council's Ad Hoc Committee on financing VKI.

In the Executive Session Professor Madelung reported on the conclusions of the Senior Advisors of AGARD and the role AGARD could play in the new, changing, political and military environment. The report would be finalized in the next few months.

17 The NATO 'London Declaration on a transformed North Atlantic Alliance' was issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in London on 5-6 July 1990. It stated inter alia: "... The Atlantic Community must reach out to the countries of the East which were our adversaries in the Cold War, and extend to them the hand of friendship ..."

Twenty-seventh AGARD Annual Meeting, Lisbon, September 1991

Gen. Mendes Dias, the Deputy Chief of the Portuguese Armed Force General Staff gave the Welcoming Address.

Maj. Gen. Stai gave a further report on developments in the NATO Military Committee and on the lessons learned in the Gulf War. It was agreed that the AGARD Steering Committee would study the lessons learned and report at the Spring Meeting so that the Panels and AASC could focus better on the military requirements.

Gen. V.Eide, Chairman of the Military Committee, gave the Fall Address. Because the West was moving from confrontation to cooperation, the question was raised as to what extent AGARD was to seek cooperation with its former adversaries of the Warsaw Pact. This subject was addressed in the Executive Session, in which it was decided to submit a proposal to the Military Committee for a visit of members of AGARD to Hungary, Czechoslovakia and Poland. This visit would cover methodology, rather than imparting technical information, and should take place, if possible, prior to the 1992 Spring Meeting, when the subject would be discussed further. The Board Members would be informed in advance of the details of this visit.

In order to reduce printing costs. the board decided that Conference pre-prints and stand-alone Technical Evaluation Reports (TERs) would be eliminated. TERs would, however, continue to be printed as part of the Conference Proceedings, as many had been in the past.

The US National Delegate was asked to consider how AGARD's position in the US could be strengthened, for example through closer cooperation with the AIAA, advertising AGARD activities in AIAA publications, etc.

Dr K.Gardner, Head of the Defence Research Section at NATO, described the plans for the 25th Anniversary of the DRG to be held on 3 March at NATO-HQ and invited AGARD to participate.

The Portuguese National Day was opened by a Session at the Gulbenkian Foundation. Presentations were given on the following subjects: National Institute of Industrial Research and Technology (JNICT), by Prof. Costa Salema; the Technical University of Lisbon (UTL), by Prof. G. Durão; the National Laboratory for Engineering and Industrial Technology (LNETI), by Prof. Veiga Simão; the Portuguese Association for Industry (API), by Eng.Rocha de Matos. The participants then were invited to visit LNETI and EID (Empresa de Investigado e Desenvolvimento de Electronica) or UTL and OGEMA.

April 1992 Meeting, Paris

During this meeting the Board devoted more time than usual to an in-depth discussion with the Panel Chairmen on the Technical Programme of AGARD. This was perhaps due to the fact that all Delegates were fully aware of the changing times and that budget reductions – at NATO and nationally – were on the horizon. It was therefore mandatory to be sure that the most urgently needed programmes would be carried out in an orderly fashion. This also applied to the Lecture Series and the Consultants and Exchange Programme. Priorities were set for the Director in

handling the budget deliberations. To alleviate the budget, the Director was also asked to prepare a proposal for charging fees for attending Lecture Series.

It was decided that the number of active Working Groups would be further limited to 21, and that when counting the number existing, a Working Group should be considered active until its report was delivered to AGARD ready for publication.

In the report on the von Kármán Institute it was noted that three high-speed work stations had been obtained with a grant from the US Air Force, giving VKI 'state-of-the-art' capabilities for flow field data analysis. ONERA had donated a small cryogenic wind tunnel (T'2) to VKI. This was a very timely addition to the facilities of the Institute; with the cryogenic National Transonic Facility, NTF, already in operation in the US and the European Transonic Windtunnel, ETW, shortly becoming available for industrial testing, practical training could be given at VKI in the near future.

During the Executive Session, Dr K.Gardner gave an overview of the DRG operations and noted the differences to and similarities with AGARD. The Chairman gave a review of the contacts with Eastern European countries.

A Strategic Planning Committee composed of NDB members had been established. Its main topic concerned the effects of the changing role of NATO from a threat-oriented organisation to a risk- and crisis- management organisation. AGARD should anticipate the changing needs of NATO and the military in particular.

Twenty-eighth AGARD Annual Meeting, The Hague, September 1992

The Opening Address was given by the State Secretary for Defence of the Netherlands, Baron B-J.M. Van Voorst Tot Voorst. The Chairman also welcomed the Commander-in-Chief of the Royal Netherlands Air Force, Lt. Gen. Manderfield.

After a review of the programme it was noted that the budget increase for the coming year was expected to be minimal and unlikely to be sufficient to cover the cost increases due to inflation. The Director had made the necessary adjustments in the publications and Lecture Series, as agreed previously by the Board.

The Steering Committee had asked the AASC in April 1992 to review the four major NATO Strategic Planning Documents and report the effects on AGARD long term plans. This had been done rapidly and a report was given about the most vital elements for the future. The Board tasked the Steering Committee to review all activities proposed in connection with the Outreach Programme.[18]

The Panel Chairmen were asked to consider what lessons had been learned from the Gulf War and report back to The Steering Committee. Their assessments would be available for the next Spring Meeting.

The Strategic Planning Committee, consisting of members of the NDB, had

18 The Outreach Programme was a result of the London Declaration (see previous footnote). The AGARD Director, with the consent of the Chairman, took it literally and in the summer of 1990 immediately went to Chairman of the Military Committee to propose contributions that AGARD could make to 'extend to them the hand of friendship'. The Chairman of the Military Committee thought this was a good idea, but the NATO Council wanted first to establish contacts via the Embassies and prepare rules as to how to proceed. Thus, although AGARD was prepared to start to act immediately, there was some delay.

proposed a re-structuring of the Panels. At present there were nine Panels and the Committee suggested that this should be reduced to six Panels and one Information Service. The arguments for this proposal were, inter alia, an apparent overlap and the need to make a distinction between technology-oriented and systems-oriented activities in order to better meet the demands in the future. After an extensive discussion it was decided to inform the Panels and ask for their response.

During the National Day, presentations were given on the following subjects: Organization of Aerospace Development in the Netherlands, by Drs. G.M.V. van Aardenne, Chairman of the Board of the Netherlands Agency for Aerospace Programmes, NIVR; The Dutch Aerospace Industry, by Dr R.J. van Duinen, Vice chairman of the Board of Management of the Fokker Aircraft Company; Aerospace Research and Development in the Netherlands, by Dr.ir. B.M. Spee General Director of the National Aerospace Laboratory, NLR; and Aerospace Engineering Education in the Netherlands, by Prof.dr.ir. J.L. van Ingen, Dean of the Faculty of Aerospace Technology, Technical University Deft.

The Participants were then invited to visit either: Fokker, The Technical University, The Physics and Electronics Laboratory, or the National Aerospace Laboratory.

March 1993 Meeting, Bordeaux

Once again, the French National Delegates chose to host a Spring meeting outside Paris.

After the normal consideration of recent past and future activities, the discussions concentrated on the Outreach Programme. The Chairman reported that Phase 1, making contacts with Embassies in Brussels, had been completed and that Phase 2, visits by himself and the Director to the nations, had started, six defence research institutes having been visited in Russia, the Czech Republic, the Slovak Republic and the Ukraine.

The Board authorised the Director to start Phase 3 by soliciting contributions for a joint Symposium on Flight Safety, co-sponsored by AGARD and the Russians, in August/September in Moscow, and proceeding with the organisation of a Lecture Series with Russian authors on 'Research and Development of Ramjets, Turbojets and Scramjets in Russia' to be held in 1993 in two locations in Europe and one in North America. He was also authorised to make preparations for further Russian-authored Lecture Series on 'Modern Mathematical Models for Prediction and Design of Gas Turbine Engines and Components', and on 'Manufacturing Technology'. It was also announced that The Netherlands had assigned an Air Force officer to AGARD as an Executive to coordinate the implementation of the Outreach Programme.

The Chairman then reported on the Steering Committee meeting. The Panels had presented the implications of the lessons learned from the Gulf War on their future activities. The conclusion was that they had well analysed the implications and had incorporated them in their future programmes. The Panels were invited to review their Terms of Reference and Topic Lists accordingly.

In the closed session, the subject of AGARD re-structuring and the adjustment of the programmes was discussed, and the NDB asked for:[19]

- a review of the AGARD membership as related to 'customers' (National MODs, Agencies, Industry, Academia and NATO military Bodies).
- an AGARD/DRG review of the 1993 and 1994 Programmes;
- a study on the organisation of NIAG[20] and co-ordination between NIAG and AGARD, and an annual review of the programmes of AGARD and DRG;
- a revision of the Topics List of the Terms of Reference of all Panels;
- the views of the Nations concerned on the effectiveness and benefits of the Support Programme;
- a review of the Consultant and Exchange Programme, particularly the distribution of the resources and the beneficiaries.

During National Day, the participants were invited to visit Aérospatiale and the Société Européenne de Propulsion or Dassault and Sogerma-Socéa (Aérospatiale's specialised maintenance centre)

Twenty-ninth AGARD Annual Meeting, Rome, September 1993

This was the 75th National Delegates Board Meeting. The Welcoming Address was given by Col. Greco, Deputy Base Commander of the Pratica Di Mare Air Force Base.

The Chairman announced that Prof. Haus, the Honorary Dean of AGARD, had recently died, and the meeting stood for one minute's silence.

It was reported that at the Aircraft Flight Safety Symposium at Moscow there had been more than 270 participants from Russia and 65 from the Western countries.

The Board decided that the Avionics Panel, the Electromagnetic Wave Propagation Panel, the Flight Mechanics Panel, and the Guidance and Control Panel, would be merged into three new Panels, which were given the provisional names: Aerospace Vehicle Systems; Integrated Operational Systems; and Aerospace Sensors Technology. Definitive names were chosen at the next meeting.

The Board also decided that the Technical Information Panel, TIP, would become a Committee in support of the AGARD Programme. It was decided to discontinue charging for attendance at Lecture Series and Special Courses, since the Military Budget Committee had decided that the benefits would not accrue directly to AGARD and there had been a considerable reduction in attendence.

The Board elected Dr M.I.Yarymovych of the USA as the next Chairman and selected Mr.J.H.Wild of Germany for the position of Director.

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19 Obviously the NDB did not want to introduce drastic changes which would be detrimental to the AGARD activities. To some NDB members, who had been associated with AGARD/NATO for a long period of time, the answers were obvious. But they also realised that in the changing NATO environment and task (which had yet to become fully defined) a full review of AGARD's activities and their relationships with the activities of other NATO bodies was in order. As an example, the 'AGARD Support to Greece, Turkey and Portugal Programme', instituted at the request of the Military Committee, was 25 % of the AGARD Technical Programme, and a review of the effectiveness for AGARD was desirable even though the positive effects of this programme were obvious to many of the 'old-timers'.

20 NIAG = NATO Industrial Advisory Group

April 1994 Meeting, Paris

The discussions at this meeting concentrated on the detailed plans for the restructuring of the Panels as agreed during the previous meeting. The names of the new Panels were now agreed as:

- Flight Vehicle Integration Panel (FVP);
- Mission Systems Panel(MSP);
- Sensors and Propagation Panel(SPP).

The recommendations made by the Steering Committee for the 1994 Outreach Programme were reviewed and approved, and this Programme was given the more appropriate name 'Technology Cooperation Programme'.

The Chairman reported that a consensus appeared to exist among the nations that there was a need for a single focus for NATO defence science and technology. This might include a fusion of AGARD and the DRG. Although the NDB members were aware of the plans, they were still not sure what would be the relations in such a situation between the government offices concerned with aerospace technology, the research and development agencies (largely sponsored by governments but often operating as separate agencies), the universities and the industry. Would the interchange of ideas between those groups, as initiated by von Kármán, be maintained? The essence of the discussion was perhaps that a sufficient degree of 'bottom-up' initiatives should be maintained. It was agreed that the AGARD NDB and the DRG would hold a joint meeting in September 1994 to discuss this important issue and develop a strategy.

Thirtieth AGARD Annual Meeting, London, September 1994

The Chairman reported with regret the death of Dr T.Benecke, the first German National delegate to AGARD (1955-1977) and Chairman of AGARD, 1970-1973.

The welcome and keynote address were given by Mr P.D.Ewens, Deputy Chief Scientific Advisor, UK Ministry of Defence. Mr M. Earwicker, UK National Delegate, gave a talk entitled, 'Technology Foresight', and Mr P.C. Ruffles, Director of Engineering at Rolls-Royce, gave one on 'The UK Industry Perspective on Aerospace R&D'.

The Chairman of the AASC reported on the results of the Workshop on the ways to improve AGARD understanding of military technology needs, on how to improve its Technical Programme and how to promote better communication/feedback between military sponsors and the AGARD technical community. The Board then reviewed and discussed documents on 'A strategy for the Future Conduct of NATO Defence Research and Technology Development' and 'The Integration of AGARD and DRG Technology Activities'. The conclusions were:

- During the subsequent phase, any proposed restructuring should only be considered if there was objective evidence that the restructuring would bring global savings to the budget of the organisation.
- Work should continue within the context of the documents but it needed to be decided what course of action should actually be pursued during the experimental phase.

The Board noted that the restructuring of the Panels had been approved by the

Military Committee.

The 1995 technical programme was approved and it was decided that, in the future, the silence procedure would be used by the NDB in the approval process in order to save time during meetings. However, all exceptions and problems would still be brought to the attention of the Board.

First Joint AGARD/DRG meeting, London, September 1994

The First Joint DRG/AGARD Meeting took place the day after the Board Meeting, on Friday, 16 September 1994. It was chaired jointly by Dr M.I. Yarymovych, Chairman of AGARD, and Drs. E.A.Van Hoek, Chairman of DRG. The Chairmen pointed out that this was a crucial moment in NATO's R&D History and said that this new joint management process must be considered as the first step which would hopefully lead to greater efficiency.

Col. P.L.Brandenburg (AGARD) and Dr K.Gardner (DRG) gave overviews of the AGARD and DRG organisations, procedures and programmes, each discussing the differences and similarities, and their relations with other NATO bodies. Dr C.C.Sanger, UK National Delegate, described a possible process leading towards the integration of the two organisations. The joint Boards agreed to continue the process of merging AGARD and DRG into one R&T single focus organisation while ensuring that the necessary networks of experts would be maintained.

March 1995 Meeting, Brussels

In opening this meeting, the Chairman announced that Mrs. Glenn Wattendorf had died early in 1995. She had been the widow of Dr Frank Wattendorf, one of the Founding Fathers of AGARD who had been Director of AGARD during the first 11 years, after which he had become successively Acting Chairman, Vice Chairman, and finally Honorary Vice-Chairman from 1967 until his death in 1986.

The Chairman stated that the NATO Council had accepted in principle the plans for forming a single focus R & T organisation, but wanted it to move at a faster pace than proposed, and had requested a detailed plan by Spring 1996.

The NDB approved a proposed project on 'Aerospace 2020 Technology', in which all the AGARD Panels and the AASC would participate in one interdisciplinary study. Mr N.Holme, Norwegian National Delegate, was chosen as the Study Director.

An NDB Technology Cooperation Programme sub-committee was formed to report to the NDB on the results of this programme element.

A presentation was given by Dr Walter Kroy, Chief of Innovation Processes at Daimler Benz, on 'The Business of the Future', in which he demonstrated the radical nature of current technology changes and how managers, scientists and engineers must adapt their thinking to cope with it.

Second Joint AGARD/DRG meeting, Brussels. March, 1995

During this session, again co-chaired by the Chairmen of AGARD and DRG, the first phase of forming a central focus of NATO R & T bodies was initiated, as

approved by the NATO Council (December 1994). Present were, besides AGARD and DRG national board members, senior representatives from STC, SACLANTCEN, NIAG, IS, IMS, and the NATO Military Commands. Their opinions and inputs were considered essential.

Field Marshall Sir Richard Vincent, Chairman of the Military Committee, gave the welcoming address. Presentations were given on:

- Status of the R&T review;
- Technology Co-ordination Report;
- Status of a Single Focus Environment;
- a Saclant Perspective;
- a SHAPE Perspective;
- the Role of the Scientific Advisor;
- DRG Maritime Operations 2015 Study Overview;
- AGARD forecasts; Aerospace 2020.

Various recommendations were made as to how to proceed. It was clear that the integration of AGARD and DRG was on its way.

Thirty-first AGARD Annual Meeting – Irvine, Ca., USA, September 1995

The Chairman reported on the 3rd joint AGARD/DRG Meeting (described below), which had taken place just prior to this meeting, and described the possible course for the future. There were differences between AGARD and DRG with respect to: customers and beneficiaries, subject matter, scope, membership, and methods and sources of funding. There were now joint board sessions but this made an extremely large group. It would be necessary to form one joint board for the new organisation with up to three members per nation. They would be appointed in accordance with the policies and the R & T structure in the nations. The on-going programmes would be continued initially, but later one coordinated programme would emerge. Finally the new R & T organisation would serve both the military and civilian sides of NATO.

Mr N.Holme, National Delegate of Norway and Director of the 2020 Study, gave a progress report; he was asked to prepare his plans in such a way that presentations could be made to the military staffs in the nations and written material would be made available to the national participants for use nationally. It was agreed that the culmination of this activity would be in Spring 1997 in Paris, on the occasion of the 45th Anniversary of AGARD, and that it would include a single multi-disciplinary, all-Panel, symposium at which future technologies would be presented.

As requested earlier, representatives of Greece, Portugal and Turkey presented reports on the effect of the 'Support Programme'. They all stated that this programme, started in 1980 at the request of the NATO Council through the Military Committee, had been very effective in building up their national aerospace R & D capabilities. The Board agreed that although it was logical to have asked the nations of the 'Support to Nations' programme about the effects of this programme, it would be only natural to ask every nation hosting a Fall Board Meeting to prepare a presentation on the benefits they obtained from their participation in AGARD, including the less tangible effects.

On the US National Day, the Opening Address was given by Dr Sheila E. Widnall,

Secretary of the USAF. Technical presentations were given on: the preliminary results from the USAF's 'New World Vistas' study – a technological look at the future for the US Air Force – by Dr Gene H. McCall, Chairman of the USAF Scientific Advisory Board and Director of the study; 'NASA and the Future' by Gen. John R. Daily, Deputy Administrator of NASA; and 'The Impact of Electronics on Weapons Systems' by Mr Kent M. Black, Executive Vice-President and Chief Operating Officer, Rockwell International. Technical visits were arranged to McDonnell Douglas (C-17 Program) and to the Hughes Space and Communications Company.

Third Joint AGARD/DRG meeting – Irvine, Calif., USA, September 1995

The meeting, co-chaired by Drs. Van Hoek and Dr Yarymovych, began with a progress report on the execution of the Council Decision on the NATO R & T Strategy. The Council had asked that the process to arrive at a single focus organisation be accelerated. A proposal was put forward to commission an independent High-Level Review Board to provide advice to the CNAD and the Military Committee on future NATO R&T management structures and procedures.

A final draft report, based on the presentation by Maj. Gen. G.B.Ferrari, of the IMS, to the NATO Council, would be circulated prior to the March 1996 Joint Session for review and comments by the participants. It was noted that the direct savings to the NATO organisation resulting from the restructuring of NATO's Research & Technology, would be small since most of the resources were made available by the nations on a voluntary basis.

March 1996 Meeting, Paris

The Eightieth National Delegates Board Meeting was convened under the Chairmanship of Dr Yarymovych. The Steering Committee had discussed the draft report to the NATO Council on the formation of the new R & T Organisation. Teams were actively preparing the transition of the two organisations into the new organisation, including the transition of the ongoing programmes. This meant, inter alia, that only six new working Groups could be approved at that time.

The last but one Aerospace Application Study, proposed under AGARD by the Steering Committee, AAS-44 study, 'Improving Battle Damage Assessment to Support NATO Operations' was approved.

A Nominating Committee would be proposed for the election of the Chairman and the selection of the Director of the new organisation.

Fourth Joint AGARD/DRG meeting, Paris, March, 1996

During this Session, co-chaired by Drs. Van Hoek and Dr Yarymovych, the participants reviewed, discussed, and edited the Draft Report to Council, incorporating National, SACLANT, SHAPE and STC comments. It would be submitted to the CNAD and the Military Committee, for their approval, before being forwarded to the NATO Council.

It was noted that a support mechanism for Greece, Portugal and Turkey had not been included in the report, since this was a policy matter, subject to annual review and approval by the Board, and it was expected that the Nations concerned would raise the

matter at the first Board meeting of the new organisation.

A further progress report on the Aerospace 2020 Study was given by Mr N.Holme. Other presentations were given on: the outcome of the USAF's 'New World Vistas' Study which had now been completed, again by Dr McCall; NATO's 'Maritime Operations 2015' Study, by Dr Paul Hazell from DERA (UK); and 'Combat Identification' by Brian Hughes of the NATO Identification System Coordination Office.

Thirty-second Annual Meeting, Ottobrunn, near Munich, September 1996

Maj. Gen. G.B.Ferrari, Ass. Dir., International Military Staff, IMS, informed the Board that the proposals for the new organisation had been endorsed by the Military Committee and the Conference of National Armament Directors and that the NATO Council had given their approval on 29 July. The Council wanted to keep the prerogative to give guidance on major issues such as the finalisation of the Charter, strategic issues, senior personnel appointments and finances. The Board regarded that positively since it showed that the Council would play a 'guardian role'.

The outline of the Charter of the new organisation was discussed. The Chairman pointed out that the major elements of the AGARD charter would be retained but with a wider range. He also described the problems of merging the technical activities of AGARD and DRG. The Charter was expected to be approved before the end of the year, but the actual 'merging' process would take somewhat longer, particularly since there were several on-going programmes which needed to be completed.

The Director presented the plan for the AGARD Conference on 'Future Aerospace Technology in the Service of the Alliance' to be given during the week of 14-17 April 1997 at the École Polytechnique, Palaiseau, near Paris, and the AGARD Panel Chairmen presented a summary of their Panel's accomplishments over the last 44 years (later published as an addendum to 'AGARD Highlights' 97/1).

It was noted that since the beginning of AGARD activities until the present day, approximately 600,000 scientists, engineers, members of the military and other interested parties in the aerospace field had been 'touched' by AGARD. The strongest part of the AGARD network was that many of these 600,000 AGARD people were still active and formed part of the whole web.

During German National Day the following presentations were given: 'The German Aerospace Industry', by Dr N.Lammert, State Secretary for Coordination of Aerospace Affairs, Federal Government; 'Daimler-Benz Aerospace', by Dr D.Russell, President of the Aircraft Group; 'Aerospace Research and Technology in Germany', by Prof.Dr W.Kröll, Chairman of the Board of DLR; and 'DASA Military Aircraft Division', by Dipl.-Ing. A.Rauen, Senior Vice-President, Military Aircraft Division of Daimler-Benz Aerospace. A visit was arranged to DASA's Flight Test Center at Manching, followed by the aircraft display area of the Deutsches Museum.

First National Delegates R & T Board Meeting – Brussels, November, 1996

The first National Delegates Board Meeting of the Research and Technology Organization, RTO, was convened at NATO Headquarters on 21 November 1996.

Dr Javier Solana, Secretary General of NATO (at right), who attended AGARD's last meeting, at the Ecole Polytechnique, near Paris, welcomed by Dr Yarymovych, last Chairman of AGARD and first Chairman of RTO

Ambassador S.Balanzino, Deputy Secretary General of NATO, formally established the Research and Technology Organisation and disbanded the Defence Research Group. (AGARD would be formally disbanded by the Secretary General of NATO at the end of the Spring meeting in 1997).

Ambassador Balzino stated that a new area in NATO research and technology was now beginning, built on the solid foundation of AGARD and DRG. He emphasised that the impressive network of experts built up by both DRG and AGARD should not be disrupted and he encouraged the nations to continue to provide the vital support required. He also said that ways should be sought to reduce costs and enhance efficiency. Moreover, close cooperation with other NATO bodies, such as the NATO C3 Agency and SACLANTCEN, should be maintained and the needs of the 'customers' should play an important role. Flexibility to be able to react quickly in times of crisis was essential.

Opening remarks were made by Mr N.W.Ray, Permanent Chairman of the CNAD and the Assistant Secretary General for Defence Support, and Lt. Gen. G.J.Folmer, Director of the IMS.

The Board elected Dr M.I.Yarymovych (US) as the first Chairman of the R&T Board and selected Drs. E.A. van Hoek (NE) for the post of Director of R&T Agency. The Assistant Director, Logistics, Armaments and Resources Division of the International Military Staff, and the Deputy Assistant Secretary General for Defence Support, had been nominated as Co-Vice-Chairmen of the R&T Board by the two parent bodies (the Military Committee and the Conference of National Armaments Directors – CNAD). Maj. Gen. G.B.Ferrari and Mr J.Velon were the current holders of those posts, respectively.

Forty-fifth Anniversary Meeting of AGARD, 14-17 April 1997

This meeting was held at the École Polytechnique, Palaiseau, near Paris. A welcome address was given by Gen. J-P. Douin, Chief of Staff of the French Armed Forces. Gen. K.Naumann, Chairman of the Military Committee, responded. He also thanked the French authorities for their hospitality to AGARD during the 45 years of its existence.[21] The Board Meeting was preceded by a Multi-Panel symposium, with over 1000 participants, which covered three topics in the form of three simultaneous

21 During this period of 45 years there had been many changes, including two re-locations of the AGARD Headquarters. The French authorities and particularly the French Air Force, had been very supportive. This support included, inter alia, assistance for quarters, local security, meeting room arrangements and the associated security measures, logistics support, the provision of drivers/general support, etc. France was to AGARD an ideal host.

inter-disciplinary symposia. It is described in more detail at the end of Chapter 6.

The Aerospace 2020 Study had triggered this Multi-Panel approach in which all the Panels, the AASC and TIC had participated, and the symposium ended appropriately with a presentation of the Study, by Mr N.Holme, Study Director.

Dr.J.Solana, Secretary General of NATO, attended the last session, at which many former Chairmen and Directors were presented to the audience and thanked for their many contributions over the years. He then expressed his appreciation to Dr Theodore von Kármán for having had the imagination to create AGARD 45 years earlier and having assisted in creating DRG some years later.

A coffee break during the final meeting

The last words of his speech were:

'Ladies and Gentlemen, it is with great appreciation that I hereby formally disband the AGARD National Delegates Board, noting that its responsibilities have been assumed by the NATO Research and Technology Board.'

The names of the members of the National Delegates Board are listed in Annex 1.

The names of the Honorary Vice-Chairmen, Honorary Dean, the Chairmen and the Directors are listed below.

Honorary Vice-Chairmen:	Dr F.L. WATTENDORF	1968-1986
	Dr A.H. FLAX	1987-1997
Honorary Dean:	Prof. F.C. HAUS	1984-1993

Chairmen of the National Delegates Board 1952-1997

Dr THEODORE VON KARMAN, US	Jan 1952-May 1963*
PROF. COURTLAND D. PERKINS, US	Sept 1963-March 1967
DIRECTOR FINN LIED, NO	March 1967-March 1970
Dr THEODORE BENECKE, GE	March 1970-March 1973
Dr ALEXANDER H.FLAX, US	March 1973-March 1976
Mr FRANK R.THURSTON, CA	March 1976-March 1979
Dr ALAN M.LOVELACE, US	March 1979-March 1982
PROF. OTTO H.GERLACH, NE	March 1982-March 1985
PROF. GERO MADELUNG, GE	March 1985-March 1988
R.ADM(retd) ROBERT K. GEIGER, US	March 1988-March 1991

PROF. JOHN B.SCOTT-WILSON, UK	March 1991-March 1994
Dr MICHAEL I. YARYMOVYCH, US	March 1994-March 1997

*DR FRANK L.WATTENDORF acted as Chairman from May to September 1963. He then became Vice-Chairman, and Honorary Vice-Chairman in 1968.

Directors of AGARD 1952-1997

Dr FRANK L.WATTENDORF, US	Feb 1952-Sept 1963*
Dr WILLIAM P.JONES, UK	July 1964-July 1967
Mr FRANKLIN J.ROSS, US	July 1967-July 1970
Dr MICHAEL I.YARYMOVYCH, US	July 1970-July 1973
Mr OLAV E.BLICHNER, NO	July 1973-July 1976
Dr ROBERT H.KORKEGI, US	July 1976-July 1979
Mr JACK BURNHAM, UK	July 1979-July 1981
R.ADM(retd) ROBERT K.GEIGER, US	July 1982-July 1985
Dr IRVING C.STATLER, US	July 1985-June 1988
PROF. JAN A.VAN DER BLIEK, NE	July 1988-June 1991
Dr ARTHUR J.WENNERSTROM, US	July 1991-June 1994
Mr JÜRGEN H.WILD, GE	July 1994-June 1997

*COLONEL GEORGE MUNROE, US, acted as Director from September 1963 to June 1964.

A large part of AGARD's history is represented by these former Chairmen, Directors and other notables who took part in the final meeting. They are, from left to right: Mr Jack Burnham (Director, 1979-82), Dr Arthur Wennerstrom (Director, 1991-94), Prof. John Scott-Wilson (Chairman, 1991-94), Prof. Gero Madelung (Chairman, 1985-88), Gen. Maj. Edgard Evrard (appointed as a National Delegate in 1967 and still serving 30 years later), Dr Michael Yarymovych (Director, 1970-73 and Chairman, 1994-97), Dr Robert Korkegi (Director, 1976-79), Mr Olav Blichner (Director, 1973-76), Dr Al Flax (Chairman, 1973-76 and Honorary Vice-President), Mr Frank Ross (Director, 1967-70), Admiral Robert Geiger (Director, 1982-85 and Chairman, 1988-91), M. Rolland Willaume (who was with Dr von Kármán at the start of AGARD in 1952 and stayed there until 1980), and Mr Jan van der Bliek (Director, 1988-91)

CHAPTER 5 THE STEERING COMMITTEE

Introduction

In addition to its other activities AGARD has since its formation conducted ad hoc studies of special interest to the NATO Military Committee and NATO military authorities. This activity reached a peak during the years 1959 to 1963 with the Long Term Scientific Studies Programme and certain studies in the field of operational research which were coordinated by an Operational Research Officer on the staff of AGARD.

When, in 1963, AGARD reduced its activity in these fields and the position of Operational Research Officer was abolished, it was recognized that new means must be found to ensure that the activities of the AGARD Panels would be responsive to the needs of the NATO military community and to maintain continuing liaison with other NATO bodies concerned with aerospace research and development. One important step towards these ends was the creation of the AGARD Steering Committee.

Formation

The AGARD Steering Committee was established by the National Delegates Board during the AGARD General Assembly, 16-17 September 1964 at Lisbon. At the time, Prof. C.D.Perkins was the Chairman of AGARD and Dr W.P.Jones its Director. The objective was to make the best use of AGARD for the benefit of the NATO Military Authorities, and this was reflected in the following terms of reference (recorded in the Summary Record of the 17th National Delegates Board Meeting).

"The function of the Steering Committee would be to identify areas of research and development of particular significance to military applications".

The focusing of AGARD's attention on areas of pertinent military technology would serve several important purposes:

"Firstly, it would provide guidance to the panels which at their discretion might direct some of their panel activity to conform to this area of interest; Secondly, it would identify areas for special ad hoc classified meetings, the results of which would be of direct interest to the Standing Group[1] and Defence Research Directors Committee. It is not envisaged that the Steering Committee would interfere with Panel plans and programmes associated with their long term interests; however, the focusing of attention on a particular military technical problem area could help provide useful guidelines for some panel activities".

As far as the membership was concerned, the AGARD National Delegates agreed at the same meeting that:

"The Steering Committee should be appointed by the Chairman of AGARD and should consist of members who have special knowledge and experience in military technology. It is assumed that at least three members would come from the National Delegates Board. One would be the Chairman of the Committee of Defence Research Directors, one should be a representative of the Standing Group, one or two might be selected outside of the AGARD/NATO Organizations. The Director of AGARD should be a member of the Committee. The Research and Development Activities

1 The Standing Group (abolished in 1966) was the Executive Committee of the Military Committee.

Officer will serve as the Secretary."

The following initial membership was approved by the AGARD Executive Committee at their 34th Meeting, 8 January 1965, in Paris:
Chairman: Dr W.P.Jones, Director of AGARD
Members:

- Mr Handel Davies, UK
- M. de l'Estoile, France
- Dr McLucas (Assistant Secretary General NATO for Scientific Affairs and Chairman of the Committee of Defence Research Directors)
- One representative of the Standing Group (to be designated)

The Secretary of the Steering Committee was the AGARD Research and Development Activities Officer; this was a newly-created post on the AGARD staff, with responsibilities for monitoring and coordinating the preparation of studies prepared under the instructions of the Steering Committee, and for liaison with such NATO bodies as the Defence Research Group, the Armament Groups, the Science Committee and the SHAPE Technical Centre.

The Steering Committee met for the first time at AGARD Headquarters in Paris on 25 June 1965, with Col. O.A.Nielsen representing the Standing Group.

At the 21st National Delegates Board Meeting on 2 September 1966, the Board passed a resolution recommending the inclusion in the Steering Committee of Representatives of the Military Committee, Defence Research Group, Science Committee and other NATO groups as appropriate.

This resolution was endorsed by the Military Committee, on 1 November 1966.

At the NDB meeting of 9-10 March 1967, it was stated that the question of membership of the Steering Committee should be reviewed. At this time of the existence of the Steering Committee, it was also felt that the function of this Committee and its position within AGARD should be more precisely defined. This view was expressed by the new Chairman of AGARD, Director Finn Lied, at the 4th Meeting of the Steering Committee, 30 June 1967, where it was agreed that there should not be two Executive Committees in AGARD, and that the purpose of the Steering Committee was to advise the Chairman of AGARD on appropriate areas of research and development of particular significance to military applications, and that the NDB would function as the review and approval body for those projects recommended to it by the Chairman of AGARD. An overall re-assessment of the desired role of the Steering Committee and of its ways of operating then appeared necessary. This was done on the occasion of the 3rd AGARD Annual Meeting on 7-8 September 1967 in Turin where Director Lied, Gen. de Cumont (Chairman of the Military Committee), Gen. von Baudissin (SHAPE), Dr Wattendorf, and Mr Ross recommended the new terms of reference, which were approved by the NDB, as recorded below.

The terms of reference of the Steering Committee approved by the NDB in September 1967 at the Turin meeting were:

1. The Steering Committee has no executive purpose but serves the important function of a forum in which military wishes for studies and advice in the aerospace R & D field are put forward and discussed before representatives of

the National Delegates Board and staff.
2. Representation of NATO Military Headquarters on the Steering Committee is to be from the military staff, not the scientific side, and should be senior staff officers so as to enable direct discussions rather than liaison.
3. The product of Steering Committee deliberations is to be the generation of recommendations to the Chairman of AGARD for proposal to the National Delegates Board (or to the Executive Committee[2] in urgent cases), whose approval is necessary to implement any recommendation.
4. Membership of the Steering Committee is to include a General Officer from the International Military Staff of the Military Committee, SHAPE and SACLANT; senior representation from the Defence Research Group and Science Committee; three AGARD National Delegates and the Director of AGARD.

The Steering Committee continued to operate under those terms of reference with only minor modifications. The specific requirement that the Committee include three National Delegates was eliminated at the National Delegates Board in 1972 by revision of the By-Laws to read 'AGARD National Delegates so designated by the National Delegates Board'.

Reorganization of 1971

During 1970 it became apparent that some subjects proposed for study by the Steering Committee could not be handled effectively within the existing organization. Various organizational options (including the creation of an additional AGARD Panel) were considered at the National Delegates meeting in Washington in 1970. The question was again reviewed by a special meeting of the Steering Committee in early 1971, and a solution was approved by the National Delegates at their Spring meeting in Paris in March 1971.

The re-organization involved three main changes: the establishment of a procedure for the identification by the NATO Military Committee of topics of interest; the creation of an Aerospace Applications Studies Committee; and the formation of a Military Committee Studies Division as a staff element within AGARD.

According to the revised procedure, the NATO Military Committee was to solicit suggestions from national defence authorities, through their National Delegates to NATO, and from other NATO agencies and annually identify a list of subjects thought to be of interest to the NATO military community. This list would be reviewed by the Aerospace Applications Studies Committee in order to determine in which areas, and within current resources, AGARD could make an appropriate and timely contribution. A list of such studies would then be proposed to the Steering Committee, and with their approval to the National Delegates for inclusion in the AGARD Technical Programme.

It is important to note that in considering the various topics, the Aerospace Applications Studies Committee distinguished between two types of studies: those which fell within the fields of expertise of one or more AGARD Technical Panels, referred to as Technology Studies; and those of a more general systems nature, designated Aerospace Applications Studies.

2 Subsequently replaced by the Advisory Committee

Technology Studies were referred to the appropriate specific Panel or group of Panels for consideration and, if accepted and approved by the National Delegates, were usually eventually published as AGARD Advisory Reports. The subjects of such Advisory Reports have included: Fatigue in Helicopter Crew Members; Military Utilization of Frequency Bands from 10 GHz to 100 GHz; Potential Benefits of Laser Technology; Radar Cross Section Definition and Measurement; Advanced Design Radomes; Helicopter Escape Measures; Effects of Buffeting and Other Transonic Phenomena on Manoeuvering Aircraft. In addition, symposia, specialists' meetings and lecture series were occasionally scheduled by Panels on subjects identified and recommended by the Steering Committee. Aerospace Applications Studies were prepared under the guidance of the Aerospace Applications Studies Committee, which is discussed in Chapter 6.

Clearly, the Steering Committee was established after von Kármán passed away. He had personally maintained many contacts with the military. The NDB decided at that time on the one hand not to broaden the AGARD activities but on the other hand that there was a need to assure that the proper contacts with the military bodies of NATO was maintained. Finally, the pattern established in 1971 fulfilled the needs.

The usefulness of the Steering Committee was reaffirmed by the report of the Study Group on 'AGARD in the 1980s and Beyond' published in December 1982. The role of the Steering Committee continued to be debated and strengthened. The National Delegates Board gave the Steering Committee authority to approve two Aerospace Application Studies per year, extended its responsibility over Technology Studies and emphasized its role as the forum for dialogue between the AGARD National Delegates Board and the Military Authorities.

The Steering Committee normally convened twice a year, at the time of the National Delegates Board Meetings. It was chaired by the AGARD Chairman. Membership included several National Delegates, senior Officers from the NATO International Staff, SHAPE and SACLANT, the NATO Defence Support Division and the Director of AGARD.

Although there were periods in which some doubted the usefulness of the Steering Committee, there were other periods in which discussions in the Steering Committee were extremely useful to the Chairman and the Director when AGARD was confronted with new developments, and a discussion in depth with a limited number of NDB members and direct representatives from NATO-HQ was important in formulating proposals to the full National Delegates Board. It then acted more or less as an executive committee for specific purposes. Examples of subjects discussed in great detail by the Steering Committee are:

- The review and the policy to be followed with respect to the Support Programme for Greece, Portugal and Turkey, around 1990;
- The Technology Cooperation Programme – the programme of contacts and cooperation with the former Warsaw Pact countries – in the early 1990s;
- Cooperation with DRG, and finally the plans for the amalgamation of AGARD and DRG in the mid-1990s.

Thus the task of the Steering Committee was often much broader than reviewing the Aerospace Application studies.

The membership of the Steering Committee is given in Annex 3.

CHAPTER 6 AEROSPACE APPLICATIONS STUDIES COMMITTEE AGARD MILITARY COMMITTEE STUDIES DIVISION

Formation and Activities

As mentioned in Chapter 5, the Aerospace Applications Studies Committee was formed in 1971. Under the direction of the Steering Committee, it organized and guided applications studies of a system nature which transcended the scope of individual Panels or groups of Panels, by organizing Study Teams and conducting periodic reviews of their progress. Its first meeting was held in May 1971 under the chairmanship of Mr J.B.Scott-Wilson of the UK. The original committee included representation from France, Germany, the United States, NATO Headquarters and SHAPE.

The AASC was a permanent AGARD Committee functioning in many respects like an AGARD Panel, but not holding symposia or specialists' meetings (although it occasionally held workshops with an invited attendance).

Meetings were normally held twice a year. The Committee membership consisted of a Chairman, appointed for a three-year term by the National Delegates Board, representatives from nations participating in Aerospace Applications Studies, the NATO International Staff, the NATO International Military Staff and SHAPE. The AASC organised, managed and reviewed studies proposed by the NATO Military Committee after consultations of the nations. It was responsible to the Steering Committee and not directly to the National Delegates Board.

In order to support the activities of the Steering Committee and the Aerospace Applications Studies Committee, a Military Committee Studies (MCS) Division was established in the AGARD Headquarters. This consisted of a Chief and two Deputies, initially one for Systems Analysis and the other for Research and Development. The post of AGARD Research and Development Activities Officer was abolished when the new Division was formed.

Members of the staff of the MCS Division were designated to act as secretaries to the Steering Committee and the Aerospace Applications Studies Committee. Their main function was to participate actively in the implementation of the Aerospace Applications Studies programmes and the preparation of studies, to provide AGARD study experience and consistency to the successive ad hoc study teams, to provide administrative support, and to monitor and coordinate progress.

In 1980, the functions of secretary to the Steering Committee and to the AASC were assumed by the Chief, MCS Division. Additionally the titles of the Deputies were changed to eliminate any difference of duty. Each acted as the Deputy Study Director for alternate studies.

In general, a new Aerospace Applications Study was initiated every six months, and a scheduled programme of reviews by the Committee maintained control over the progress of each study and the quality of the product. For each study a special Study Team was established through the 'network' of AGARD and other NATO bodies. A study lasted nominally one year and the participants met several times during such a period, reporting on their 'homework'. The results of the Studies were published as AGARD Advisory Reports.

To date, some 45 such studies have been completed. These studies covered a wide range of topics – sometimes arising from a short term need but more often of a strategic nature – ranging from the physical vulnerability of aircraft, systems concepts of unmanned aircraft, defence against direct energy (laser) weapons, etc. to measures to reduce the impact of low level high speed training flights and to the detection and neutralisation of land mines.

The AASC also organised occasionally Workshops on topics advanced by the Nations and various NATO bodies. These served also to determine the feasibility of the formation of a Study Group or ended up as recommendations for the Panel programmes.

Needless to say, it required a considerable effort to organise the studies, each of which was carried out by a different team of 10 to 20 experts. Invariably the members of the Study Teams felt that it was professionally a very stimulating experience to work in an international team of experts on a topic of strategic importance.

An especially extensive study resulted from a request from the NATO Military Committee to AGARD, September 1975, to undertake a technological forecasting study to be called 'Project 2000'. The purpose of this study was to evaluate the fundamental technological developments in aerospace up to the year 2000 and their impact on military applications.

In March 1976, Admiral Sir Peter Hill-Norton, Chairman of the Military Committee, addressed the National Delegates Board to emphasize the importance of 'Project 2000' and to highlight the uses to which the results of such an effort would be put: prevent technological surprise; assist in long-term planning for R & D; provide input to long-range planning for NATO equipment needs; assist in interoperability and standardization goals.

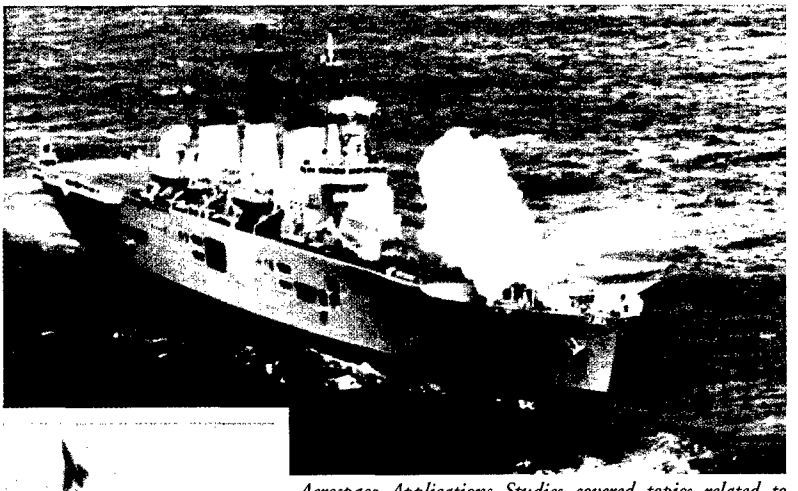
In September 1976 the NDB decided to pursue a two-phase approach to the project. The first phase was to accomplish two objectives: first, to complete an assessment of technology forecasts already available within the Nations, and in particular of the von Kármán Committee Long-Term Studies, conducted by AGARD in 1960 and 1961, in order to determine how much more actual forecasting needed to be done; secondly, to identify the structure of accomplishing Project 2000 in the next phase. The AGARD Panels were asked to forecast the technologies available in the year 2000.

Two ad hoc groups were formed for this Phase I:

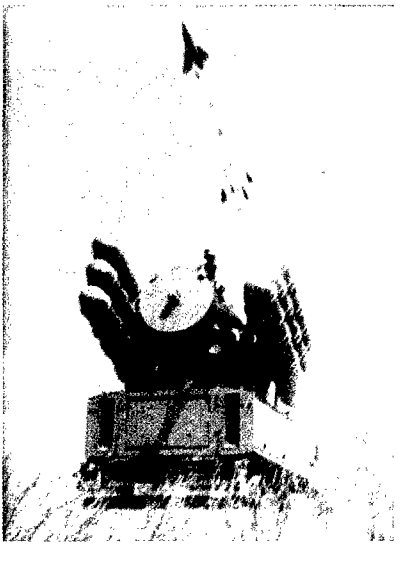
- a Study Committee, chaired by Ing. Gén. Carpentier, charged with doing the first task and with developing ideas for the second;
- a Steering Group, chaired by Dr A.H.Flax, to review the findings of the Study Committee and make recommendations to the NDB about the future conduct of the project.

During the conduct of Project 2000, the 'normal' Aerospace Applications Studies programme was suspended because the MCS Division was providing support to the Project 2000 activity similar to the support to the Aerospace Applications Studies programme. In March 1977, the NDB approved Phase I and approved the results of the Steering Group and Study Committee and also received a draft of the International Military Staff input on potential future military missions. The NDB

Aerospace Applications Studies provided NATO with concepts for future aircraft systems that would enhance their weapon delivery and their self defence.



Aerospace Applications Studies covered topics related to naval systems when they had aerospace aspects of interest to NATO.



Aerospace Applications Studies covered not only protection of aircraft from missiles but also system concepts for defence against tactical (theatre) missiles.

requested further refinements from the IMS to ensure that land and sea warfare would be considered.

In September 1977, the NDB approved the start of Phase II of Project 2000. Three Study Groups were formed to investigate the impact of technological advances on future military systems in three key mission areas:

- Attack of Surface Targets;
- Defence Against Missiles;
- Detection, Location and Recognition of Ground Targets.

To provide these Study Groups with guidance, the NDB created a Project 2000 Review Board, chaired by Mr John Scott-Wilson of the United Kingdom, to establish study terms of reference, provide technical and managerial guidance and to review the study results. Phase II was to be completed in the Fall of 1979. They also proposed a list of participants by discipline for use in forming the study groups. Forty-six members were appointed by the Nations and the NATO Military Authorities.

In March 1978 the NDB approved the overall Study Schedule. The mid-term review was held in November 1978 in London. In May 1979 draft written and oral reports were presented by each group to the Review Board. Unfortunately, Dr Paxson, who had been assigned as the Study Coordinator, died early in 1979. This was a significant loss to the study effort. Mr Seymour Deitchman of the United States succeeded him in this position. In November 1979, the Review Board approved the three individual studies' Executive Summaries and the Overview Report which were provided to the NATO Military Committee in December 1979.

The Main Reports and Appendices were issued in July and August 1980 under the report numbers and titles: AR-160, 'Project 2000 Overview'; AR-161, 'Attack of Surface Targets'; AR-162, 'Defence Against Missiles', and AR-163, 'Detection, Location and Recognition of Ground Targets'.

The Military Committee endorsed an assessment of Project 2000 in April 1982. In that assessment, which included comments by the Nations, the project reports were both praised and criticized. Although the assessment pointed out gaps and limitations, it did recognize the wide scope of the study and the enormous effort given to it. Areas for further study were identified as well as the need for an update of the technology forecast. It was emphasized that follow-on or update studies should focus on special areas for which very clear terms of reference could be written; this was done in the following years. The AASC has focused on systems that complement the evolution of tactics such as Follow-On Forces Attack (FOFA) and Extended Air Defence.

It was not always easy for the AASC to respond directly to demands from NATO and the Nations. The main reasons were that in order to carry out a meaningful study, the support and participation of many experts from the nations was mandatory. For example, Lt.-Gen. P.S.Williams, Deputy Chairman of the Military Committee, noted in his Fall address at the NDB meeting in 1985 that, after Lt. Gen. J.A.Abrahamson's address on the US Strategic Defense Initiative (SDI) at the Fall 1984 NDB meeting, there was no unanimous agreement for AGARD to contribute. The SDI programme did influence the various AGARD programme elements and there were bi-lateral arrangements, but there was no concerted effort

and AGARD could do no more than the nations would support.

On several occasions during meetings in 1986 and 1987, the AASC discussed ways to participate in AGARD's response to the NATO CMF (Conceptual Military Framework). After reviewing several concepts such as workshops and symposia, it was concluded that such activities could best be pursued using the procedures for providing consultants to other NATO Bodies (described in Chapter 4 in the notes on the Fall 1986 National Delegates Board Meeting). A criticism about the time required to approve an Aerospace Applications Study was coped with by a new procedure, approved in 1986 by the National Delegates Board, shortening the time between topic selection and study completion by up to 11 months.

The last large scale forecast in which the AASC was involved was 'Aerospace 2020', carried out in the period 1995-1997 under the direction of Mr N.Holme of Norway. This study capitalised on the strengths of all the Technical Panels, composed of experts in fields ranging from aerospace medicine to fluid dynamics, as well as the AASC. It also tapped the expertise of the Technical Information Committee. In the AGARD tradition, each of the participants expanded the network of professionals to include views and opinions of civilian and military experts from industry, government and academia.

The results were presented at the last AGARD meeting, 14-17 April 1997, at Palaiseau, near Paris, and were published as:

Aerospace 2020, AGARD, Advisory Report AR-360:
Volume I – Summary, April 1997
Volumes II – Main Report, September 1997
Volume III – Background Papers, September 1997

This masterwork explains in a very readable form the possibilities and limitations facing us in the next 25 years. Volumes I and II have both been published in English and French. The papers in Volume III are in their original language only.

At the same meeting, a multi-Panel conference was held, in which the Panels presented the results of their combined studies on the same subject. This was in the form of three parallel sessions, each organised by two Panels. There were also three plenary sessions on:

- Future trends facing NATO: a context for Aerospace 2020;
- Future directions in Aerospace Missions;
- Human Machine Interaction 2020.

The meeting finished with a round table discussion.

The papers presented, but not the round table discussion, were published as:

Future Aerospace Technology in the Service of the Alliance, AGARD Conference Proceedings CP-600
Volume 1 – Affordable Combat Aircraft
(this volume includes the plenary sessions)
Volume 2 – Mission Systems Technologies
Volume 3 – Sustained Hypersonic Flight

In total it can be concluded that the AASC worked remarkably well. It was a tremendous task to assemble teams of experts from the various nations and NATO bodies; to work together during a period of one year and, invariably, still having to

carry out their tasks at home; meet at different locations and produce timely high quality results.

The experience gained and the associated network of experts are a real asset for the new RTO organisation.

The membership of the AASC is listed in Annex 4

CHAPTER 7 THE AGARD TECHNICAL PANELS

General

The Panels were the heart of AGARD. The foregoing chapters dealt with the history of the National Delegates Board (where the final programmes and therefore the national commitments were agreed), the Steering Committee and the Aerospace Applications Studies Committee (where a top-down approach was generally chosen to serve very specific military needs of NATO and the nations). With some notable exceptions, the Panel programmes were 'bottom up'. The Panels were composed of members from government and semi-government laboratories and agencies, universities and industry, and this meant that, in general, they had sufficient knowledge of their national programmes and policies and the limitations for international cooperation. However the NDB had to approve the programmes and took corrective measures when necessary. After all the NDB members were directly or indirectly responsible for making available the resources and information to the Panels.

The Panel structure was really invented by von Kármán and Wattendorf. It was their intention to get the best scientists and engineers from government, universities and industry together to propose the programmes, to participate in the meetings and symposia, initiate workshops, propose the writing of AGARDographs and other publications, etc.

As described in Chapter 3, AGARD started in 1952 with four Panels (Combustion, Aeromedicine, Flight Test and Instrumentation, and Wind Tunnel and Model Testing). Von Kármán had a direct personal interest in the Panels – based on his life-long scientific work and his association with the military – and he gave them his guidance. It must be noted however that initially there were less than 100 Panel members. Their number grew rapidly to 200 in 1960 and with the expansion to nine Panels in 1970, there were more than 500 Panel members in the 1990s. The number of Panels was reduced to seven, plus a Technical Information Committee, in 1994

Clearly, even if von Kármán had been alive after 1963, it would not have been possible to continue with his personal touch to the same extent as in the first few years of AGARD. It is not surprising then that after he died in 1963, the NDB took a more 'formal' course. However the character of the Panels and their programmes remained. After all it was up to the nations and their participating organisations to determine to what extent they wanted to contribute.

AGARD triggered an unprecedented enthusiasm among aerospace scientists/engineers to cooperate internationally and to contribute to the Panel activities. Indeed, Panel members often referred to AGARD as 'The AGARD Family'. Sometimes it took longer than planned to produce the reports they had proposed, but invariably the final products were of a high quality.

Several times the question arose in the nations: what did all this contribute to our national programmes and what did we give away in this process? In several nations an analysis was made of the benefits resulting from participation in Panel activities, and attempts were made to compare the effectiveness of AGARD with their own bi- or multi-national arrangements in the research area. Although there were many very positive statements in both the larger and smaller countries, an overall assessment is

not available. It is of course often very difficult to trace benefits in the area of research, even though the Panels were mainly concerned with applied research. Nevertheless, each of the Panels has an impressive list of achievements. AGARD was to the Panel members and their organisations a unique Transatlantic Forum from which many cooperative projects emerged. It was the breeding ground for international cooperation.

The Panel members, experts actively engaged in research, development or management in academic institutions, government establishments or industrial enterprises related to the aerospace field, were appointed by their respective National Delegates. They were normally appointed for a term of three years but in many cases the period was much longer, particularly in the smaller countries. The detailed areas of interest of each Panel varied fairly rapidly as the field of aerospace science and technology expanded and as interactions between specialist areas became more or less relevant.

In very general terms, the mission of each Panel was to fulfill the AGARD mission within its own area of scientific and technical interest and competence. Each Panel defined a programme of meetings and publications in its own specialty, within the general constraints of AGARD policy as determined by the National Delegates Board. Panel members were responsible for enlisting the necessary support and participation from their own countries. In all these activities, Panels could call upon the resources of the AGARD staff; in particular, each Panel was assisted by a full-time Panel Executive, who acted as the AGARD Director's representative.

Panels operated in accordance with the AGARD Charter and By-Laws. Each Panel elected from among its members a Chairman and Deputy Chairman, each nation having one vote for this purpose. These Panel officers normally served for a two-year term, and the Deputy Chairman usually succeeded to the post of Chairman.

Generally Panels held two major meetings each year, and these, like the AGARD Annual Meetings, were rotated among the NATO Member-Nations. Thus, each country in turn had the privilege and duty of acting as host to each of the Panels. AGARD tried to arrange the subjects of meetings in each country so that they were suited to the special needs of that country, but naturally this requirement could not always be observed in view of the other criteria which often determined choices.

Symposia were technical meetings of about 100 – 200 persons concerned with subjects of relatively general interest within specific fields. Attendance was by invitation only and normally limited to citizens of NATO Member-Nations. Specialists' Meetings were addressed to narrower and more specialized areas of interest. They were normally limited to between 20 and 100 individuals, who were invited by name through National Delegates or Panel Members. The Panels also proposed Lecture Series, up to 6 a year in total, and Special or Short Courses, sometimes in cooperation with other organisations. To facilitate their activities, Panels could establish or make use of: Permanent Committees, for planning, policy or programme coordination; Sub-Committees, to perform specific tasks within the Panel programme; and Working Groups, where it was felt that outside expertise was required for a specific project. The printing and dissemination of Panel publications was organized by AGARD Headquarters. Publication arrangements are described in more detail in Chapter 10.

The names of the Panel Members (nearly 2,500) are listed in ANNEX 5.

The descriptions of the Panels that follow were all prepared by Panel Executives and their Chairmen. In the case of the long-established Panels, they were edited and updated by different people each time there was a new edition of the History. Thus the approach and the level of detail are not uniform. In addition, it must be noted that two of the Panels (MSP and SPP) were formed only three years before the end of AGARD. The third new one formed at that time (FVP) was essentially a continuation of a long-established Panel and does not have a separate section.

The illustrations accompanying the descriptions of the long-established Panels are all taken from a booklet published in 1987 in association with the exhibition at NATO HQ to mark the 35th anniversary of AGARD. Thus they represent a relatively late stage in the development of AGARD's work, but not the end point.

Aerospace Medical Panel (AMP)

The Aeromedical Panel was officially established in September 1952 at the direction of Dr von Kármán to promote international exchange of information on aeromedical research and development and to stimulate aeromedical research activities which assist the human pilot's performance in the aviation environment. Throughout its lifetime, the Panel kept pace with advances in aviation, especially during the evolution from propeller- to jet-powered aircraft, and man's entry into space. Accordingly, the name was changed to the Aerospace Medical Panel in 1959. The Panel continued to devote attention to all aspects of human performance in conventional aviation as well as the space environment.

From the beginning, the Panel's objectives have been consistent with the mission of AGARD, specifically through:

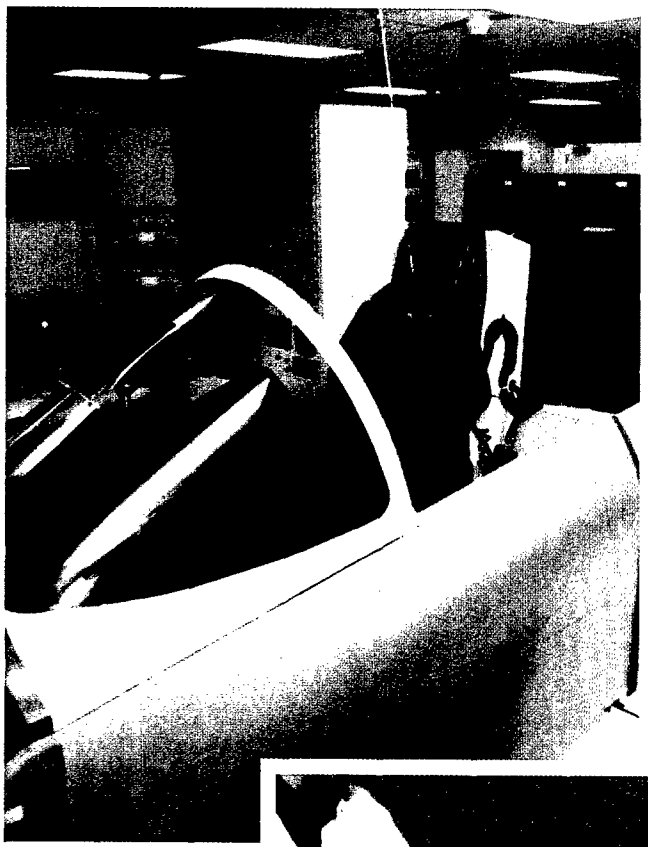
- advice to NATO authorities on the results of current aeromedical research and development
- free exchange of information between experts in the NATO nations.

The Panel's wide range of activities also addressed such topics as:

- Selection methods and criteria for aircrew
- Aeromedical aspects of flying safety
- Emergency escape and survival
- Human engineering aspects of aircraft design
- Physiological and psychological stress
- Aeromedical information for aircrew training
- Human information-processing
- Specialised protection for aircrew (chemical defence, thermal protection, G-protection, etc.)

It was a policy of the Panel to be aware of the scientific and medical work being performed in the various NATO nations and to arrange personal contacts which contributed to both informal and formal exchanges of ideas and information. These often resulted in cooperative endeavours in R & D activities as well as indirectly to standardization, particularly in such areas as aircrew medical standards and programmes designed to maintain aircrew medical fitness.

To facilitate the work of the Panel, laterly membership was allocated to four Sub-



Visually coupled airborne systems simulator (VCASS).

Physiological Monitoring.

Committees as follows:

1. Behavioural Sciences Committee
2. Aircrew Protective Systems Sub-Committee
3. Special Clinical and Physiological Problems in Military Aviation Sub-Committee
4. Sensory Systems and Neural Sciences Sub-Committee

Each of these Sub-Committees was headed by a Chairman who was an expert in that particular field. In order to ensure that adequate expertise was available for all Committees, a list of Non-Panel-Member Experts was maintained. These experts in some cases were former Panel Members. The list was reviewed regularly to ensure that the needs of the Panel were served.

In addition, the Panel operated a Sub-Committee whose specific responsibility was the management of the Support to Greece, Portugal and Turkey Programme. The activities of this Programme were aimed mainly at training of aerospace medical and para-medical personnel from the supported nations. The Sub-Committee administered the plans for training programmes as well as the longer-term objectives within the supported nations.

An Advanced Operational Aviation Medicine Course for NATO Flight Surgeons was sponsored on an annual basis.

The themes for AMP symposia reflected the wide range of topic areas having aeromedical implications. They demonstrated that the scope of Panel interests was very wide, covering matters from the purely clinical to the human engineering aspects of fitting the aircrew with the machine.

A noteworthy accomplishment was the publication by AGARD/AMP (in co-operation with the Armstrong Laboratory, Wright-Patterson AFB) of the 3-volume Engineering Data Compendium in 1988, followed by the interactive CD-ROM Computer Aided Systems Human Engineering Performance Visualisation System (CASHE) in 1994, both by Drs Kenneth Boff and Janet Lincoln. The Compendium is a reference document which consolidates human sensory/perceptual and performance data in a form useful to system designers. It provides comprehensive information on the capabilities and limitations of the human operator's ability to acquire, process, and make use of task-critical information. The CD-ROM is interactive and allows users to perceive the effects described.

Another recent significant accomplishment was a Working Group, active over a period of five years and with the support of 13 NATO nations, which collected and analysed more than 1200 echocardiographs. The goal was to determine whether prolonged acceleration over the life time of pilots detrimentally affected the size of their hearts. Not only is this work of direct interest to flight surgeons and cardiologists world wide, but the data were also published in a number of medical journals so that general practitioners and those physicians not directly involved in aerospace medicine have access to the data and results.

AMP was the first Panel to hold a Symposium and Business meeting in a former Warsaw Pact nation. The symposium, 'Selection and Training Advances in Aviation', was held in May 1996 in Prague, Czech Republic, and attracted people from as many as 22 different countries. As a result of this endeavour, AMP was able to establish

many contacts in other countries and opened an entirely new world of expertise to its Panel Members.

Finally it is interesting to note that among the AGARD Panels, the AMP was unique in two respects. It was the only Panel largely composed of serving military officers. Furthermore, its field of interest was extremely broad – it was as though there were a single Panel for 'engineering'. Thus each of the sub-committees covered an area almost as broad as any of the other Panels. For the chief medical officers of the air forces of the Alliance it was a very effective forum of interchange of information and mutual assistance.

Avionics Panel (AVP)

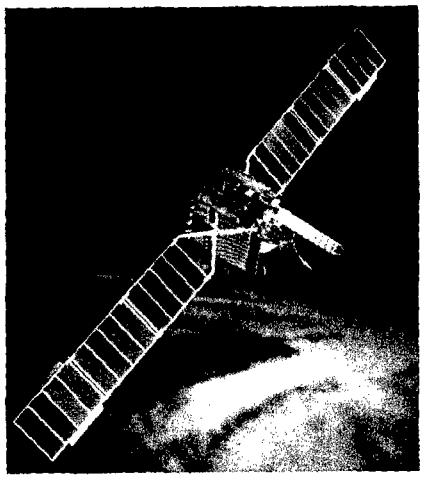
The formation of an Avionics Panel was recommended by a group of experts convened by Dr von Kármán in May 1957. The AGARD National Delegates in an Executive Session, later in the same month, approved the recommendations and formally authorized the establishment of the new Panel as part of the AGARD structure. The Panel was created for the purpose of promoting international cooperation within the NATO community in electronics research and development which has application to aeronautics.

An organizational meeting was held in Paris during February 1958. Mr. Roland J.Lees (UK) was elected Chairman and Dr Eberhardt Rechtin (US) was elected Deputy Chairman. At this meeting the Panel agreed that in order to fulfill the purpose for which it was created, it would: survey and promote advances in avionics relating to common defence; recommend the solution of problems referred to it by agencies within NATO; evaluate research and development projects submitted by individual nations; recommend methods leading to improved scientific cooperation among member nations; explore methods for facilitating the exchange of research and development information; and promote and assist in the establishment of joint NATO facilities for scientific research, testing, and training.

The Ionospheric Research Committee, which had been organized in 1956 with Mr Finn Lied (Norway) as Chairman, was constituted as a Committee of the new Panel and continued its work under Panel direction. This Committee became the Electromagnetic Wave Propagation Panel in 1970.

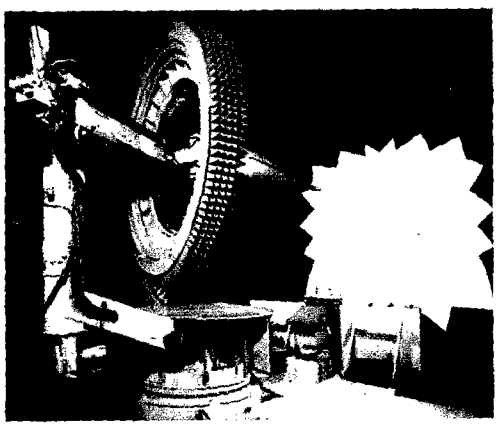
In 1957 the Avionics Panel, in cooperation with SHAPE, contributed to the task of making site and instrumentation surveys of possible locations for a NATO Missile Firing Installation. This project was successfully completed in 1960 and resulted in the establishment of the installation in Greece.

During the years between 1957 and 1962 the Panel was instrumental in encouraging, organizing and in some cases obtaining facilities for a number of cooperative basic research projects. These included studies of the ionosphere by the aid of satellites, studies of radio meteorology, studies of the relation between the night glow and the ionosphere and cosmic ray measurements from balloons. In addition the Panel helped Greece and Turkey develop much-needed astronomical facilities for modernizing national observatories. Most of this work was carried out with assistance from the Scientific Affairs Division of NATO and other NATO and national organizations. In its role as adviser to the Standing Group of NATO, the Panel, working with the Aerospace Medical Panel, completed a classified study on



Skynet 4 Communications Satellite.

Advanced avionics and cathode ray tube displays highlight the design of this Airbus Industries A320 transport aircraft cockpit design.



Test chamber in which a radar dome is undergoing measurements of its radar cross section.

aircraft identification in 1962.

To examine the impact of present and future technologies, the Panel conducted its first Workshop in October 1985, at SHAPE Technical Centre in The Netherlands. The Workshop, 'The Potential of Developments in Electronic Technology on the Future Conduct of Air Warfare', included representatives of all other AGARD Panels. The results of the Workshop were briefed directly to the NATO Military Committee.

From 1970, when the Ionospheric Research Committee of the Panel became the Electromagnetic Wave Propagation Panel, the administrative support to both Panels was provided by one Executive and one Secretary, until an additional Executive and Secretary were appointed in 1987. The Avionics Panel interacted with all the AGARD Panels but its work was most closely associated with that of the Guidance and Control Panel and the Electromagnetic Wave Propagation Panel.

The Panel sponsored Working Groups on the subjects of:

- Displays for Approach and Landing of V/STOL Aircraft
- Radomes, Advanced Design
- Avionic Radome Materials
- Processing of Airborne Reconnaissance Data for In-Flight Display and Near Real-Time Transmission
- Computer Applications
- Optimisation of Pilot Capability and Avionic System Design
- Communications with Low-Flying Aircraft
- Modern Display Technologies & Applications
- Interaction of Avionics Imaging Sensor Signals for Tactical Aircraft
- Satellite Communications.

Following a Panel restructuring, the Avionics Panel was disbanded early in 1994. Many former members were nominated as members of the newly formed Panels: Flight Vehicle Integration Panel, Mission Systems Panel (the majority), and the Sensor and Propagation Panel.

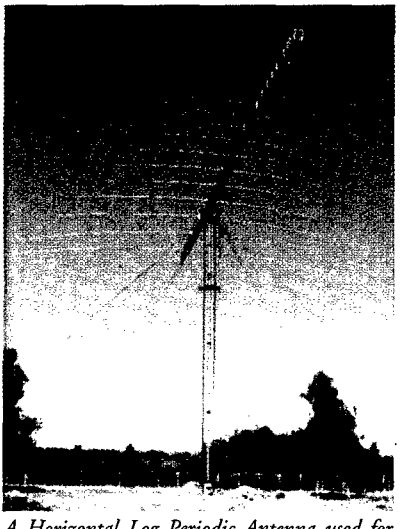
Electromagnetic Wave Propagation Panel (EPP)

The Electromagnetic Wave Propagation Panel had its origins in the Ionospheric Research Committee which was organized in 1956 under the Chairmanship of Mr Finn Lied (Norway) and in 1957 became a Committee of the Avionics Panel. The Committee was originally established to address problems in communication systems in which the ionosphere played an important role. By 1965, however, it was realised that the requirements of NATO had given rise to many new propagation problems not only in the ionosphere but also in the troposphere, space, the ground and the sea. It was therefore resolved that the terms of reference of the Committee be broadened to allow these problems to come within its scope. It was recommended that the Committee be retitled "The Electromagnetic Wave Propagation Committee" and that it should concern itself with the propagation of electromagnetic waves with special reference to their application in communications, navigation, guidance and surveillance.

In January 1970, in recognition of the breadth and scope of the work undertaken by the Committee, it was elevated to full Panel status and became the Electromagnetic

Time-lapsed photograph of a laser beam during an atmospheric experiment to correct for phase distortions introduced by the atmosphere.

High Frequency/Very High Frequency antenna calibration measurements, using a Wessex helicopter.



A Horizontal Log Periodic Antenna used for high frequency communications research in difficult propagation regions of high latitude.

Wave Propagation Panel. The first Panel Chairman was Dr K.Davies (USA). The Panel started out sharing one Executive and Secretary with the Avionics Panel. This situation continued until 1987 when new posts of Executive and Secretary of EPP were created.

The terms of reference of the Panel covered all aspects of electromagnetic wave propagation of relevance to NATO in the aerospace field. In view of the variety of military systems used for communications, detection, ranging, homing etc. this implied coverage throughout the whole spectral range from radio frequencies through microwave and millimetre waves to the infrared and visible regions of the electromagnetic spectrum. All aspects of the propagation characteristics of electromagnetic waves were considered, such as scattering, absorption, reflecting, refraction, ducting, fading, modulation, etc. The propagation medium was also a subject of the Panel's activities, including the atmosphere, the sea, the ground and optical fibres. The practice of having joint meetings with other Panels to discuss problems of mutual interest was successfully adopted.

The Panel was also involved with the organization of a number of cooperative basic research projects, often in conjunction with other NATO bodies. Gradually the area of interest in the context of NATO widened.

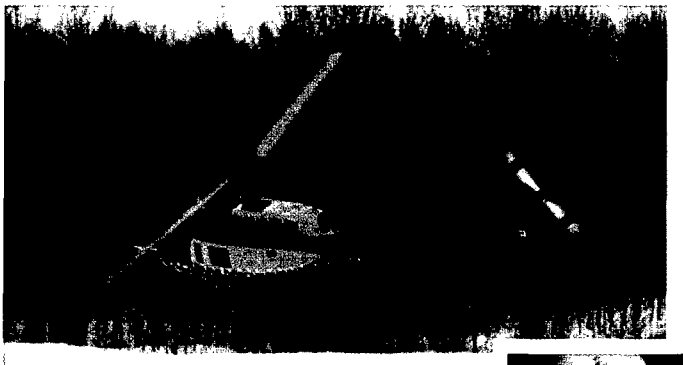
Following a restructuring of the AGARD Panels in 1994, the Electromagnetic Wave Propagation Panel was dissolved. Many of its members were appointed to the newly formed Panels, notably the Sensor and Propagation Panel.

Flight Mechanics (FMP) / Flight Vehicle Integration Panel (FVP)

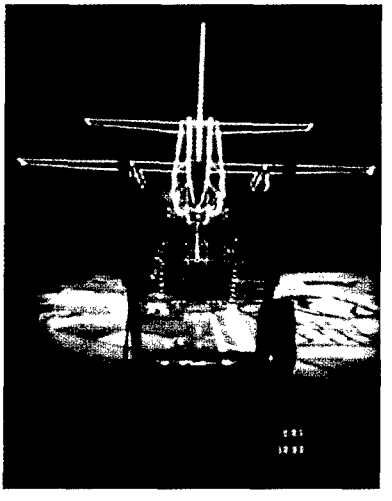
The Flight Mechanics Panel was one of the four original Panels established by AGARD in 1952. As originally conceived, the Panel's primary focus was on the flight test problems of the NATO nations, and it was called the Flight Test and Instrumentation Panel. The name was changed in 1960 to reflect the increased breadth of technical interests dictated by the expanding requirements of NATO's aeronautical research and development community.

From that time, the Panel's terms of reference covered the original Flight Testing, plus Flight Dynamics, Flight Simulation, Operational Aspects, and Flight Vehicle Design and Integration, including primary responsibility for the associated man-machine interfaces. The Panel was concerned with the engineering aspects of air and space vehicle design, integration, testing, operations and cost. Panel technical activities focussed primarily on new and evolving technologies and engineering techniques most relevant to NATO and national mid to long term system level operational needs. All classes of manned and unmanned aerospace vehicles were addressed, including airplanes, rotorcraft, missiles, unmanned air vehicles, trans-atmospheric vehicles, spacecraft and launchers. Additional areas of interest included Life-cycle Issues, and Crew Interfaces.

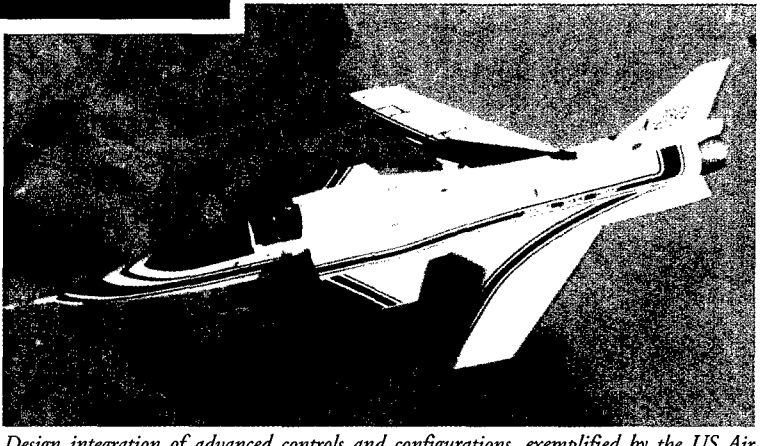
In 1994, as part of a general re-organization of the AGARD Panel structure, the Flight Mechanics Panel was renamed the Flight Vehicle Integration Panel. This redesignation emphasized the Panel's increased emphasis on systems integration, and reflected the incorporation of members and missions from the former Guidance and Control and Avionics Panels.



This helicopter belonging to the national aerospace establishment of Canada was configured as an airborne simulator to evaluate control strategies, pilot interfaces and handling qualities for helicopters, particularly in "nap of the earth" (NOE) operations.



Man-in-the-loop simulation is a potent design tool, essential to cost-effective development of a wide range of technology integration and man-machine interface issues.



Design integration of advanced controls and configurations, exemplified by the US Air Force/NASA DARPA X-29 Technology Demonstrator Aircraft.

The first meeting took place at Boscombe Down, UK, in September 1952. Some highlights selected from the activities of the Panel since it was established are given below. In the period from 1952 to the present, the Panel:

- Conducted a survey of the current flight test problems and future test requirements of primary interest to the NATO nations, leading to the publication of the AGARD Flight Test Manual (1952-56).
- Sponsored the preparation of the Recommended Flying Qualities of Military V/STOL Aircraft, which was the widely accepted standard (1962-64, revised 1970-73).
- Sponsored a survey of Problems Associated with Low-Altitude, High-Speed Flight (1963-67).
- Fostered the definition and adoption of the definitive pilot rating scale (the 'Cooper-Harper' scale) for aircraft handling qualities, now used throughout NATO nations. (1968)
- Sponsored several symposia in the field of simulation including 'Flight Simulation and Testing Techniques' (1966), and 'Flight Simulation – Where are the Challenges?' (1995).
- Sponsored Working Groups, resulting in definitive reports, on 'Dynamic Considerations of Flight Simulator Motion Systems' (1977-79), 'Validation of Simulation Systems for Aircraft Acceptance Testing' (1986-1988), and 'Piloted Simulation in Low Altitude, High Speed Mission Training and Rehearsal' (1993-1996). Additionally, the Panel has sponsored the production of an AGARDograph on Simulation of Aircraft on the Ground.
- Sponsored major revision of, and additions to, the AGARD Flight Test Manual leading to the current series of volumes in both the AGARDograph 160 'Flight Test Instrumentation' and the AGARDograph 300 'Flight Test Techniques' Reports (1968-present), now amounting to more than 30 major volumes.
- Sponsored the preparation of an Advisory Report on 'Escape Measures for Combat Helicopter Crews', in response to a request from the NATO Military Committee (1971-73).
- Sponsored a study of 'The Effects of Buffeting and Other Transonic Phenomena on Manoeuvring Combat Aircraft' at the request of the Military Committee (1972-75).
- Complemented the NATO initiated exchange of operational data on rotorcraft icing encounters by studying the status and prospects of rotorcraft icing technology, research, and development (1979-81).
- Considered the important cost and time scale element of flight vehicle design by means of Symposia such as 'Design to Cost and Life Cycle Cost' (1980) and 'Flight Vehicle Development Time and Cost Reduction' (1987).
- Conducted a survey of the NATO countries' Flying Qualities Research and Development Needs which resulted in the formation of a Working Group to address the topic of 'Handling Qualities of Unstable Highly Augmented Aircraft', the generation of a Lecture Series on 'Advances in Flying Qualities', and provided the framework for a Flying Qualities Symposium (1982-89).
- Sponsored a study on 'Integration of Externally Carried Weapon Systems with Military Aircraft' (1985-88).
- Provided briefing to the NATO Military Committee on Enhancing NATO Flight Test Capability (1986).
- Sponsored a Lecture Series on 'The Integrated Design of Advanced Fighters'

(1987).

- Was instrumental in establishing and supporting programmes to set up flight test facilities and train test personnel for Greece, Portugal and Turkey (starting 1985).
- Sponsored a Working Group and a Lecture Series on Rotorcraft Systems Identification (1986-1990).

Activities which best illustrate the cooperative involvement of the Panels are the joint FMP and FDP Symposium on 'Unsteady Aerodynamics' (Spring 1985), the joint FMP and GCP Symposium on 'The Man-Machine Interface in Tactical Aircraft Design and Combat Automation' which included strong support from AMP (Fall 1987), the joint GMP/GCP Symposium on 'Combat Automation for Aircraft Weapons Systems: Man Machine Interface Trends & Technologies' (Fall 1992) and the joint symposium with SMP on Combat Aircraft held in Palaiseau, France in April of 1997.

Fluid Dynamics Panel (FDP)

The Fluid Dynamics Panel, originally named the Wind Tunnel and Model Testing Panel, was one of the four working Panels established by AGARD at its inaugural session held in Paris, France, in May 1952. The Panel held its first meeting in September 1952 at the Royal Aircraft Establishment, Farnborough, UK. Its initial mission was to encourage the development of an adequate capability within the NATO community for performing necessary research and development tests, using wind tunnels and model test facilities. The initial interests of the Panel were:

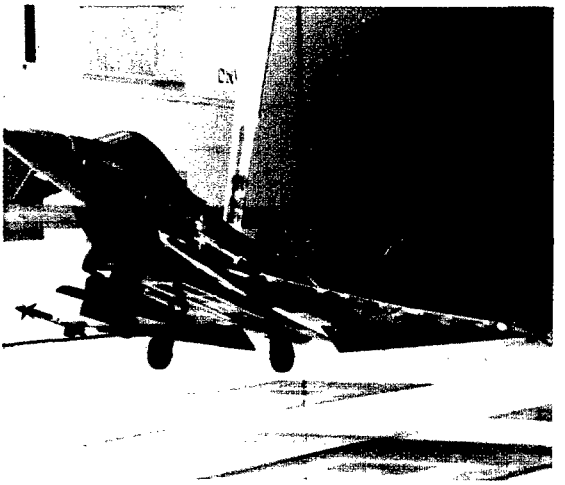
1. Wind tunnel design.
2. Operating techniques (including instrumentation, analysis, methods of data reduction).
3. Inter-NATO utilization.
4. Exchange of staffs and individual personnel.
5. Common system for codification of aerodynamic data.

First efforts were directed toward publication of wind tunnel design data, exchange of instrumentation, selection of standard calibration models, and recommendations for common use of wind tunnel and model testing facilities of the NATO nations for solving aerodynamics problems. Initially the meetings were concerned primarily with wind tunnel design, operating techniques, instrumentation and model testing. Some of the important events were:

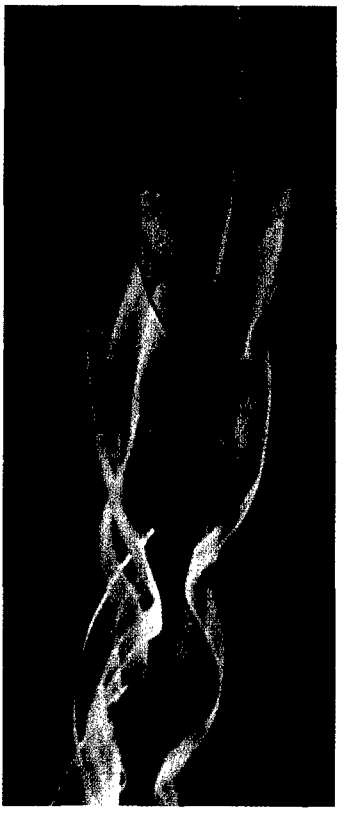
- At the second meeting in December 1952 a programme to publish AGARDographs was initiated to disseminate information on wind tunnels;
- Codification of aerodynamic data was begun;
- The programme to exchange personnel between laboratories was started at the third meeting in May 1953;
- Tours were made of major aerodynamic test facilities;
- Formal technical presentations were begun at the fourth meeting and publication of these technical papers was initiated at the fifth meeting.

The Panel began to discuss test results and data, broadening its activities.

During this period, the practice of having joint meetings with other panels to discuss problems of mutual interest was adopted. In November 1956, several panel members



Model of conceptional European fighter undergoing tests in the German/Dutch (DNW) wind tunnel.



Flow visualization studies of the flow patterns about a rocket-shaped body of the Ariane type. (From ONERA)

Water tunnel flow visualization illustrates the vortex flow structure over the wing of a highly swept canard-wing-body fighter configuration at two angles of attack. (From MBB)

took part in the activities of an ad hoc Advisory Group, which discussed with SHAPE the state-of-the-art of development of short and vertical take-off aircraft.

The first specialists' meeting sponsored by the Panel was held in London in March 1958 on the subject: 'Pressure Measurements'. The success of handling a specific single detailed technical subject by gathering together the active workers on the subject for presentations and thorough discussions and the dissemination of this information in a series of reports was clearly demonstrated by this meeting.

During the first eight years, the scope of the Panel's activities gradually widened. Having, to a large extent, accomplished its initial mission of encouraging the development of tests using wind tunnels and model testing facilities, and having repaired some of the post-war deficiencies in communication of ideas, the Panel considered that it was desirable to broaden its mission to cover the rapid and important developments in the various branches of Fluid Dynamics. This is demonstrated by the more extensive scope of topics for Panel technical meetings. At its sixteenth meeting, which was held in London, in April 1960, the Panel agreed to adopt a broader mission statement and to assume its present name to better describe the widened scope of its interests and activities.

Broadly its mission was:

1. To assist the interchange of aerodynamic information including that pertaining to experimental techniques and experiments.
2. Where desired, to lend assistance in suggesting and coordinating research work in the field of fluid mechanics.

During the 1960s and 1970s, the Panel devoted increasing attention to the needs of the NATO nations for improved model testing facilities and especially for new wind tunnels. Increases in the speed, size and aerodynamic complexity of modern aircraft opened a wide gap between the behaviour of full-scale airflows and those obtained in the wind tunnel; needs were perhaps greatest in the field of transonic testing but little less for low speed testing, and supersonic and hypersonic facilities had also to be borne in mind. Starting with a Transonic Aerodynamics Symposium in 1968 the Panel held a number of discussions, leading to the formation of the High Reynolds Number Study Group (HiRT) in 1969, and of the Large Wind Tunnel Working Group (LaWs). The HiRT Group reported on the inadequacy of existing facilities; the LaWs Group, following a year of intensive work in 1972, described the new wind tunnels required to meet the foreseen needs. Because these tunnels would be very large and expensive, they were to be provided on an international collaborative basis. For their efficient use, it was necessary to develop advanced techniques for both the design and operation of these wind tunnels. Through its Working Group MiniLaWs (1973) the Panel stimulated and coordinated these developments.

In the 1980s and 1990s three major developments influenced the activities of the Fluid Dynamics Panel.

- First, tactical military aircraft now operated and maneuvered in more complex nonlinear flow regimes than ever before. As a result, mixtures and interactions between shock waves, concentrated vortices, and separated flow had to be analysed, measured and understood in greater detail and with greater precision, by both researchers and designers.
- Second, computational fluid dynamics (CFD) became a significant factor in

aeronautical and aerospace application. The rapid progress in computer capabilities, the general availability of supercomputers, and the parallel achievement in numerical analysis, algorithm development, and user experience transformed the aerodynamic design and analysis processes, including the traditional roles of theoretical analysis and experimentation.

- Third, the renewed interest in hypersonic flight vehicles rekindled activities in dormant facilities, stimulated the development of new experimental techniques, and gave new impetus to numerical simulations of flow conditions that are unattainable in ground-based test facilities.

The Fluid Dynamics Panel responded to these new challenges by organising programmes on new wind tunnel testing techniques, new developments in computational aerodynamics, and basic flow physics. In order to implement these new programmes, two new Committees were formed to complement the Wind Tunnel and Testing Techniques Committee: The Computational Fluid Dynamics Committee in 1984, and the Fundamental and Applied Aerodynamics Committee in 1987.

The need for CFD code validation by special purpose experiments led the panel to promote increased collaboration between experimentalists and computational aerodynamicists. The panel formed a Working Group to select Experimental Test Cases for CFD Validation. In this Working Group, both theoreticians and experimentalists were represented. The present requirement for predictions of rapid high angle-of-attack maneuvers opened up a new area for application of rotary-balance data. The Panel through its working group on Dynamic Wind Tunnel Experiments for Maneuvering Aircraft conducted an ambitious, multinational, multi-facility collaborative program of dynamic tests, using a schematic fighter configuration. In response to the increased emphasis on Hypersonic Aerothermodynamics, a Working Group provided the basis for a series of cooperative efforts in this area which have generated new experimental data and further defined remaining design challenges.

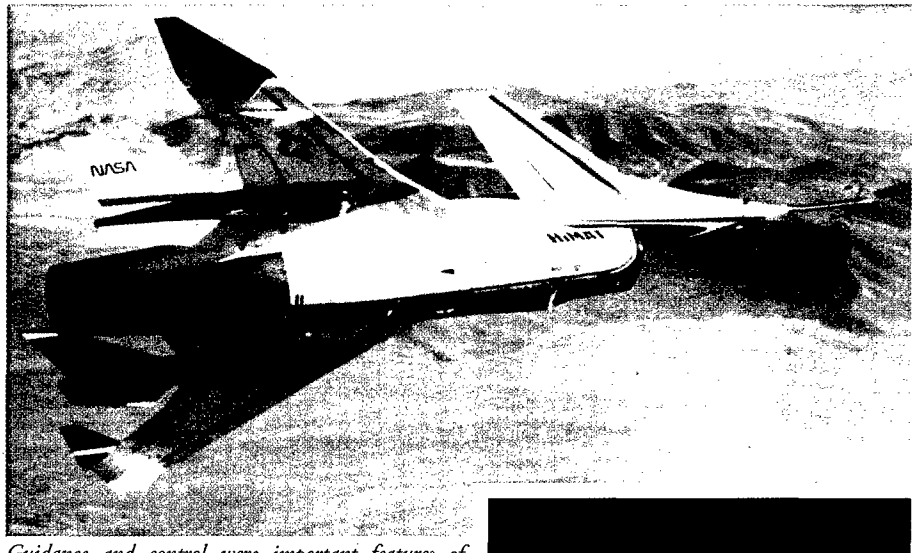
By the end of 1996 the following Working Groups were in progress:

- Sonic Nozzles for Mass Flow Measurements and Thrust Calibration;
- Experimental Data Base for Validation of Turbulence and Transition Simulations;
- Test Cases for Validation of Computational Unsteady Aerodynamics Codes;
- Feasibility Study of Collaborative Multi-facility Wind Tunnel Testing for CFD Validation.

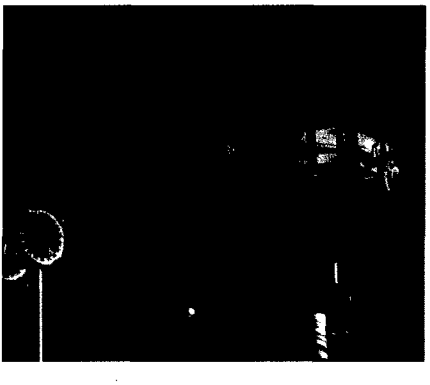
These Working Groups, in conjunction with the themes for recent Symposia, indicate that the Panel continued to remain active in addressing the many remaining challenges in the field of Fluid Dynamics.

Guidance and Control Panel (GCP)

The formation of a new Panel in AGARD to cover the growing area of guidance and control was first proposed to the National Delegates in March 1965. The Delegates realised that there would be some overlap with some of the existing Panels. The Board appointed an ad hoc meeting of leading experts in this field to gain a better understanding of the possible activities of such a Panel. It was recommended to



Guidance and control were important features of HIMAT, a remotely piloted research vehicle developed by NASA to investigate unusual and hazardous flight régimes.



Testing a ring laser gyro, used for the precision navigation and control required by modern weapon systems.

This Bell helicopter, selected for the US Army Helicopter Improvement Programme, included a number of advanced guidance and control features for target acquisition and weapon delivery.

establish an ad hoc Panel for a period of two years. Two years later the NDB agreed on the establishment of a permanent Panel.

At the first meeting of the ad hoc Guidance and Control Panel in Paris, 12 November 1965, professor Walter Wrigley of the Massachusetts Institute of Technology was elected as Chairman. Under his stimulating leadership and that of his successors from both sides of the Atlantic, the GCP developed a very effective programme.

The Panel was concerned with the theory and technology involved in closed loop control dynamics and elements for three principal missions:

- Navigation – the determination of the state (i.e. position, velocity, acceleration) of an aerospace vehicle;
- Guidance – the determination of the difference between the actual vehicle state and the desired vehicle state;
- Control – the generation and implementation of commands which drive the vehicle to the desired state.

The primary functional areas of the Panel were:

- guidance systems and concepts;
- air traffic control and C3;
- weapon delivery;
- inertial navigation systems and update.

The scope of applications achieved by the Panel included ground control and command, covered by several meetings. In several symposia much attention was paid to Inertial Navigation. Air Traffic Control Systems were the subject of a symposium in 1972 and this subject was a focal point thereafter. Several publications were devoted to this subject, often with very relevant civil applications also.

The Panel's continued interest in Air Traffic Control resulted in a series of meetings and an extensive series of publications. These AGARD publications constitute a source of basic literature for all those who are concerned with military air traffic control and the control of the continually growing world-wide civil aviation traffic.

While most meetings focussed on items of more traditional GCP interests, occasionally meetings were held addressing new areas. An example was the meeting held in October 1983 on Guidance and Control Techniques for Advanced Space Vehicles. This symposium was organised in response to the growing military applications of space technology.

In several instances there was a common interest with those of the other Panels of AGARD. On several occasions the expertise was combined with that of the Flight Mechanics Panel, and joint activities were undertaken. Typical of that was a joint symposium with FMP on the subject of flight simulation and guidance and control systems simulation, held in 1975.

Man-machine interaction (human factors in operating aircraft) was a subject of ever increasing importance, and from 1981 this became a major subject, often in conjunction with the FMP.

From 1987 the Panel stressed both guidance and control technology base considerations as well as the system application issues, relative to highly integrated

systems, the man-machine interface, unmanned vehicles and automated mission management functions.

In October 1992, a Symposium on Combat Automation for Airborne Weapon Systems: 'Man/Machine Interface Trends and Technologies', sponsored by the Flight Mechanics and the Guidance and Control Panel was held in Edinburgh, Scotland. The theme of this meeting was the following:

Recent advances in combat automation technologies offer significant potential for improving overall mission effectiveness. Development of advanced situational awareness display concepts, parallel distributed computer architecture, and tactical information fusion techniques have paved the way for new operational capabilities and weapon system employment tactics. Harnessing these innovative technologies is critically dependent upon establishing an effective and intuitive pilot-vehicle interface.

Following the Persian Gulf War, the GCP organized an ad hoc sub group to assess the long-term technology implications. The results, published in a NATO Restricted Report, clearly demonstrated the relevancy of guidance and control technologies to current and future NATO military systems. The Report served as a key factor in realigning the GCP technical programme planning.

The 59th – and last – Symposium of the Guidance and Control Panel was held in the Practica di Mare Air Force Base near Rome, Italy, 20-21 October 1994. The subject of this Symposium, 'Dual Usage in Military and Commercial Technology', was very timely in view of the reductions taking place in military procurement. Future military options may be supported by commercial market development of products which fulfill important military needs. Guidance and control is a natural field for dual-use of technology.

The Symposium was noteworthy in including a large proportion of papers from Russia and Ukraine, as Cooperation Partners under the terms of AGARD's Technical Cooperation Programme. The subject of dual civil/military use was considered highly appropriate to the spirit of international cooperation underlying that initiative.

The Panel generally published two AGARDographs each year. One of the most successful GCP publications has been the AGARDograph on the 'Theory and Application of Kalman Filtering', which was updated and published as 'Advances in the Theory and Technology of Nonlinear Filters and Kalman filters'.

The Panel was active in the provision of support to Greece, Portugal and Turkey, i.a. through Consultant Missions, Short Courses and Special Courses addressing their specific needs. The Panel was also active in maintaining close contacts with the other military and civilian bodies of NATO, thus ensuring that the Panel's activities were relevant to the NATO community.

In January 1994 the GCP, along with AVP, FMP and EPP, were re-aligned into three new system-oriented Panels. The core GCP technical areas of interest migrated to the newly created Mission Systems Panel.

Mission Systems Panel (MSP)

The Mission Systems Panel was formed in January 1994 after a re-arrangement of the Panels. Elements of the GCP and AVP Panels were integrated along with

additional new membership to forge a new direction in the mission systems technology area. The MSP technology legacy was based on the disciplines of guidance, control and avionics. Mr J.K.Ramage (US), who had been the Deputy Chairman of the GCP, became the Chairman.

The integrated mission system problem is in fact a complex multi-dimensional control optimization problem. The enabling technologies and mechanization architecture transcend the full spectrum of system functions, ranging from the vehicle inner loop guidance and control system, to the outer loop flight/mission management system and ultimately to the battlefield command and control function.

The MSP focussed on integrated mission systems, automation techniques and supporting technologies. This is illustrated by the highly successful symposia on tactical C3I, precision strike technologies, and advanced mission system architectures, and a Workshop on air traffic management automation. In addition, the MSP initiated two Working Groups dealing with distributed command and control system functions and defence against tactical missiles, respectively.

The first Symposium of the AGARD Mission Systems Panel (MSP) was held in Copenhagen, Denmark, in May 1994. The title of the Symposium was: 'Guidance and Control Techniques for Future Air-Defence Systems'. Advanced air-defence has become one of the primary issues of operational concerns for NATO. Within this context operational aspects of potential scenarios must be expected to be considerably diversified. Previously assumed scenarios have become obsolete and NATO must redefine the structure and role of its air-defence.

The Gulf War had demonstrated how stealth technology can reduce the effectiveness of air-defence systems. Advances in stealthy and fast moving nap-of-the-earth strategic and tactical weapon systems, as well as strategic and tactical ballistic missiles, operating either individually or in combination, necessitate the development and application of effective guidance and control techniques for advanced air-defence.

In October 1996, the sixth (and last) MSP Symposium on 'Advanced Architecture for Aerospace Mission Systems' was held in Istanbul, Turkey. Mission systems for weapon platforms have become extremely complex and costly in their existing form – that is, a collection of stand-alone systems providing dedicated functions of EW, fire control, communications, etc. The Symposium was concerned with advanced architectures that deal with the mission systems suite as a whole, emphasizing functional integration and data interchange and management. In addition to architectural concepts, applications, and technologies, there was a session on the use of commercial components and a concluding discussion devoted to the beneficial impact of advanced architectures on affordability.

Clearly, the MSP as such was short-lived, but in the programme of the new RTO the subjects initiated by the Mission Systems Panel will receive ample attention.

Propulsion and Energetics Panel (PEP)

The Panel was formed in 1952 as the Combustion Panel, one of the first four Panels. In 1956 the name was changed to Combustion and Propulsion Panel and in 1964

the name became Propulsion and Energetics Panel. The Panel met for the first time in Cambridge, Mass., USA in September 1952, in order to participate in the Fourth International Combustion Symposium and to plan its own activities. Under the acting chairmanship of Dr von Kármán, who stimulated very much the development of the science of combustion, an effective plan for the next few years was made. During the second meeting, held in Rome, December 1952, Dr Surrugue (FR) and Dr Mullins (UK) were elected as the first Chairman and Deputy Chairman, respectively, and definite plans were agreed.

The years 1954-1956 saw a steady build-up of the Panel's programme concerning voluntary research projects, AGARDographs, consultants, and exchanges. The Panel pioneered the way for commercial publication of selected AGARD documents, in addition to the normal AGARD publications. In all, 14 technical volumes were published commercially.

The year 1956 went well for the group; during its tenth meeting at Oslo, Dr von Kármán complimented the Panel on the scientific level it had attained in all its endeavours and he suggested that the Panel expand its scope to include broader propulsion problems and so the first change of the name of the Panel was introduced. The inclusion of propulsion brought the Panel in closer working relations with the other, more aircraft-related, panels. As an example, the Panel started to work with AMP and SMP on an AGARDograph on aircraft noise problems.

The Panel took up many other problem areas such as heat transfer, engine materials, fluid flow problems in compressors and turbines, rocket propulsion, nuclear applications, etc. which required close cooperation with other panels. Thus, the Panel progressed from a small group concentrating on basic combustion problems to a larger group concerned with all the propulsion systems problems.

During the early 1960s, the increasing interest in processes of energy production and conversion, not necessarily combustion in the classical sense, and their application to propulsion systems, led to a further broadening of the scope of the Panel. Therefore the name of the Panel was changed to Propulsion and Energetics Panel in 1965.

Besides the technical meetings, the Panel continued to meet the goals laid down in the Charter of AGARD, by means of Working Groups. The purpose of Working Groups was to bring together experts in a specialised field from several nations to gather existing knowledge, experience and methods, to prepare a report and, when appropriate, to recommend further investigations and applications to AGARD and NATO. This Panel activity started in the early 1970s. Each Working Group involved a number of non-Panel members. The results of the Working Groups were very well received. The major topics were:

- Aircraft Fire Safety;
- Boundary-Layer Effects in Turbomachines;
- Modern Methods of Testing Rotating Components of Turbomachines;
- Improved Nozzle Testing Techniques in Transonic Flow;
- Propulsion and Power Supply for Unmanned Vehicles;
- Future Aviation Fuels;
- Engine Deterioration in Air Force Service;
- Turbulent Transport Phenomena;

- Through-Flow Calculations in Turbomachines;
- Alternative Jet Engine Fuels;
- Suitable Averaging Techniques in non-Uniform Internal Flows;
- Producibility and Cost Studies of Aviation Kerosines;
- Performance of Rocket Motors with Metalized Propellants;
- Uniform Engine Testing Programme;
- Test Cases for the Computation of Internal Flows in Aero Engine Components;
- Recommended Practices for Instrumentation of Aircraft Turbine Engines and Components under Development;
- Test Cases for the Application of Engine Life Assessment Technology;
- Terminology and Assessment Methods of Solid Propellant Rocket Exhaust Signature;
- Experimental and Analytical Methods for the Determination of Connected-Pipe Ramjet and Ducted Rocket Internal Performance;
- Guide to the Measurement of Transient Performance of Aircraft Turbine Engines and Components;
- Recommended Practices for the Assessment of the Effects of Atmospheric Water Ingestion on the Performance and Operability of Gas Turbines.

Each of these Working Groups prepared a final report which in many cases served as a handbook for NATO Countries. As an example, the report of the Working Group on 'Terminology and Assessment Methods of Solid Propellant Rocket Exhaust Signatures' resulted in a Standardisation Agreement of NATO (STANAG) on 'Solid Propellant Smoke Classification' in June 1996.

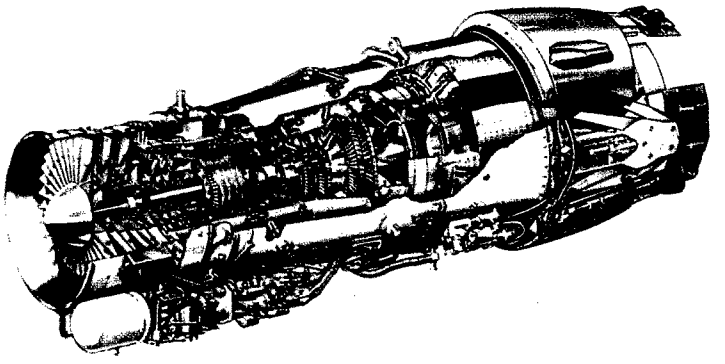
The Panel continued also to sponsor publication of AGARDographs. The most important one in the second half of the 1970s was AGARDograph 220, on 'Aerodynamics of Cascades', and in the 1980s, AGARDograph 298, the 'AGARD Manual on Aeroelasticity in Axial-Flow Turbomachines', sponsored jointly with SMP.

The largest exercise of PEP concerned the 'Uniform Engine Testing Programme' in which the same jet engines were tested in a number of jet engine test stands in various NATO countries. This enormous exercise involved many people at a total cost of several million dollars. Of course the costs were born by the participating nations, but the Panel was instrumental in arranging the programme and in analysing the data.

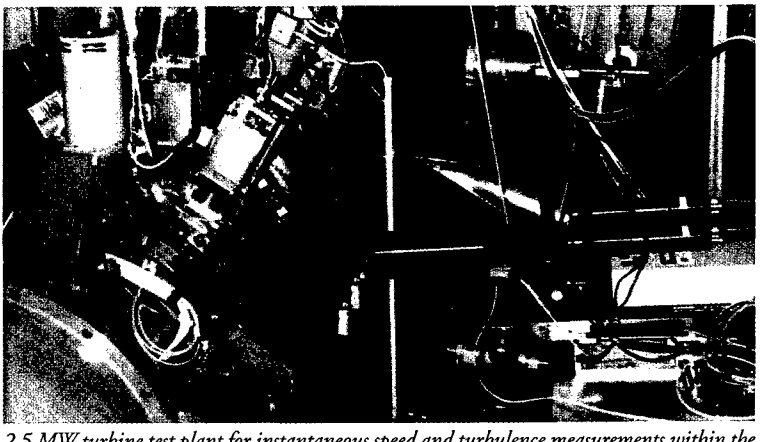
During the late eighties and in the nineties several trends could be observed in the work of the Panel. First of all, and most obvious, were the activities concerned with anticipating the future trends in engine development. Engine development, as almost all technology, had started with the pure quest for performance. It may be recalled that the Panel had been founded only 13 years after the first jet engine had been successfully flown[1].

Secondly, the increase of efficiency and the development of engines as integrated systems of the vehicle system followed. In the '80s and '90s the emphasis was shifting more and more towards the reduction of cost, reliability and safety as well as general

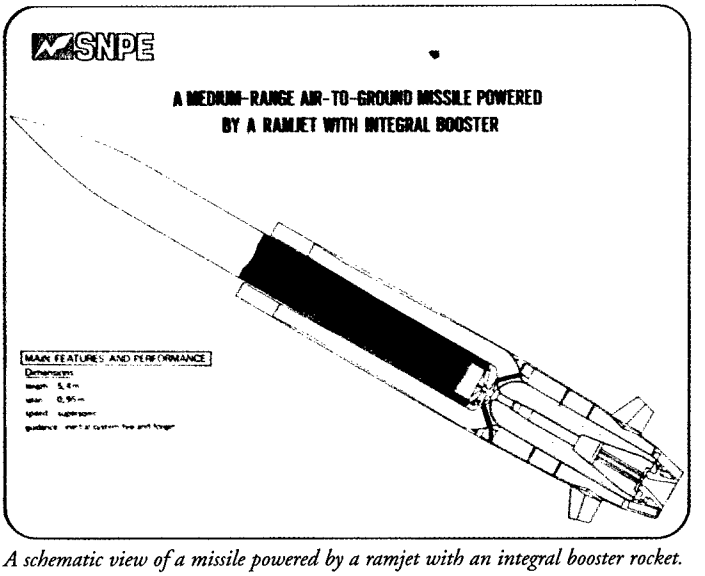
1 Of the two independent inventors, Whittle and von Ohain, the latter was a US Panel Member from 1966 to 1971.



The RB 199 turbo fan engine for the Tornado. The engine was manufactured in collaboration by Rolls-Royce, MTU and Fiat.



2.5 MW turbine test plant for instantaneous speed and turbulence measurements within the rotating blades applying laser-2-focus instrumentation (orange box).



A schematic view of a missile powered by a ramjet with an integral booster rocket.

simplification of operations in adverse environments and, last but not least, the control and minimisation of side effects such as environmental influences. This trend was reflected in the topics chosen for several symposia and working groups.

Meetings on combustion in turbo engines lately dealt very much with fuel economy and the reduction of harmful emissions. As an example, the papers selected for the 1993 Spring Meeting on "Combustion and Fuels in Gas Turbine Engines" were very much concerned with this topic. A meeting on the topic of "Loss Mechanisms and Unsteady Flows in Turbo Engines" was not only concerned with the increase of efficiency and economy and but also with the reliable operation of the engine in off-design conditions as they occur in advanced fighter manoeuvering.

The demands of the 'new' NATO had their effect on the Panel Programme. The requirements became even more severe with respect to response at short notice, possibly on a large scale and in a wide variety of different environments – from an almost tropical climate to an arctic climate. The equipment must have a long service life, be economical to maintain and stock and ready for use at very short notice. While PEP was not able to cover all these aspects, meetings such as "The Service Life of Solid Propellant Systems" and "Erosion, Corrosion and Foreign Object Damage in Gas Turbines" were very applicable. The former was concerned with the functioning and handling of safety aspect of missiles and gun charges; the latter dealt with the minimisation of turbine damage by regular corrosion effects and operation under adverse conditions, e.g. in the sand-laden atmosphere of deserts.

A meeting on "Low Temperature Environment Operations of Turbo Engines" in 1990 was also of much interest.

In the area of safety, PEP contributed to the foundation of the NATO Insensitive Munitions Information Center (NIMIC) by arranging meetings on relevant topics at the appropriate time.

Gun propulsion and rocket propulsion have in common that they employ rapidly expanding gases in a confined volume and they use closely related chemicals as propellant. In the past, PEP activities were occasionally concerned with gun propulsion. In 1993/1994 the PEP Terms of Reference were expanded to include gun propulsion and the topic was pursued thereafter.

Working Groups aimed at reviewing, evaluating and standardising the knowledge on a certain topic available in NATO. They generally resulted in handbooks for designers or operators and suggestions for further research.

PEP continued topics of high interest which do not have sufficient coverage elsewhere such as "Aircraft Fire Safety" in 1989 and 1996. These meetings met with an extremely high interest and regrettably PEP could not comply with all the requests to hold these meetings more frequently.

Sensor and Propagation Panel (SPP)

The Sensor and Propagation Panel was created in 1994 following a re-structuring of the former Electromagnetic Wave Propagation Panel, Avionics Panel, Guidance and Control Panel and Flight Mechanics Panel.

The Terms of Reference of this new Panel covered:

- Electro-optical/laser sensors (including signatures; environmental/ propagation/battle effect limitations; optical components and detectors, lasers, signal and image processing and pattern recognition; hardening)
- Radar and passive radio sensors (including signatures and radar cross sections; environmental/propagation/battle effect limitations; high frequency and radar components, sources, signal processing and information extraction; hardening)
- Communications systems (including environmental/propagation limitations, transmitter and receiver components; coding and signal processing; hardening)
- Electronic warfare and directed energy technology (including electronic support and counter-measures (ESM, ECM), optical/optronical support and counter-measures (OSM, OCM), directed energy technology and systems at all frequencies and wavelengths, as well as camouflage, concealment and deception (CC&D) and signature/cross section reduction technology and measures; relevant environmental/propagation aspects are included too).

The first Chairman of the Panel was Mr. D.Höhn (GE). Through the events following the re-organisation within AGARD, this panel had, like the Mission Systems Panel (MSP), only a short period in which to develop its programme. Fortunately the elements for effective Symposia were there already. Essentially this Panel took over various elements of the preceding Panels. The SPP managed to organise six very timely Conferences during the period 1994-1996 on the following subjects:

- High Power Microwaves;
- Propagation Assessment in Coastal Environments;
- Environmental Factors in Electronic Warfare, Related to Aerospace Systems;
- Digital Communication systems: Propagation Effects, Technical solutions, System Design;
- Remote Sensing; a Valuable Source of Information;
- Radar Signature Analysis and Imaging of Military Targets.

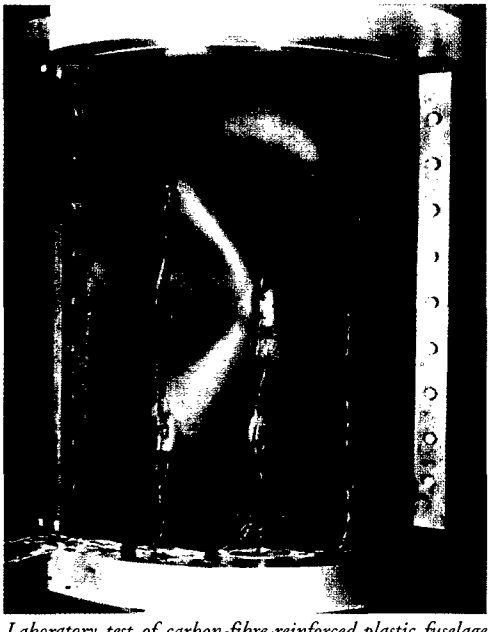
Again as in the case of the MSP, these and similar subjects will be taken up by the new RTO, often in a broader context.

Structures and Materials Panel (SMP)

The Structures and Materials Panel was formed in June 1955. It met for the first time in Ottawa on the occasion of the fifth General Assembly Meeting, under the Chairmanship of Prof. Luigi A.Broglio. Seven Panel Members and six observers attended the inaugural Meeting. In 1996 the Panel was the largest, with 75 members.

The role of the SMP was to deal with the many and diverse problems arising during the various phases of requirements definition, design, manufacturing, maintenance and operation of aerospace vehicles. As implied in its name, Panel activities had a predominant "structures" or "materials" bias. All Panel activities were based either on problems existing or anticipated in the field of air and space vehicles and their equipment or on the development of potentialities which were expected to be of value in the years ahead.

From the beginning, the Panel initiated and monitored progress on Collaborative Test Programmes involving several laboratories across the NATO nations. In all



Laboratory test of carbon-fibre-reinforced-plastic fuselage panel.

Hot corrosion of gas turbine blade.

Typical damage to runway for study of landing gear behaviour under operational conditions.

collaborative programmes, the test materials and the work itself were provided by voluntary contributions from the participating laboratories. Areas where major collaborative efforts were made include: Unsteady Aerodynamics, Active Flutter Suppression, Composite Materials, Fatigue and Corrosion Fatigue.

The Panel first concentrated its attention on structural heating[2], structural material development and structural loading and response. These studies were also aimed at providing solutions to some of the problems posed by the concept and design of lightweight high-speed aircraft in the late 1950s and early 1960s. At the same time, the Panel surveyed most of the outstanding aeronautical structural and materials-related problems of the era.

In 1988 the Panel realigned its technical areas of interest into four Groups to embrace its current and foreseen working activities. The Groups thus constituted were named:

Group 1 – Aero-elasticity, Loads and Dynamics
Group 2 – Structural Design, Analysis and Optimization
Group 3 – Damage Tolerance and Durability
Group 4 – Materials, Processes and Corrosion

A technical Programme Committee was charged with the coordination of the Groups' initiatives during each Panel Meeting.

A summary of the main themes addressed by the Panel throughout the years follows.

Aero-elasticity: The work in the field of Aero-elasticity was initiated by the Panel in 1959, with the collaboration of some fifty authors. A Manual, composed of five volumes, was completed in 1963 and published in loose-leaf form. A sixth volume was added, containing tables and derivatives for the designer's use.

Subsequent efforts dealt with the development of methods of analysis and experimental techniques in unsteady aerodynamics, and transformation of results into design information. In order to further this aim, AGARD Standard Aero-elastic Configurations for the Dynamic Response of two and three dimensional airfoils and aerodynamic conditions were established. More recently, the availability of reliable and efficient computational methods has greatly enhanced the ability to predict the aero-elastic behaviour of modern aircraft operating under the extremely critical transonic flow conditions. The Panel continued to promote further progress in transonic unsteady aerodynamics and aero-elasticity.

Airframe Response to Separated Flow: Analytical and model techniques for the prediction of transonic unsteady air loads during manoeuvering flight, including maneuvers at high angles of attack, require intensive research and development. The Panel's activities were directed towards identifying potential approaches to the problem, including the development of similarity laws, the establishment of correlations between analyses, model tests and flight tests, and the development of

2 In retrospect it is somewhat surprising that the SMP was not started in 1952 when AGARD began with four Panels. From the history it can be surmised that the problems associated with high speed and heating of aircraft structures and ballistic missiles were a major stimulant for Dr von Kármán to initiate the Structures and Materials Panel. As AGARD became more involved in the practical problems of designing, operating and maintaining aircraft, and the SMP paid attention to the subjects concerned with these aspects, the activities of SMP drew more and more the attention of the nations and it became, and remained, the largest Panel of AGARD.

accurate analyses for prediction of the dynamic response of aircraft to transonic separated flows. Important subjects were the evaluation of the capabilities and limitations caused by separated flow and the resulting dynamic response on gun firing, bomb delivery, tracking, and pilot environment, response and performance. Most of this work was carried out in close cooperation with the Fluid Dynamics Panel, FDP.

The Flight of Flexible Aircraft in Turbulence: The Panel collected data on atmospheric turbulence events and assessed new methods for predicting the response of flexible aircraft to turbulence. Related studies in this field included an assessment of the modern operational loads data acquisition programmes and alternative methods of data analysis.

Structural Design Technology: Panel work in this area concentrated mostly on bringing together generalists in the field of design into direct contact with selected specialists to address specific problems such as: the aspects of design technology that are most difficult, least understood and need the most improvement; evaluating the impact on design of new materials, servo-aero-elasticity and fatigue; analyzing the complete design process and formulating procedures which reflect the latest developments in airframe integrated design methods.

In a 1991 Panel activity, participants from USA and Europe, representing the leading aircraft manufacturers and research organisations, took part in a Workshop on the state-of-art for a variety of design objects (wing with engines, fin, swept-forward wing) and materials reflecting the latest developments in the field. This was followed in 1993 by a Meeting on Integrated Airframe Design Technology to show the key factors in multi-disciplinary design optimization. For example, the interface between structures and manufacturing at the conceptual design phase needed to be addressed so that weight and costs of structural design decisions could be traded-off with manufacturing costs. In 1992, between these two meetings, the Panel directed its activity to the novel applications of Smart Structures and Smart Materials for which the close co-operation of nearly all the disciplines currently involved in the design/development activity is mandatory.

Structural Aspects of Active Controls: Active controls offers benefits in at least six important areas, including: improved aircraft performance, improved stability and control, flutter suppression, improved ride qualities, reduced loads, and improved fatigue life. The development of advanced digital flight control systems for a modern military aircraft is strongly influenced by aero-servo-elastic effects, which, therefore, play a very important role in the qualification of aircraft with digital controls. Panel efforts in the field of Active Control Technology have been directed towards the determination of the best philosophy concerning the use of active controls, to evaluating the reliability and safety aspects of active control systems, and to examining the ingredients of proper design criteria and specifications.

Fracture Mechanics: Work in this field has centered first on preparation of a comprehensive survey of the pertinent information available on the applications of fracture mechanics to metals, and to probe such problem areas as flaw susceptibility, stress corrosion, non-destructive testing, fractographic material examination, crack propagation and residual strength aspects of aircraft structures and the brittle fracture problem in general. Collected information has been applied to the methodology of

aircraft structural design and to the practical application of fracture mechanics concepts in the design of many types of components.

Efforts have focussed on the development of damage tolerance concepts in connection with the "lifing" philosophy, which is based upon the assumption that structural components are not necessarily free from cracks and harmful defects, but that knowledge of the loading of the component and the ability to predict the crack and defect behaviour in service will lead towards reliable assessment of the durability between inspections.

Designers must apply advanced stress analysis and fracture mechanics beyond linear elastic considerations to demonstrate the lifetime for each component while maintaining an adequate level of safety. For the implementation of damage tolerance concepts a fundamental understanding of the materials properties, the operational environment, the loading, and failure modes is required. The Panel has carried out work in this field during the last several years.

Fatigue: The Panel has carried out work in this area since its beginnings. Main problems in the area include, Cumulative Damage, Residual Strength, Creep Fatigue Correlations, Corrosion Fatigue, Acoustic Fatigue, Low-Cycle High Temperature Fatigue and Thermal Mechanical Fatigue. The Panel produced a Manual on Fatigue for the design engineers and operators of aircraft.

Widely accepted procedures for the fatigue life evaluation and management of airframe structures by designers and operators are provided for the definition of the load environment, the development of analytical methods for fatigue life substantiation, including crack propagation and residual strength calculations and for techniques for monitoring the fatigue life consumption during actual operation.

Panel activities included Collaborative Test Programmes on research for short-crack effects in engine disc materials. A recent Collaborative Test Programme conducted by the Panel on Fatigue Crack Growth in Engine Disc Materials with the participation of engine manufacturers, government research organisations, and universities, has produced extremely valuable experimental data.

Non-Destructive Inspection/Non Destructive Evaluation: The Panel published a handbook on non-destructive inspection methods. The Panel work illustrates the various NDI/NDE methods in their application to typical airframe inspection problems, and to show their capabilities, limitations and reliability. In 1992 at a Specialists' Meeting on the impact of NDE-NDI methods on aircraft design, manufacture and maintenance, representatives of the design, manufacturing, airworthiness and maintenance communities exchanged views and ideas on their respective research efforts.

Composite Materials: The application of composite materials was explored by the Panel since 1964. High strength, fibre reinforced polymer matrix composites were considered for highly strained primary aircraft structures. Fibre reinforced metal matrix composites (MMC) offer major benefits for aircraft and airframe applications, where the combination of stiffness, strength and high temperature resistance provided by these materials can be used to reduce weight and improve performance. The Panel was active in the study of composite materials in order to improve the understanding of the manufacturing, design and application of these

materials, to review activity with respect to research, and to study and to summarize theoretical and experimental knowledge on the failure modes of composite materials with organic or metallic matrices and provide practical advice in this field to designers. Questions on what the designer needs to know about their behavior, what measurements and test methods are available and in use, how results are related to materials modeling and component behavior and what tests and analysis techniques, have been addressed by the Panel in recent meetings. In addition the evaluation of state-of-the-art technology for the repair of aircraft structures involving composite materials was an important subject of a recent meeting due to the need to extend aircraft service well beyond original design life.

High Temperature Materials: Many advanced turbine materials are now being used to a very high fraction of their ultimate capabilities. There is a pressing need to develop materials with enhanced high temperature properties. The present need to characterize the properties of materials under complex combined states of high temperature and stress, and to estimate the service life of the materials under these conditions, was the subject of a Cooperative Test Programme initiated by the Panel which had as its main purpose the recommendation of methods to design lower-cost, more durable and more reliable high-temperature materials components. The Panel also supported a Working Group to establish internationally accepted methods for elevated temperature testing and data analysis for aerospace materials with regard to crack growth and low cycle fatigue. Other efforts in this field have covered the use of ceramic materials in turbines and the improvement of component utilization by life extension and repair.

Advanced Manufacturing Techniques: Advanced fabrication techniques of aerospace materials such as casting of super-alloys, planetary rolling, explosive bonding, and electroforming, has played an important role in improving the economic production of aerospace structural components. The work of the Panel consists of collecting and reviewing available data, determining needs for additional research and development efforts, convening meetings of specialists in the field for direct interchange of the latest information and developments, and the publication of documents concerning the efforts and results achieved in this field. The Panel has prepared a Manual on Advanced Castings for use by designers. It has also considered developments in materials process modelling, particularly for the forming of pre-shaped components, such as castings and forgings. These developments can both lower costs and increase reliability in the manufacture of components.

More recently the Panel was concerned with Virtual Manufacturing technology, i.e., the integration of enabling technologies with traditional and new manufacturing tools. The integrated set of Virtual Manufacturing technologies provide an accurate, 3-D simulation environment for rapid evaluation of new methods and processes and alternative production scenarios across facilities and enterprises. The ultimate purpose of Virtual Manufacturing is to dramatically reduce lead times and costs.

In summary, the Structures and Materials Panel of AGARD consistently focused its thrust on intermeshed, wide scope subjects which have the potential for significant payoffs in a not too-distant-future. It should be recognized that the fall-out of these activities was often of dual use, equally applicable within any of the aerospace communities of the member nations of NATO.

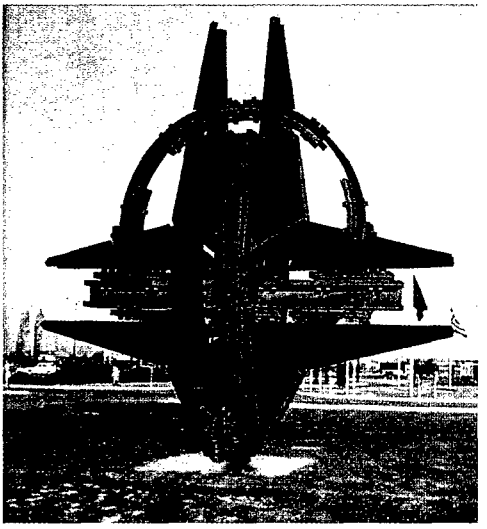
Technical Information Panel/Committee (TIP/TIC)

The Documentation Committee, which later became the Technical Information Panel, was established at the Rome General Assembly in December 1952, its first meeting being held on the 30th of March 1953. The primary purpose of the Committee was to provide service and advice in documentation for the AGARD Technical Panels, to assist in resolving publication problems of the Panels and, through the individual members of the Committee, to stimulate the national agencies for aeronautical documentation.

To achieve these ends, the Documentation Committee was concerned with the following activities:

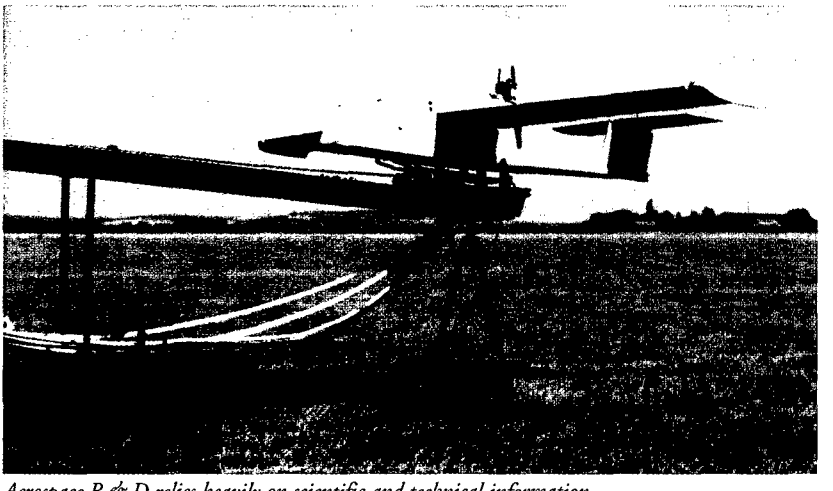
- The standardisation of the form of the technical reports produced within the NATO countries (AGARD Specification 1);
- The provision in all scientific and technical reports of detachable index cards, containing an abstract of the subject matter of reports. Such index cards assisted in the classification and indexing of aeronautical information;
- The publication of a report on 'Sources of Translation of Aeronautical Interest';
- The production of the AGARD Aeronautical Multilingual Dictionary of aeronautical terms in eight languages, namely: Dutch, English, French, German, Italian, Russian, Spanish and Turkish, and providing in each language a definition of the concept of each term;
- The production of a number of relevant biographies at the request of the Panels. The members of the Committee also collaborated in the production of biographies required for ad hoc activities;
- In the subject classification of aeronautical material, agreement was sought on a common system of classification and on adequate linking of the individual systems used in the various member countries;
- Discussion of the problems of exchanging scientific and research films and the production techniques for such films. A document was published on 'The Preparation of Research Films';
- The Committee stressed the importance of adequate abstract services for both published and unpublished aeronautical material. In the unpublished field, the Committee's requirements for index cards, with abstracts, produced valuable results. The Committee's requirements for abstracts of published material led to increasing cooperation and coordination from the national agencies;
- The study of retrieval systems to assist in the classification and subsequent retrieval of recorded material;
- Contacts with other international documentation agencies, both through the Committee as a body and through appropriate national members;
- Advice on AGARD publications, including proceedings of General Assemblies, AGARDographs, reports, bibliographies, and occasional special publications, of which the Flight Test Manual and the Aeronautical Multilingual Dictionary are examples.

For many years the AGARD Documentation Committee worked closely with the NATO Science Committee in an effort to facilitate the exchange of information within NATO countries. Studies of this problem were carried out over a long period. Consultants were sent to Turkey and Greece to aid them in establishing National Defence Documentation Centres, thus enabling them to participate actively in the



The Technical Information Panel carried out a study of the information management needs of the NATO Organisation and NATO HQ, where this sculpture stands.

"We are drowning in information but starved for knowledge"
J. Naisbitt, 1984.



Aerospace R & D relies heavily on scientific and technical information.

exchange of information programmes.

Because of its active participation in the exchange of information, the name was changed to Technical Information and Documentation Committee (abbreviation: TIDOC) in 1962. Subsequently, in 1965, the National Delegates Board decided to give the Committee full panel status under the name of Technical Information Panel. Meetings were held at least once in each year since the original foundation of the Documentation Committee and in 1968, in addition to its own ordinary Panel Meeting, the Panel collaborated with the Avionics Panel in holding a large-scale Symposium on Storage and Retrieval of information.

From 1965 to 1993, the Technical Information Panel, while maintaining an interest in the majority of activities originated by the Documentation Committee, in addition initiated new projects in the following areas:

- A Specialists' Meeting was held annually. These meetings generally alternated between those which helped the user to get the best out of existing systems (and which often addressed problems being experienced by the Nation hosting the meeting) and those which reported on the state-of-the-art of information science subjects.
- Because of the widespread interest in Information Science the Panel sponsored Lecture Series on aspects of this topic in the aerospace/defence subject fields.
- As part of its programme, the Panel instituted the preparation of a series of Indexes of AGARD Publications commencing with a four-part compilation covering the years 1952-70. Since that time, machine-compiled Supplements were produced, each covering a period of three years up to the end of AGARD publications in 1998. In addition, from 1992 a computer database of unclassified AGARD publications was compiled by NASA, under TIC auspices. This was used as input to a commercially published CD-ROM containing details of AGARD and NATO Scientific Affairs Division publications.
- In 1980 a new multilingual dictionary, now known as the 'AGARD Multilingual Aeronautical Dictionary' and containing two additional languages: Greek and Portuguese, was published. This publication was unique at that time in relying extensively upon computer techniques for its text-setting in the various languages.
- Modern data files greatly facilitated the rapid preparation of bibliographies, and the Panel and Committee provided these, when asked, for AGARD Lecture Series and in support of other Technical Panel activities
- The Panel remained active in the preparation of numerous publications specifically directed to those with information science responsibilities in the aerospace/defence field. Publications produced included a 5-volume Manual of Documentation Practices Applicable to Defence-Aerospace Scientific and Technical Information, a Guide to Aerospace and Defence Technical Report Series in the NATO Nations, and a Manual on the Evaluation of Information Centres and Services, which was (subsequent to normal publication and distribution by AGARD) sold commercially (and successfully) by the American Institute of Aeronautics and Astronautics (AIAA).
- The Panel, concerned with the problems of identifying and obtaining NATO scientific and technical documents, held a meeting on this topic in 1984. As a direct result of the presentations and discussions at this meeting a Working

Group was set up to investigate the need for a scientific and technical information service for NATO HQ. Although NATO did not accept the recommendations of this Working Group, it was instrumental in persuading NATO to accept the need for compatibility between all information systems such as those for standards, insensitive munitions and the registries.

In 1994, as part of the reduction in the number of Panels, TIP reverted to being a committee, the Technical Information Committee, and no longer held Specialists' Meetings or ran Lecture Series. It continued to meet twice-yearly for a business meeting, sometimes in conjunction with a workshop organised by the host nation or including a seminar on topics of interest addressed by outside experts. Its main purpose was to advise and assist AGARD in its information management programme. In this role, TIC played a large part in guiding the Scientific Publications Executive in the preliminary steps leading to the production of a set of CD-ROMs containing page images of all AGARD publications, in preparing for electronic publication by RTO, and in designing a proposed Web Site for AGARD and later RTO. Renamed Information Management Committee in 1998, it continued to provide similar advice to RTO.

CHAPTER 8 AGARD CONSULTANT AND EXCHANGE PROGRAMME

As mentioned in Chapter 3 under the heading 'Second General Assembly', Dr von Kármán and others early recognised that the activities of the internationally constituted technical panels would be greatly enhanced by the formation of a corresponding international Consultant and Exchange of Personnel Programme. Though such a programme was not novel at that time, there was little experience to draw from and it became clear that in order to start an exchange programme with a limited budget and to organize a consultant service of value to the NATO Aeronautical Establishments it would be necessary to institute new procedures.

The AGARD Exchange Programme was started by pioneering work to find laboratories willing to receive foreign scientists for periods of from three months to a year; and when a suitable number had agreed, AGARD informed the various NATO nations through the appropriate channels of National Delegates and Panel Members.

The Consultant activities started in a similar way, by selecting requests from laboratories of the NATO nations and appointing highly qualified scientists for consulting assignments of short duration.

The seed was planted and as time passed it became evident that the Consultant and Exchange Programme was a most effective way to increase contacts and coordination between NATO aeronautical research and development engineers and scientists, research establishments, universities, private laboratories and government agencies.

From the beginning the Programme promoted:

- Assignments of scientists and engineers at research establishments, laboratories or universities in the various member countries for research on subjects of mutual interest;
- Organization of scientific lectures on fundamentally important problems at the request of the NATO nations;
- The implementation of short duration courses enabling engineers from NATO nations to become acquainted with specific techniques under the guidance of qualified professors or experts;
- Visits to laboratories or research centres with a view to improving the coordination of aeronautical research in the member countries;
- The exchange or loan of research instruments or equipment at the request of participating nations wishing to carry out a particular research programme;
- The organization of scientific missions.

The budget for this Programme was extremely limited and most of the exchanges of scientific personnel were organized without financial support from AGARD. Many nations very willingly participated in the exchange of personnel in providing fellowships, research grants, etc. Through the assistance of the US Air Force, the Consultant Programme was started by two main flows, visits of US scientists funded by NASA and the US Air Force to European laboratories, and assignments of European scientists to other NATO nations.

It is of interest to mention that, in implementing this new Programme, Dr von Kármán was convinced that to be successful AGARD had to do two things:

a. To increase the exchange of information among nations at the frontier of

knowledge, and

b. To improve continuously the knowledge and state-of-the-art in the nations having only a partial knowledge of the most recent advances made in aeronautical research.

The Consultant and Exchange Programme encompassed the support for AGARD's Individual Consultants and Lecture Series activities. Financial support was provided for missions performed by individual consultants, for Short Courses, and Exchange of Scientists and Engineers for which specific approval of the National Delegates Board was not required, as well as for Special Courses which required the prior approval of the Board. Individual Consultants were requested by the Nations, by the Panels, and by NATO Organizations. The number of such requests started with 13 in 1954 and gradually increased to the level of 150 and more per year.

Individual Consultants

After the financial support of NATO became effective for AGARD – as of 1954 – the Director of AGARD proposed in the AGARD budget a Consultant Programme which would permit making 500 days of consultant services available to the nations. However, this number was in fact greatly exceeded largely owing to the various voluntary contributions made by the nations. In 1960 a detailed survey of the work performed by the consultants was made by the National Delegates Board and an increase in the Programme was unanimously recommended.

Other International organizations have studied the AGARD Consultant Programme and under various and different names the same Modus Operandi has been implemented elsewhere, which indicated the acceptance of this successful pioneering effort.

It is not possible to review here the many cases and successful tasks performed by the AGARD consultants. It is true to say that almost all scientific establishments dealing with aerospace research in the NATO nations have been involved in this Programme, either as donor establishments making their scientists available, or as receiving partners. One interesting aspect of this activity has been that, regardless of the task assigned to a given consultant, the contacts made were always mutually beneficial. New ideas or new approaches were often discovered, and when the ideas were brought back home they often proved to be of significant interest.

Lecture Series

The AGARD programme of Lecture Series was addressed to wider and sometimes less specialized audiences than the AGARD Specialists' Meetings, and was intended to present state-of-the-art reviews of a variety of technical and scientific fields.

Lecture Series were organized at the request of Member nations, as a result of suggestions from Panels or the AGARD staff. Appropriate Panels assisted the Chief, Plans and Programmes in organizing the Lecture Series, especially by suggesting qualified Lecture Series Directors.

AGARD organized a limited number of Lecture Series each year. The continuing popularity of this programme was demonstrated by the increasing number of requests received from the Nations. The Panels were very much interested in the

Lectures series and generated many proposals. Starting with one Lectures Series in 1954, it was built up to four to six per year each lasting two days, and given at two to four locations.

The texts of Lectures presented in this programme were published and distributed by AGARD to the member nations through the National Distribution Centres.

During the period 1954-1997, a total of 208 Lecture Series was organised.

Since the creation of the AGARD Consultant and Exchange Programme, close to 5000 experts, representing all aspects of the aerospace sciences, have participated in this programme, of which a third were engaged in the Lectures Series Programme.

Lecture Series Organised by the AGARD Consultant and Exchange Programme and the Panels

Year	Number	Subject
1954	1	Travelling Seminar: Aerodynamics, Propulsion, Structures
1957	2	Conference on Operational Research with NATO and SHAPE
1957	3	Military Application of Operational Research
1958	4	Space Research and Technology
1959	5	Operational Research
1960	6	Space Propulsion Seminar
1961	7	Astronautics
1961	8	Navigational Satellite Systems
1962	9	Nuclear Rocket Propulsion
1963	10	Physics of Gases for Aerodynamicists
1963	11	Micropower Electronics
1964	12	Satellite Technology for Meteorology
1964	13	Nuclear and Electric Rocket Propulsion
1964	14	Orbit Optimization and Advanced Guidance Instrumentation
1965	15	Fluid Mechanics in Radial Turbo Machines
1965	16	Introduction to the Aerodynamics of Ground Effect Machines
1965	17	Space Navigation, Guidance and Control
1965	18	Engineering Application of Advanced Techniques of Random Process Analysis
1965	19	Guided Missile Engineering
1965	20	Bionics
1965	21	Flutter
1966	22	The Application of Micro-electronics to Aerospace Equipment
1966	23	Fluid Control-Components and Systems
1967	24	Boundary Layer and Circulation Control
1967	25	Supersonic Turbo-Machinery
1967	26	Industrial Aerodynamics
1967	27	Energy Sources for Space Power
1967	28	Fluid Dynamics of Turbo-machinery
1968	29	Radio Wave Propagation
1968	30	Inertial Component Testing Methods
1968	31	Air and Space Borne Computers
1968	32	Aerodynamics of V/STOL

1968	33	Mechanics of Boundary Layer Transition
1969	34	Applications Technology Satellites
1969	35	Fluidic Control Systems for Aerospace Propulsion
1969	36	Applications and Methods of Random Data Analysis
1969	37	High Reynolds Number Subsonic Aerodynamics
1969	38	Hypersonic Boundary Layers
1970	39	Advanced Compressors
1970	40	Large-Scale Integration in Microelectronics
1970	41	Applications of Propagation Data to VHF Satellite Communication and Navigation Systems
1970	42	Aerodynamic Problems of Hypersonic Vehicles
1970	43	Assessment of Lift Augmentation Devices
1970	44	Scientific and Techno-Logical Information — Why? Which? Where? and How?
1971	45	Attitude Stabilization of Satellites in Orbit
1971	46	Small Gas Turbines for Helicopters and Surface Transport
1971	47	Reliability of Avionics Systems
1971	48	Numerical Methods in Fluid Dynamics
1971	49	Laser Technology in Aerodynamic Measurements
1972	50	Flight Test Instrumentation
1971	51	Characterization and Application of Materials
1972	52	Guidance and Control of Tactical Missiles
1972	53	Airframe-Engine Integration
1972	54	Abbreviated Test Language for Avionics Systems
1972	55	Composite Materials
1972	56	Aircraft Performance Prediction, Methods and Optimization
1972	57	Heat Exchangers
1973	58	Spread-Spectrum Communications
1973	59	Determination and Use of Radar Scattering Characteristics
1973	60	Testing Philosophy and Methods of Guidance and Control Systems and Sub-systems
1973	61	Optics of the Sea (Interface and In-Water Transmission and Imaging)
1973	62	Fatigue Life Prediction for Aircraft Structures and Materials
1973	63	Helicopter Aerodynamics and Dynamics
1973	64	Advances in Numerical Fluid Dynamics
1974	65	Preliminary Aircraft Design
1974	66	Laminar and Turbulent Separation, Including 3-D Effects
1974	67	Predication Methods for Aircraft Aerodynamics Characteristics
1974	68	(Replaced by an AGARD Consultant Mission)
1974	69	How to Obtain Information in Different Fields of Science and Technology – A User's Guide
1974	70	Structural Optimization
1974	71	Opto-Electronics
1974	72	Distortion-Induced Engine Instability
1975	73	Computational Methods for Inviscid and Viscous Two and Three-Dimensional Flow Fields
1975	74	Aircraft Stalling and Buffeting
1975	75	Custom Design for Large-Scale Integration

1975	76	Electro-Optical Systems
1975	77	Aircraft Engine Noise Generation Emission and Reduction
1975	78	Radiation Hazards (Non-Ionizing Radiations æ Biologic Effects and Safety Considerations)
1975	79	Laser Hazards and Safety in the Military Environment
1976	80	Aerodynamic Noise
1976	81	Avionics Design for Reliability
1976	82	Practical Aspects of Kalman Filtering Implementation
1976	83	Modern Prediction Methods of Turbo-machine Performance
1976	84	Prevention and Combat of Corrosion in Aircraft Structures
1976	85	Review of Developments in Computer Output Microfilm
1976	86	Computational Fluid Dynamics
1977	87	Microprocessors and their Applications
1977	88	Applications of Remote Sensing to Ocean Surveillance
1977	89	Task-Oriented Flight Control Systems
1977	90	Laser Optical Measurement Methods for Aero Engine Research and Development
1977	91	Advanced Manufacturing Techniques in Joining of Aerospace Materials
1978	92	The Application of Inexpensive Minicomputers to Information Work
1978	93	Recent Advances in Radio and Optical Propagation for Modern Communications, Navigation and Detection Systems
1978	94	Three Dimensional Unsteady Separation at High Reynolds Numbers
1978	95	Strap-Down Inertial Systems
1978	96	Aircraft Engine Future Fuels and Energy Conservation
1978	97	Fracture Mechanics Design Methodology
1979	98	Missile Aerodynamics
1979	99	Aerospace Propagation Media Modelling and Prediction Schemes for Modern Communications, Navigation and Surveillance Systems
1979	100	Methodology for Control of Life Cycle Costs for Avionics Systems
1979	101	Guidance and Control for Tactical Guided Weapons with Emphasis on Simulation Testing
1979	102	Bonded Joints and Preparation for Bonding
1979	103	Non-Destructive Inspection Methods for Propulsion Systems and Components
1979	104	Parameter Identification
1979	105	Sleep, Wakefulness and Circadian Rhythm
1980	106	Materials Coating Techniques
1980	107	The Application of Design to Cost and Life Cycle Cost to Aircraft Engines
1980	108	Aircraft Assessment and Acceptance Testing
1980	109	Fault Tolerance Design and Redundancy – Management Techniques
1980	110	Atmospheric Electricity
1980	111	Cryogenic Wind Tunnels
1980	112	Patents – An Information Resource

1981	113	Microcomputer Applications in Power and Propulsion Systems
1981	114	Dynamic Stability Parameters
1981	115	Personal Visual Aids for Aircrew
1981	116	Electromagnetic Compatibility
1981	117	Multi-variable Analysis and Design Techniques
1981	118	Fatigue Test Methodology
1982	119	Image-Processing Techniques
1982	120	Electro-Magnetic Propagation Problems in the Tactical Environment
1982	121	High Angle-of-Attack Aerodynamics
1983	122	Application of Digital Mapping Technology to Guidance and Control Systems
1982	123	Aircraft Fire Safety
1982	124	Practical Considerations of Design, Fabrication and Tests for Composite Materials
1982	125	Human Factors Aspects of Aircraft Accidents
1983	126	Modern Display Technologies for Airborne Applications
1983	127	Modern HF Communications
1983	128	Computer-Aided Design and Analysis of Digital Guidance and Control Systems
1983	129	Speech Processing
1983	130	Development and Use of Numerical and Factual Data Bases
1983	131	The Performance of Antennas in their Operating Environment
1984	132	Operation and Performance Measurement on Engines in Sea-Level Test Facilities
1984	133	Advances in Strapdown Inertial Systems
1984	134	Aeromedical Support in Military Helicopter Operations
1984	135	Advanced Technology for SAM Systems Analysis Synthesis and Simulation
1984	136	Ramjet and Ramrocket Propulsion Systems for Missiles
1984	137	Process Modeling Applied to Metal Forming and Thermomechanical Processing
1985	138	The Impact of Proposed Radio Frequency Radiation Standards on Military Operations
1985	139	Helicopter Aeromechanics
1985	140	3-D Computation Techniques Applied to Internal Flows in Propulsion Systems
1985	141	Management of Corrosion
1985	142	Artificial Intelligence and Robotics
1985	143	Fault-Tolerant Hardware/Software Architecture for Flight Critical Function
1986	144	Interaction between EMP, Lightning and Static Electricity with Aircraft and Missile Avionics Systems
1986	145	Propagation Impact on Modern HF Communications System Design
1966	146	Application of ADA Higher Order Language to Guidance and Control
1986	147	Practical Application of Finite Element Analysis to Aircraft Structural Design

1986	148	Engine-Airframe Integration for Rotorcraft
1986	149	The Application of Microcomputers to Aerospace and Defence Scientific and Technical Information Work
1987	150	Design Methods in Solid Rocket Motors
1987	151	Microwave Antennas for Avionics
1987	152	Theoretical Aspects of Target Classification
1987	153	Integrated Design of Advanced Fighters
1987	154	Superplasticity
1987	155	Knowledge-Based Concepts and Artificial Intelligence Applications to Guidance and Control
1988	156	Visual Effects in the High Performance Aircraft Cockpit
1988	157	Advances in Flying Qualities
1988	158	Computing Systems Configuration for Highly Integrated Guidance and Control Systems
1988	160	Evaluating the Effectiveness of Information Centres and Services
1988	161	The Navstar GPS System
1988	162	Media Effects on Electronic Systems in the High Latitude Region
1989	163	Human Performance Assessment
1989	164	Systems Engineering
1989	165	Modern Antenna Design using Computers and Measurement and Application to Antenna Problems of Military Interest
1989	166	Kalman Filter Integration of Modern Guidance and Navigation Systems
1989	167	Blading Design for Axial Turbomachines
1989	168	Superplasticity (LS 154 repeated)
1990	169	Comparative Engine Performance Measurements
1990	170	Speech Analysis, Synthesis and Man-Machine Speech Communications for Air Operations
1990	171	Benefits for Computer assisted Translation to Information Managers and End-Users
1990	172	Propagation Limitations for Systems using Band-Spreading
1990	173	Missile Interceptor Guidance System Technology
1990	174	New Light Alloys
1990	175	Motion Sickness: Significance in Aerospace Operations and Prophylaxis
1990	176	The Conflicting Forces Driving Future Avionics Acquisition
1991	177	Electromagnetic Interference & Electromagnetic Compatibility
1991	178	Rotorcraft System Identification
1991	179	Artificial Neural Network Approaches in Guidance and Control
1991	180	Combustion of Solid Propellants
1992	181	Intellectual Property Rights
1992	182	Fundamentals and Special Problems of Synthetic Aperture Radar
1992	183	Steady and Transient Performance Prediction of Gas Turbine Engines
1992	184	Advances in Fiber Optics, Technology in Communications and for Guidance & Control
1992	185	Machine Perception
1992	186	Integrated Design Analysis and Optimization of Aircraft Structures
1992	187	Visual Problems in Night Operations

1993	188	Rocket Motor Plume Technology
1993	189	Cardiopulmonary Aspects in Aerospace Medicine
1993	190	A Recommended Methodology for Quantifying Non-Destructive Inspection (NDI) and Evaluation (NDE) based on Aircraft Engine Experience
1993	191	Non-Linear Dynamics and Chaos
1993	192	New Advances in Mission Planning and Rehearsal Systems
1994	193	Advanced Guidance and Control Aspects in Robotics
1993	194	Research and Development of Ram/Scramjets and Turboramjets in Russia (given by Russian speakers)
1994	195	Turbomachinery Design using CFD
1994	196	Propagation Modelling and Decision Aids for Communications, Radar and Navigation Systems
1994	197	Flight in an Adverse Environment
1994	198	Mathematical Models of Gas Turbine Engines and their Components (given by Russian speakers)
1995	199	Optical Processing and Computing
1995	200	Knowledge Based Guidance and Control Functions in Aerospace Systems
1995	201	Environmentally Safe and Effective Processes for Paint Removal
1995	202	Current Concepts on G-Protection Research & Development
1995	203	Cancelled
1995	204	Advanced Polymeric and Metallic Composite Materials for Space and Aerospace Vehicle Structures and Strength Optimization of Composite Structures and their Certification (given by Russian speakers)
1996	205	Smart Structures & Materials
1996	206	Aging Combat Aircraft Fleets
1996	207	System Implications & Innovative Application of Satellite Navigation
1997	208	Injury Prevention in Aircraft Crashes : Investigative Techniques and Applications
1997	209	Helicopter / Weapon System Integration
1997	210	Advances in Soft Computing Technologies Application in Mission Systems

Not in the regular Lectures Series but organised by the same Division and using the same procedures:

1990 Seminar on the Structure of Aeronautical R & D (Held in Greece, Portugal and Turkey under the aegis of the Support Programme and published as AGARD-R-782).

CHAPTER 9 PROGRAMME OF SUPPORT TO GREECE, PORTUGAL, AND TURKEY

From the beginning of AGARD, forty-five years ago, one of the aims was to improve the strength of the technologically weaker countries and especially improve their capabilities in the aerospace field. This was in line with the NATO strategy. As the strength of the larger European nations grew, the flow of information and activity in AGARD among the major nations became more and more a 'two-way street'. At the same time, the less technologically advanced nations of the Alliance began to take a greater interest in aeronautics and thus in AGARD's activities, and AGARD's efforts to assist them increased.

Those nations benefitted from AGARD activities such as Lecture Series, the Consultant and Exchange Programme, and from the many AGARD publications; and their Panel members took part in AGARD activities to some extent. However it was realised that the benefits from participation in AGARD – as with most other activities – are more or less proportional to the efforts one puts into the organisation. It was realised that further benefits would only come to those nations to the extent that they played an active role in AGARD. This meant that the appointed Panel members should be able to attend the meetings regularly and undertake active roles in the Panels.

In March 1979 the National Delegates Board agreed to start a programme to assist in the meeting attendance of Panel members from Greece, Portugal and Turkey. This was called the 'Support to Nations' Programme. In May 1979 the NATO Military Committee formally instructed AGARD to propose further assistance to Greece, Portugal and Turkey to improve their capabilities in the aerospace field. As a result, the National Delegates Board approved, and the Military Committee endorsed, a programme under the title 'Additional Support to Greece, Portugal and Turkey' to begin in January 1981.

This programme covered forms of assistance not available under other parts of the AGARD programme, and in particular provided long-term assistance and training related to specific research programmes in the three countries. The AGARD Panels played an important role in the initiation of the activities and in continually reviewing the programme. The projects were carried out on a bi-lateral basis between organisations of one of the three countries and those of the other NATO countries.

Over 300 cooperative projects (Support Projects) were carried out. Some were small, in that simple meetings between experts of the countries with their counterparts in the other NATO nations produced quickly a cooperative effort; sometimes they involved transfer of equipment and the associated knowledge and experience. In almost all cases the Panels played an important role. Panel members became acquainted with each other and knew what was feasible and what not. It was often surprising how much could be accomplished through simple procedures in their own organisations once the Panel members were convinced that it was a worthwhile project. With what may be called 'seed money' AGARD was a real catalyst.

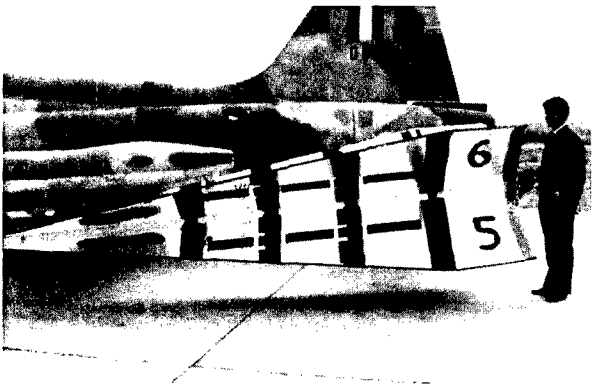
Funds were provided for Panel members from these nations to attend Panel meetings each year, staring with 17 in 1981 and rising to about 100 a year in the 1990's. The number of active 'Support Projects' sponsored by the Panels varied from year to year, but typically it was at the level of 60 at any one time. Some were small, but in general

the impact was considerable. A leading aerospace scientist from one of these countries stated that he owed all his international relations to AGARD; through the cooperation with other nations he managed to upgrade the research of his institute to an international level.

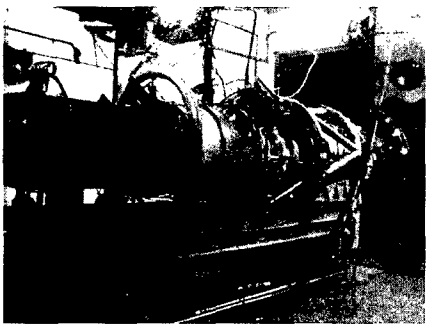
The last major review of the Support Programme was given at the National Delegates Board meeting in September 1995. It was clear that the programme had had a considerable impact over the last 15 years and that the aeronautical R & D base and also the direct capabilities to support the air forces of the nations concerned had been strengthened by this programme.

The Plans and Programmes Division at AGARD Head-Quarters coordinated and administered the programme and the Panel Executives acted as Project Officers.

The Aerospace Medical Panel Working Group's work on the orientation/disorientation training of flying personnel led to the development by the Portuguese Air Force of this Spatial Disorientation Trainer.



The Flight Mechanics Panel sponsored a project to help Greece develop a capability in store separation techniques. Although intended mainly for bombs and pods, it was also used for a Dart towed target, as shown here.



The Propulsion and Energetics Panel sponsored support by the National Research Council of Canada in which the same engines were tested in Canada and by the Turkish Air Force (TUAF). The photograph shows one of the test engines in the TUAF facility.

CHAPTER 10 AGARD PUBLISHING PROGRAMME

Although most AGARD activity took place in conferences, symposia, workshops, lecture series and other meetings and consultations, it is in the printed word that the results of this work and these exchanges are preserved and disseminated. From its beginning, therefore, AGARD devoted considerable attention to its publishing programme. In fact, in terms of numbers of titles per year and excluding standard text books, AGARD was one of the largest scientific and technical publishers in the world.

For much of its life, AGARD published some seventy to ninety titles a year. Apart from Technical Evaluation Reports of meetings and Executive Summaries of studies carried out for the Military Committee, they had an average size of about 200 pages, but individual publications varied from a few pages to more than 500. Quantities printed ranged from less than 400, for classified publications (about 15 to 20% of the output) and occasional reprints, to 1,000-1,200 for the normal distribution of unclassified publications. Occasionally, publications were judged to be of such general interest that 4,000 or 5,000 copies were printed.

Most publications were in English, or had English as the predominant language, as in Conference Proceedings, but some were printed in both French and English versions and a few appeared only in French. Most appeared in paper covers, but a few reference works and other publications thought likely to be of value for many years were bound in hard covers. There were generally not more than five such in any year.

Until 1970 some AGARD publications were printed as case-bound books and released on the commercial market by a series of commercial publishers: NATO received royalty payments on such sales. Such publications were discontinued mainly because of the very long delays inherent in commercial publication. A few publications – notable among them the AGARD Multilingual Aeronautical Dictionary – were produced by AGARD on an on-sale basis in addition to the normal distribution to Nations.

Initially, there was a large number of different types of publications, but by 1968, they had been reorganised into five categories, which collectively constitute a simple and easily recognisable set of aerospace technical literature. The categories are as follows:

AGARDographs (AG): the principal formal publication category for work prepared by, or on behalf of, AGARD's Panels. An AGARDograph pertained to a single, clearly-defined subject and comprised material generally agreed to be of lasting interest. This material was sometimes the work of a single author and at other times the coordinated and edited contributions of several authors. Often the preparation time for AGARDographs was measured in years rather than months.

Reports (R): publications which dealt, generally not at any great length, with subjects of more limited scope (such as a specific item of research work) and which were expected to be of relatively short-term interest. They may consist of a single paper or be a collection of papers on a common subject. This category was also used for the proceedings of workshops and for the course notes provided with special courses.

Advisory Reports (AR): these were distinguished from Reports by the fact that they also contained advice and/or recommendations for action, such as the initiation of

further research on a particular subject. This being so, they were usually addressed primarily to a specific readership. For example, this category was used for all the reports arising from the studies carried out at the request of the Military Committee of NATO. It was also used for Technical Evaluation Reports (reports evaluating the papers presented, discussions held, and the outcome of a Conference, Symposium, etc.) when they were deemed of sufficient intrinsic interest to be published as separate documents. During the later years, however, all Technical Evaluation Reports were included in the corresponding Conference Proceedings.

Conference Proceedings (CP): these contained the full text of the papers presented at a symposium or specialists' meeting. Some also included a summary of the discussions which followed the presentations.

Lecture Series (LS): these consisted of the full texts of the presentations at Lecture Series. They were normally published just before the lectures were presented and made available to persons attending the lectures.

A sixth category was *Conference Pre-Prints (CPP):* these included such of the papers as were available for printing a few weeks before a symposium or specialists' meeting, and were distributed to the participants at the meeting. Pre-prints were never given a full distribution, since they were always replaced later by the full conference proceedings. For this reason, too, they do not appear in the indexes of AGARD publications. During the final years of AGARD, the issuing of pre-prints was abandoned.

AGARD also published a number of classes of miscellaneous publications, such as AGARD Bulletins, AGARD Highlights, Annual Reports of AGARD activities, Calendars of Meetings, Membership Lists, Handbooks and Indexes of AGARD publications.

AGARD distributed its publications within the NATO Member-Nations only. Copies were sent free of charge to National Distribution Centres in each NATO nation, and redistributed by these Centres in accordance with the needs of the country. AGARD had no influence on this secondary distribution. The Centres were not part of AGARD, but national agencies (often a national defence or aerospace scientific information unit) which redistributed AGARD publications in accordance with their own procedures. Copies of publications were also sent to all the members of the relevant Panel(s), to the authors, and (where applicable) to those attending a meeting, lecture series, or course.

AGARD also authorised three Sales Agencies, in US, UK and France, to sell photocopies or microfiches of its unclassified publications. It was known that some of these could, and indeed did, go to nations outside NATO, including communist ones, but AGARD had a stringent clearance procedure to ensure that only information approved for public release was published in this way.

During the period 1952-1997 AGARD issued well over 3,000 technical publications, including classified ones and classified supplements to unclassified conference proceedings, amounting to over half a million pages. These publications had an enormous impact on the development of aerospace engineering in the Alliance as is evidenced by the large number of references made to AGARD publications.

Apart from the entries in various national and international reference data bases, there are now also available CD-ROMs with an index of most unclassified publications (and including those published through commercial publishers by the NATO Scientific Affairs Division), and a set of CD-ROMs with page images of all the unclassified ones is being prepared.

It is impossible to do justice in two pages to the wide range of topics studied and published over the years, in many of which AGARD was very early in the field or even the forerunner. However, it is hoped that the following titles of manuals and AGARDographs, chosen almost at random and presented in date order, will give some indication of the scope, although all old AGARDians reading this will have their own lists which will be completely different. These publications are of course only a small selection (just over 1% of the titles), and do not include Conference Proceedings, Lecture Series, the publications arising from Working Groups, or any of the many Reports.

Anthropometry and Human Engineering, AG-6, 1955

Icing Problems and Recommended Solutions, AG-16, 1957

Flight Test Manual – 4 volume loose-leaf manual of nearly 3000 pages, published between 1959 and 1963.

The Chemistry of Propellants, 1960

Advances in Upper Atmosphere Research, 1960

Aeronautical Multilingual Dictionary, 1960 (and a complete revision, 1980)

Aircraft Accident Investigation Manual for Air Surgeons – 1961

Full-Scale Fatigue Testing of Aircraft Structures, 1961

Manual on Aeroelasticity – 6 volume loose-leaf manual published in 1968

The Aerodynamics of V/STOL Aircraft, AG-126, 1968

Space Power Systems, AG-123, 1969

Air and Spaceborne Computers, AG-127, 1970

Computers in the Guidance and Control of Aerospace Vehicles, AG-158, 1972

Supersonic Ejectors, AG-163, 1972

Fracture Mechanics of Aircraft Structures, AG-176, 1974

Flight Test Instrumentation, AG-160, a series of 19 volumes, 1974 to 1994

Non-destructive Inspection Practices, AG-201, 1975

Fatigue Design of Fighters, AG-231, 1978

Assessing Pilot Workload, AG-233, 1978

Manual of Documentation Practices Applicable to Defence-Aerospace Scientific and Technical Information, AG-235, a series of 5 volumes, 1978 to 1982

Sleep and Wakefulness Handbook for Flight Medical Officers, AG-270, 1982 and 1987

Medical Aspects of Survival: Training for Aircrew, AG-283, 1983

Flight Test Techniques, AG-300, a series of 15 volumes, 1983 to 1996

Simulation of Aircraft Behaviour on and Close to the Ground, AG-285, 1985

Corrosion Handbook, AG-278, 1985/87

Shock-wave Boundary Layer Interactions, AG-280, 1986

Techniques of Flow Visualization, AG-302, 1987

Computational Fluid Dynamics: Algorithms and Supercomputers, AG-311, 1988

Hazard Studies for Solid Propellant Rocket Motors, AG-316, 1990

High G Physiological Protection Training, AG-322, 1991

Design and Testing of High-performance Parachutes, AG-319, 1991

Human Performance Assessment Methods (a standard battery of performance tests), AG-308, 1991

A Manual on the Evaluation of Information Centres and Services, AG-310, 1991

Radio Wave Propagation Modelling, Prediction and Assessment, AG-326, 1991

Considerations for NATO Satellite Communications in the Post 2000 Era, AG-330, 1991

Applications of ASICs (Application Specific Integrated Circuits) to Avionics, AG-329, 1992

Advanced Methods for Cascade Testing, AG-328, 1993

On-line Handling of Air Traffic: Management, Guidance and Control, AG-321, 1994

Multi-sensor, Multi-target Data Fusion, Tracking and Identification Techniques, AG-337, 1996

CHAPTER 11 AGARD HEADQUARTERS

The Organisation

The staff of AGARD was headed by a Director, appointed by the North Atlantic Military Committee on the advice of the National Delegates Board for a period of three years. The Director acted as the executive officer of the Board, and his general terms of reference were defined in Section VI of the AGARD Charter, Appendix A. He was assisted by a staff consisting of permanent NATO International Staff members and national military and civilian staff assigned to AGARD by their governments for periods, usually of two or three years, as Voluntary National Contributions.

During much of the period of 1952-1997 the internal organisation was as given in the organigramme in Appendix B. Changes in the tasks and responsibilities were introduced as the work load changed and depending on the personnel available. By-and-large the division of tasks was as follows.

- Chief, Administration and Finance, responsible for budget, finance, procurement, travel, security and general services and assisted by a Deputy specifically in charge of budgetary and financial matters. During the later years this position was filled by a senior US officer who also served as a liaison with the US.
- Chief, Plans and Programmes, responsible for AGARD programme planning, in liaison with the member nations and the AGARD Panels. He was also responsible for the planning and execution of the Consultant and Exchange Programme, the coordination of the Programme of Support to Greece, Portugal and Turkey, and the administrative support of the Lecture Series. Translation and interpretation services were organised and coordinated through his office. From 1964 to 1994, he was assisted by a Deputy. Both posts were always filled by French nationals, and one or both also served as liaison officers with the French authorities and in particular with the French Air Force.
- Chief, Military Committee Studies, assisted by two Deputies, was responsible for the implementation of the programme of the Aerospace Applications Study Committee and the secretariat of the AGARD Steering Committee.
- Panel Executives (starting with four in 1952, grew to nine in number and re-organised into seven in 1994), most of whom were engineers and/or officers serving as Voluntary National Contributions, acting as links between the Director of AGARD and the Panels.
- Executive for External Relations, conducted external coordination and liaison. From 1983, this post was combined with that of Chief, Military Committee Studies.
- Scientific Publications Executive, responsible for the management of the AGARD publications printing and distribution programme, as well as for press and public relations and similar activities. From 1977, this post was combined with that of Executive, Technical Information Panel.

The Housing

The French Government was the host for the Headquarters and provided the buildings.

From 1952 until 1960 AGARD was housed in the Palais de Chaillot in Paris XVI. From 1960 until 1968, the Headquarters was at 64 rue de Varenne, Paris VII.

In 1968 the offices were moved to 7 rue Ancelle, Neuilly-sur-Seine, one of the inner suburbs of Paris. The last location has served AGARD very well. The French authorities gave support in many different ways, including Voluntary Contributions (personnel), security assistance, meeting facilities and special transportation.

The Staff

The following list, which is in chronological order of assignments to AGARD, includes both the NATO international staff members (marked with an asterisk) and the officers and civilians whose services have been provided to AGARD as part of the nations' contribution to the organization.

AGARD also has been well served by its secretarial, administrative and support staff, and the contribution made by these members who have not been listed here is acknowledged here.

*F.L.WATTENDORF	Director/Acting Chairman/Vice-Chairman	1952-1968
*R.A.WILLAUME	Director Plans & Programmes;Consultant and Exchange Programme	1952-1980
B.J.DRISCOLL	Executive Secretary	1952-1954
P.H.DANE	Executive, Wind Tunnel Panel	1952-1955
J.J.DRISCOLL	Executive, Flight Test Panel	1952-1954
*J.MERKER	Administrative Officer/Executive to the Chairman	1952-1964
G.COLCHAGOFF	Executive, Aeromedical & Combustion Panels	1952-1952
G.ZINNEMANN	Executive, Aeromedical Panel	1953-1957
K.W.BAKER	Executive, Combustion Panel	1953-1955
E.D.CONNELLY	Executive, Technical Info. & Doc. Ct. Publications Editor	1953-1964
E.P.SCHULD	Executive, Flight Test Panel	1954-1958
*C.MOORE	Associate Director	1954-1957
M.ZUBON	Executive Secretary	1954-1957
E.G.SHARKOFF	Executive, Wind Tunnel Panel	1955-1958
*D.C.SMITH	Executive, Structures & Materials Panel	1955-1959
R.M.HORRIDGE	Executive, Combustion & Propulsion Panel	1956-1960
G.E.LAIRMORE	Executive, Avionics Panel	1956-1961
*M.DUBOIS	Translator	1956-1985
B.O.GREEN	Executive, Aeromedical Panel	1957-1958
*J.R.DESCHAMPS	Deputy Director	1957-1961
M.STRATIGAKIS	Special Assistant to the Chairman	1957-1964
J.J.PELLEGRINI	Executive Secretary/Special Projects Officer	1957-1959
R.DASTEEL	Executive Secretary	1958-1959
H.A.ELLISON	Executive, Fluid Dynamics Panel	1958-1964
*J.LELIEVRE	Administrative Officer	1958-1978
F.R.PETIPRIN	Executive, Aerospace Medical Panel	1958-1964
*A.G.VANNUCCI	Technical Information Officer, Executive, Technician Information Panel	1958-1971
A.WOIDA	Executive, Flight Mechanics Panel	1958-1961

F.E.BIADASZ	Special Assistant to the Chairman	1959-1960
*G.H.COOPER	Executive, Structures & Mat. Panel	1960-1966
F.F.HART	Executive, Combustion & Propulsion Panel/ Executive Secretary	1960-1963
F.N.MORTENSEN	Operational Research Officer	1960-1960
D.P.ANDRE	Operational Research Officer	1960-1964
I.DETHMAN	Executive, Flight Mechanics Panel	1961-1964
E.F.DUKES	Executive, Avionics Panel	1961-1965
*J.JENNISSEN	Deputy Director	1961-1962
E.A.ROBIE	Executive, Combustion & Propulsion Panel	1962-1963
F.J.READDY	Executive, Combustion & Propulsion Panel/ R&D Activities Off.	1963-1966
G.MUNROE	Acting Director	1963-1964
A.P.CHARTIER	Executive, Aerospace Medical Panel	1964-1965
E.R.GIESEMAN	Executive, Flight Mechanics Panel	1964-1966
*J.F.P.H.GREENE	Scientific Publications Officer	1964-1973
*B.HELIOT	Deputy Director, Plans and Programmes	1964-1980
*W.P.JONES	Director	1964-1967
C.LUPOLD	Executive, Propulsion & Energetics Panel	1964-1966
G.ZINNEMANN	Executive, Secretary/Executive, ASMP	1964-1966
S.C.SKEMPS	Executive, Fluid Dynamics Panel	1964-1966
G.L.INGERSOLL	Executive Secretary	1965-1968
W.E.FANNIN	Executive, Avionics Panel	1965-1968
G.GEHL	Executive, Flight Mechanics Panel	1966-1968
H.GRUNHOFER	Executive, Aerospace Medical Panel	1966-1969
R.BARTH	Executive, Fluid Dynamics Panel	1966-1970
W.A.STUDABAKER	Executive, Guidance & Control Panel	1966-1969
*T.ISKIT	Executive, Structures & Materials Panel	1967-1970
C.SEVESTRE	R&D Activities Officer	1967-1971
*F.J.ROSS	Director	1967-1970
G.W.BARNES	Executive Officer	1967-1970
R.HAGERTY	Executive, Propulsion & Energetic Panel	1967-1972
C.R.SMITH	Executive, Avionics Panel	1968-1971
W.B.FAVORITE	Military Assistant	1968-1971
L.WOLKER	Executive, Flight Mechanics Panel	1968-1971
A.PFISTER	Executive, Aerospace Medical Panel	1969-1971
C.D.MOUNT	Executive,Guidance and Control Panel	1969-1971
L.H.TOWNEND	Executive, Fluid Dynamics Panel	1970-1972
*M.I.YARYMOVYCH	Director	1970-1973
P.BAMBERG	Executive, Structures & Materials Panel	1970-1973
	Deputy for Research & Development	1973-1974
W.W.ROSS	Executive, Avionics & Electro-magnetic Wave Propagation Panels	1971-1973
E.M.B.SMITH	Executive, Aerospace Medical Panel	1971-1973
J.E.JAKES	Chief, Operations & Budget Division	1971-1973
C.E.BORGEAUD	Deputy for Systems Analysis	1971-1977
W.H.LYNCH	Chief, Military Committee Studies	1971-1974
R.J.WASICKO	Executive, Flight Mechanics Panel	1971-1975
H.A.HERTRICH	Deputy for Research & Development	1972-1973

J.A.LAWFORD	Executive, Fluid Dynamics Panel	1972-1975
A.TAILLE	Executive, Guidance & Control Panel	1972-1975
J.B.CATILLER	Executive, Propulsion & Energetics Panel	1972-1976
*A.J.R.WHITEHEAD	Executive, Technical Information Panel	1972-1977
C.C.McBRIDE	Chief, Operations & Budget	1973-1974
P.VARENE	Executive, Aerospace Medical Panel	1973-1975
*O.E.BLICHNER	Director	1973-1976
N.R.OGG	Executive, Avionics and Electro-magnetic Wave Propagation Panel	1973-1976
*J.H.W.TROTMAN	Scientific Publications Executive	1973-1977
E.R.WAY	Executive, Structures & Materials Panel	1973-1976
L.BACCHIERI	Chief, Operations and Budget	1974-1977
G.H.DIMON,Jr	Chief, Military Committee Studies	1974-1977
J.H.WILD	Deputy for Research and Development	1974-1979
M.CAVENEL	Executive, Guidance and Control Panel	1975-1978
G.P.L.CHEVAILLIER	Executive, Coordination and Liaison	1975-1976
M.C.FISCHER	Executive, Fluid Dynamics Panel	1975-1978
A.GUBERNALE	Executive, Aerospace Medical Panel	1975-1976
I.HAMILTON	Executive, Flight Mechanics Panel	1975-1976
F.MONESI	Executive, Aerospace Medical Panel	1976-1980
D.CARRUTHERS	Executive, Avionics Panel and Electromagnetic Wave Propagation Panel	1976-1978
D.STANGROOM	Executive, Flight Mechanics Panel	1976-1979
J.M.WILLIS	Executive, Structures and Materials Panel	1976-1982
J.H.KRENGEL	Executive, Propulsion & Energetics Panel	1976-1979
*R.H.KORKEGI	Director	1976-1979
J.E.BONNET	Executive, Coordination and Liaison	1976-1985
*E.T.SHARP	Executive, Technical Information Panel and Scientific Publications	1977-1985
R.E.KAHLER	Chief, Operations and Budget	1977-1980
G.A.BRON	Deputy for Systems Analysis	1977-1980
L.de CHAMPEAUX de la BOULAYE	Deputy for Project 2000 and Executive for External Affairs	1979-1980
*M.MOREAU	Chief, Budget and Travel	1978-1984
J.B.CATILLER	Executive, Avionics Panel and Electro-magnetic Wave Propagation Panel and Special Assistant to Director for ADP	1978-1982
R.M.ROLLINS	Executive, Fluid Dynamics Panel	1978-1986
J-C.de BURETEL de CHASSEY	Executive, Guidance and Control Panel and Deputy, Plans and Programmes	1978-1980 1980-1983
T.WILCOCK	Executive, Flight Mechanics Panel	1979-1982
E.E.RIESTER	Executive, Propulsion and Energetics Panel	1979-1989
J.A.TOPP	Deputy for R & D (MCS)	1979-1982
*J.BURNHAM	Director	1979-1982
P.A.PRYOR	Chief, Military Committee Studies	1979-1983
A.A.PESTRICHELLA	Chief, Operations and Budget	1980-1983
R.KELLER	Deputy, Military Committee Studies	1980-1981
J.M.MULLANEY	Executive, Aerospace Medical Panel	1980-1983
*B.HELIOT	Executive, Guidance and Control Panel	1980-1985

G.P.ALEXIS	Deputy, Military Committee Studies	1981-1983
F.J.CALDERON	Executive for External Affairs	1981-1983
*C.E.BORGEAUD	Chief, Plans and Programmes	1981-1994
*R.K.GEIGER	Director	1982-1985
T.B.RUSSELL	Executive, Avionics Panel and Electro-magnetic Wave Propagation Panel	1982-1985
J.A.LAWFORD	Executive, Flight Mechanics Panel	1982-1984
A.WOWK	Deputy, Military Committee Studies	1982-1986
D.A.DRANE	Executive, Structures and Materials Panel	1982-1987
V.J.CLINE	Chief, Military Committee Studies and Executive for External Affairs	1983-1986
*G.P.ALEXIS	Deputy, Plans and Programmes	1983-1994
F.COLIN	Deputy, Military Committee Studies	1983-1984
L.B.CROWELL	Executive, Aerospace Medical Panel	1983-1987
J.BEAUGRAND	Deputy, Military Committee Studies	1984-1985
D.M.BOHLER	Chef, Administration and Finance	1984-1987
M.BUSH	Special Assistant to Director for ADP	1984-1986
H.A.TORODE	Executive Flight Mechanics Panel	1984-1987
*I.C.STATLER	Director	1985-1988
*J.J.BALSTER	Budget and Finance Officer and NATO Personnel Matters	1985-1997
*G.W.HART	Executive, Technical Information Panel and Scientific Publications Executive	1985-1997
*C.DITTMANN	Fiscal Officer	1985-1986
P.CARRE	Executive, Guidance and Control Panel	1985-1986
M.V.STRATTON	Executive, Avionics Panel and Electro-magnetic Wave Propagation Panel	1985-1988
*R.TIMMERMANS	Fiscal Officer	1986-1997
W.M.BROWNING	Chief, Military Committee Studies and Executive for External Affairs	1986-1989
G.GOURLET	Deputy, Military Committee Studies	1986-1987
K.RUMER	Deputy, Military Committee Studies	1986-1988
M.C.FISCHER	Executive, Fluid Dynamics Panel	1986-1990
A.ROCHER	Executive, Guidance and Control Panel	1986-1988
R.CRUZ	Chief, ADP and General Services	1987-1989
*R.HICKMAN	Translator	1987-1997
H.R.VADNEY	Chief, Administration and Finance	1987-1991
E.DELGOVE	Deputy, Military Committee Studies	1987-1989
J.A.WINSHIP	Executive, Aerospace Medical Panel	1987-1990
M.K.FOSTER	Executive, Flight Mechanics Panel	1987-1993
P.BRUNELLI	Executive, Eletromagnetic Wave Propagation Panel	1987-1990
M.C.McCONNEL	Executive, Structures & Materials Panel	1987-1991
N.WIENER	Deputy, Military Committee Studies	1988-1989
J.E.CLAY	Executive, Avionics Panel	1988-1991
*J.A.van der BLIEK	Director	1988-1991
M.MOUHAMAD	Executive, Guidance & Control Panel	1988-1993
G.GRUBER	Executive, Propulsion & Energetics Panel	1989-1991
J.S.NOONE	Chief, Support Activities and ADP	1989-1991

J.C.OGÉ	Deputy, Military Committee Studies	1989-1991
T.W.REDMOND	Chief, Military Committee Studies	1989-1992
A.RETSCH	Deputy, Military committee Studies	1989-1993
B.LYLE	Executive, Aerospace Medical Panel	1990-1993
W.D.GOODRICH	Executive, Fluid Dynamics Panel	1990-1994
C.SAUTTER	Executive, Avionics Panel	1991-1992
J.D.SZOSTAK	Chief, Administration & Finance Division	1991-1992
*A.J.WENNERSTOM	Director	1991-1994
J.VAISSIE	Deputy, Military Committee Studies	1991-1994
E.E.RIESTER	Executive, Propulsion & Energetics Panel	1992-1993
R.CARIGLIA	Executive, Avionics Panel	1992-1993
P.BRANDENBURG	Chief, Administration & Finance Division	1992-1993
	Chief, Military Committee Studies and Executive for External Affairs	1992-1995
M.MOUHAMMED	Executive, Mission Systems Panel	1993-1994
R.CARIGLIA	Executive, Sensors & Propagation Panel	1993-1994
J.B.BLYSTONE	Chief, Administration & Finance Division	1993-1995
J.CARBALLAL	Executive, Structures & Materials Panel	1993-1997
W.J.KAUW	Executive Technology Cooperation Programme (the Outreach Programme)	1993-1997
R.POISSON	Executive, Aerospace Medical Panel	1993-1997
R.STEIERT	Deputy, Military Committee Studies	1993-1997
P.TONN	Executive, Propulsion & Energetics Panel	1993-1997
G.DEL DUCA	Executive, Sensors & Propagation Panel	1994-1997
J.WHEATLEY	Executive, Flight Vehicle Integration Panel	1994-1997
P.FORTABAT	Executive, Mission Systems Panel	1994-1997
*G.P.ALEXIS	Chief, Programme Coordination Division	1994-1997
*J.H.WILD	Director	1994-1997
S.SLIGAR	Executive, Aerospace Technology Initiatives	1994-1997
J.K.MOLLOY	Executive, Fluid Dynamics Panel	1994-1997
A.deTELLIER	Deputy, Military Committee Studies	1994-1997
M.SHOEMAKER	Chief, Military Committee Studies and Executive for External Affairs	1995-1997
H.MONTFORT	Deputy, Programme Coordination Division	1995-1997

Secretaries to the Director

*J.MERKER	Secretary to the Director	1952-1964
*O.SAMUELS	Secretary to the Director	1964-1986
*H.M.LAGET	Secretary to the Director and later also Chief Directorate Assistant	1986-1997

* NATO staff members

ANNEX 1 NATIONAL DELEGATES AND NATIONAL COORDINATORS

A. Members of AGARD National Delegates Board

The names of the members of the National Delegates are listed below.

The first formal appointement of National Delegates took place in May 1952.

The Honorary Vice-Chairmen, the Honorary Dean, the Chairmen and the Directors are listed at the end of Chapter 4.

Belgium	
J. DUCARME	1952-1954
M. FRESON	1952-1969
F.C. HAUS	1952-1986
E. EVRARD	1967-1997
J. DELHAYE	1970-1971
R. DALLEUR	1971-1978
V. GEORGE	1978-1984
H. ROBYNS DE SCHNEIDAUER	1984-1990
G. VAN DIEST	1990-1994
A. VAN DAELE	1994-1997
Canada	
J.J. GREEN	1952-1959
J.H. PARKIN	1952-1956
D.C. McPHAIL	1957-1959
J.L. ORR	1960-1963
J.W. COX	1963-1968
F.R. THURSTON	1965-1981
G.H. TIDY	1968-1973
E.J. BOBYN	1976-1983
D. SCHOFIELD	1977-1990
G.M. LINDBERG	1981-1986
G.L. NELMS	1985-1986
R.M. HEGGIE	1986-1990
G.F. MARSTERS	1987-1994
G. KIMBELL	1990-1995
K. PEEBLES	1992-1997
T. LEFEUVRE	1994-1997
Denmark	
P.N. BRANDT-MOELLER	1952-1967
K. REFSLUND	1960-1982
V.W. MOURITZEN	1967-1970
V. GUNTELBERG	1982-1991
E. W LANGER	1982-1997
K. JESSEN	1991-1997
France	
J. GERADIN	1952-1954 1962-1972
M. ROY	1952-1962

J. PERES	1952-1962
M.P.L. WANNER	1954-1961
G. de COLIGNY	1962
L. MALAVARD	1962-1981
P. GERMAIN	1962-1968
R. CASTAING	1968-1972
	1981-1985
A. VIALATTE	1971-1977
P. CONTENSOU	1973-1979
R. BOSCHER	1978-1981
A. AURIOL	1979-1988
J. GAY	1981-1982
R. FLEURY	1983-1986
G. SAADA	1985-1997
P-H. CHEVALIER	1986-1989
M. EL GAMMAL	1988-1994
M. LAMY	1989-1994
G. BONNEVALLE	1994-1996
J-P. MAREC	1994-1997
F. GONIN	1996-1997
Germany	
T. BENECKE	1955-1977
A.W. QUICK	1955-1960
F. BOLLENRATH	1960-1969
K. FISCHER	1964-1965
A. WAHL	1966-1974
K.H. DOETSCH	1970-1977
W. STRATHMANN	1974-1977
J. BARCHE	1977-1982
H. LANGFELDER	1977-1978
J. TRIENES	1977-1980
G. MADELUNG	1978-1997
W.D. MEISEL	1980-1988
H.L. JORDAN	1982-1989
P. RUNGE	1988-1989
W. KRÖLL	1989-1994
J. HEYDEN	1989-1993
J. WEYAND	1993-1994
M. HARTL	1994-1997
F. THOMAS	1995-1997
Greece	
D. HONDROS	1952-1954
M. STRATIGAKIS	1954-1957
N. PAPADIMITRIOU	1958-1959
M. ANASTASSIADES	1960-1967
N.G. PLATIS	1962-1965
	1967
	1968-1969

T. HOULIS	1966-1968
P. KARAYANNIS	1970-1972
N. MORAITIS	1972-1977
K. PAPASPIRIDIS	1977-1978
A. ACHTIDAS	1978-1981
V. MAKIOS	1978-1983
G. FRAGOYANNIS	1981-1982
N. STAVROPOULOS	1982
I. ARKOUMANEAS	1982-1983
P. KONTODIOS	1982-1986
D. XANTHOUDAKIS	1982-1985
N. STAVROPOULOS	1983-1985
G. BANAKOS	1985-1990
A. PAMBOUKIS	1985-1986
G. STAFILIDIS	1986-1988
E. ARGYROS	1988-1990
TH. LIAKAKIS	1989-1991
P. KAMBAS	1990-1993
F. PERRAKIS	1990-1991
S. TSAOUSOGLOU	1991-1992
G. KELAIDIS	1991-1992
E. SKLIRIS	1992
P. MANOUSOS	1992-1994
G. GOULIOS	1992-1993
P. AVDELIDIS	1993-1994
D. KATELOUZOS	1993-1994
G. CHRISIKAKIS	1994-1996
A. GIOLDASIS	1994-1997
TH. MOSCHOS	1994-1996
D. HELIOTIS	1996-1997
D. KATELOUZOS	1996-1997
Iceland	
H.Sv. BJORNSSON	1980-1985
T.A. TOMASSON	1986
E. BENEDIKTSSON	1987
T. PALSSON	1988-1997
Italy	
C. ALIPPI	1952-1965
G. GABRIELLI	1952-1976
D.F. COLUMBA	1966-1969
L. BROGLIO	1969-1976
	1977-1996
S. CAGGIANI	1976-1977
U. FABI	1978-1982
M. MARCONI	1983-1986
R. GRAZIOLI	1986-1987
A. ROSSETTI	1988-1990
	1996-1997

G. OLIVERO	1991-1992
C. BRANCALEONI	1992-1993
A. VANNUCCHI	1993-1995
P.G. CRUCIOLI	1995
P. GARRIBBA	1995
The Netherlands	
C. KONING	1952-1953
H.J. van der MAAS	1952-1971
C. ZWIKKER	1953-1956
A.J. MARX	1957-1976
O.H. GERLACH	1971-1991
J.A. van der BLIEK	1976-1988
B.M. SPEE	1988-1997
J. van HOUWELINGEN	1992-1997
D. ALTENA	1992-1996
Norway	
E. TUSTER	1952-1953
L. HARANG	1953-1959
S. HEGLUND	1953-1960
F. LIED	1960-1972
O. BLICHNER	1962-1972
H.K. JOHANSEN	1973-1991
T. KROG	1973-1984
E. KLIPPENBERG	1991-1993
N. HOLME	1993-1997
Portugal	
B. DELGADO	1958-1961
J.A. de ALMEIDA VIANA	1962-1964
J.P. do NASCIMENTO	1964-1969
J. de SOUSA OLIVIERA	1970-1972
H. de FARIA QUEIROZ	1972-1974
M. PASSOS MORGADO	1974-1976
F.J. de QUEIROS de AZEVEDO e BOURBON	1976-1986
J.G. CALVAO BORGES	1985-1994
A. de ALDEIA PORTELA	1987-1997
J.M. da COSTA NEVES	1990-1992
C. MENDES JORGE	1992-1997
Spain	
S. SANZ ARANGUEZ	1983-1984
H. MARIN ARAEZ	1984-1987
M. BAUTISTA ARANDA	1988-1992
J. SIMON CALERO	1991-1997
L. GUITART POCH	1992-1997

Turkey	
F. ÜLAG	1953-1969
J. UNSAL	1953-1954
S. ISIMER	1962
R. TAYKUT	1962-1965
E. DEMOKAN	1966-1969
M. AKMAN	1969
F. CELIKER	1969-1970
N. SERDAROGLU	1969-1976
O. YAPGU	1970-1971
M. UZER	1971-1972
R. ERTAS	1972-1973
V. ATAKLI	1974-1975
E. SIFA	1975-1977
H. BENTURK	1977-1982
H.B. GOKCIGDEM	1977-1983
I. ISAK	1982-1983
S. CANOVA	1983-1986
S. SOYLERKAYA	1985-1995
S.S. ORUN	1986-1987
D. KAYA	1987-1990
S. KANTAR	1990-1992
H. OZERI	1992
S. BATMACA	1993-1995
A. ÜÇER	1995-1997
B. KARAN	1995-1997
United Kingdom	
A.A. HALL	1952-1955
E.T. JONES	1952-1962
W. CAWOOD	1955-1961
	1967
G.W.H. GARDNER	1955-1959
R.E. BISHOP	1957
W.S. FARREN	1959-1965
M. MORGAN	1962-1964
L.F. NICHOLSON	1962-1967
	1969-1971
H. DAVIES	1964-1969
W.O.W. CHALLIER	1965-1973
P.A. HUFTON	1967-1972
N. COLES	1971-1974
J.Y.G. EVANS	1973-1977
B.P LAIGHT	1973-1982
W.J. CHARNLEY	1975-1977
J. ALVEY	1977-1980
E.W. ROGERS	1977-1985
D.J. HARPER	1980-1983
J.B. SCOTT-WILSON	1982-1994

D.E. HUMPHRIES	1983-1985
F.W. ARMSTRONG	1985
J.E. GREEN	1985-1987
F.W. ARMSTRONG	1987-1991
D. GARDNER	1991-1994
R. JONES	1991-1993
M. EARWICKER	1993-1997
A.C.H. MACE	1993-1994
C.C. SANGER	1994-1995
I. McFARLANE	1994-1997

United States

T. von KÁRMÁN	1952-1963
H.L. DRYDEN	1952-1965
D.L. PUTT	1960-1964
C.D. PERKINS	1963-1969
H. BROWN	1964-1965
R. SEAMANS	1966-1969
A.H. FLAX	1969-1987
G.L. HANSEN	1969-1973
T.O. PAINE	1969-1970
N. ARMSTRONG	1970-1975
W.B. LABERGE	1973-1976
A.M. LOVELACE	1975-1982
J.J. MARTIN	1976-1979
R.J. HERMANN	1979-1981
A.G. KEEL	1981-1982
H. MARK	1982-1984
T.E. COOPER	1983-1987
R.K. GEIGER	1986-1991
D. MYERS	1987-1989
J.J. WELCH Jr	1987-1992
J.R. THOMPSON JR	1989-1991
M.I. YARYMOVYCH	1991-1997
G.K. WINCUP	1992-1993
J.R. DAILEY	1994-1997
J.J. MATTICE	1994-1995
D.C. DANIEL	1995-1997

Ex-Officio

G. RANDERS	1969-1973
N. ÖZDAS	1974-1979
J.B. WALSH	1979-1980
V. GARBER	1980-1983
R. BEARD	1984-1987
	1992-1995
M. MATTINGLY	1987-1990
P. MERRILL	1990-1992
N.W. RAY	1995-1997

B. AGARD National Coordinators

In order to coordinate within their countries the various actions to be taken in relation to AGARD activities, NATO Member Nations appointed National Coordinators. The duties assigned by the National Delegate to the National Coordinators varied from one nation to another, but in general they concerned coordination within the Nations and liaison with the AGARD Director and Staff on matters agreed upon by their National Delegates.

The first meeting of National Coordinators was held in 1971, and since then a meeting was held every year in March before the NDB Meeting. From 1976 NASA provided AGARD with a Coordinator. The National Coordinators were:

Belgium:	
A. CUFFEZ	1984-1988
N. JULY	1988-1990
L. GABRIEL	1990-1991
P. BODET	1991-1993
J.J. LECLUYSE	1993-1995
J.P. VANDERHASTEN	1995-1997
Canada:	
J.C. BARIL	1980-1991
K.N. STREET	1991-1995
M.J. NITUCH	1995-1997
Denmark:	
H.H BAKLAND	1987-1993
E. DANNENBERG	1993-1997
France:	
M. GUILLEMINET	1971-1978
M. DEFOURNEAUX	1978-1982
D. PAGET	1983-1984
G. de BIGNICOURT	1985-1993
Y. TANGUY	1993-1994
G. SEGUIN	1994-1997
Germany:	
R. BARTH	1971-1985
F. GUNTHER	1985-1997
Greece:	
M. IOSIFIDES	1978-1981
N. VLAHOPOULOS	1981-1982
S. ARMENIS	1982
A. GOTSIS	1982-1983
E. AXIOTOUPOULOU	1983-1988
P. KOURIS	1988
N. NICKIFORAKIS	1988-1989
J. SCHIZAS	1989-1991
L. NASOPOULOU	1989-1991
E. KORMAS	1991-1994

H. PAPASPYROS	1994-1996
E. ANDRIANOS	1996-1997
Italy:	
F. VAGNARELLI	1971-1985
O. MARTINELLI	1985-1986
P. BRUNELLI	1986-1987
P. MARCONI	1987-1991
G. FANTESINI	1992-1996
F. CELEGATO	1992-1997
The Netherlands:	
A.H. GEUDEKER	1971-1977
R.A. JAGER	1978-1985
E.J.H BLEEKER	1984-1988
L. SOMBROEK	1988-1997
Norway:	
J.I. BOTNAN	1991-1997
Portugal:	
A.J. da SILVA PEDROSO	1979-1981
C. MENDES JORGE	1981-1982
	1990-1992
J.G.C. BORGES	1983-1986
A.A. NOGEUIRA PINTO	1986-1990
A. JORGE AFONSO	1992-1995
F.A. CEBOLA MOGAS	1995-1997
Spain:	
D.A. GONZALEZ BETES	1987
M. CRUZ GUTIERREZ	1988-1993
C. GONZALEZ HERNANDEZ	1993-1996
F. MERIDA MARTIN	1996-1997
Turkey:	
D. KAYA	1971-1987
T. AKYUREK	1988-1989
	1990-1996
E. TORUN	1990
Y. K KIRAN	1996-1997
United Kingdom:	
D.B. SMITH	1971-1975
J.S PRICE	1976-1979
R. HILLARY	1980-1988
D. HALLIDAY	1988-1991
S. MARTIN	1991-1997
United States:	
M.H. BRADLEY	1971-1973
H. MITCHELL	1973-1974
F. DIETRICH	1974-1975

D. MAIO	1975-1976
M.V. VASILIK	1977-1978
I. PAYNE	1978
D.A. BEAM	1979-1980
R. GROSSEL	1980-1981
J.P. HENDREK	1981
G.RADIC	1981-1985
J. MEEUWISSEN	1986-1988
L.L. BURGE JR	1988-1990
R. GROCHOWSKI	1990-1992
S.P. MARINO	1992-1996
C.J. MALLORY	1996-1997

NASA Coordinators

J.M. COULTER	1976-1979
J. HOWELL	1979-1981
W.R. COUPLAND	1982
P. CHRISTIAN	1982-1984
C.O. FORSYTHE	1985-1997

NATO Headquarters Liaison Office

D. COLLINS	1977-1978
H. LANKHORST	1979-1982
C.P. SAVOIE	1982-1985
R.C. MORRISON	1985-1989
D. McNIERNEY	1989-1992
T. FRANKS	1992-1996
G. SCHNEIDER	1996-1997

ANNEX 2 AGARD AWARDS[1]

A. The Von Kármán Medal

The von Kármán Medal is a silver copy adapted from the gold medal presented to Dr. von Kármán by the Secretary General of NATO at the NATO Headquarters in Paris, July 1962, on the occasion of the Tenth Anniversary of the formation of AGARD.

The face of the medal has an image of Dr. von Kármán and the reverse side bears the inscription: 'To ... in recognition of outstanding contributions to AGARD NATO' and the year of the award.

The medal is awarded for outstanding contributions to aerospace science and technology and to the enhancement of progress in scientific and technological cooperation among the NATO Nations carried out in conjunction with AGARD activities. Only persons who have participated in, or been associated with, AGARD activities are eligible for the award, either for repeated outstanding contributions or for a single exceptional achievement.

Three medals were awarded in 1972 on the occasion of the Twentieth Anniversary of the formation of AGARD.

Normally one medal was awarded each year, although two were awarded in some years. Nominations for the award of the von Kármán Medal could be made by National Delegates, Panel Chairmen, the Chairman of the Aerospace Applications Committee and the Director of AGARD. The medal was normally presented during the AGARD Annual Meeting with a citation signed by the NDB Chairman.

The Awards Committee (until 1990 called The von Kármán Medal Committee), reviewed the nominations and made a recommendation to the NDB. The Committee was composed of National Delegates who served on a rotating basis.

Recipients of the von Kármán Medal were:

1972: Prof. Courtland D.Perkins (United States)
Mr. Ernest T.Jones (United Kingdom)
Mr. Roland A.Willaume (France)
1973: Prof. Frederic C.Haus (Belgium)
Prof. Hendricus J.van der Maas (Netherlands)
1974: Dr. Frank L.Wattendorf (United States)
1975: Prof. Guiseppe Gabrielli (Italy)
Prof. John B.Scott-Wilson (United Kingdom)
1976: Prof. Lucien Malavard (France)
Prof. Karl H. Doetsch (Germany)
1977: M. Jean Fabri (France)
Prof. William R.Sears (United States)
1978: Dr. Alexander H.Flax (Unites States)
Prof. Teunis van Oosterom (Netherlands)
1979: Prof. Alec Young (United Kingdom)
1980: Prof. Hermann Schlichting (Germany)
Mr. Frank R.Thurston (Canada)

1 The citations for the Awards were published in the periodical AGARD Highlights.

1981: M. Philippe Poisson-Quinton (France)
1982: Dr. Johannes M.Dathe (Germany)
1983: Prof. Luigi Broglio (Italy)
1984: Dr. Alan M.Lovelace (United States)
1985: Prof. Corrado Casci (Italy)
1986: Mr. John P.Hartzuiker (Netherlands)
1987: Maj.Gen.(Retd) Edgard E.O.Evrard (Belgium)
1988: Dr. Gabriel Coupry (France)
1989: Dr. Kasik J.Orlik-Rückemann (Canada)
1990: Prof. Eugene E.Covert (United States)
1991: M. Jean F.Renaudie (France)
1992: Prof. Otto H.Gerlach (Netherlands)
1993: Dr. André Benoît (Belgium)
1994: Dr. H.J.Albrecht (Germany)
1995: Dr. William J. McCroskey (United States)
1996: Prof. Gero Madelung (Germany)
1997: Prof. Jacobus W.Slooff (Netherlands)

B. Scientific Achievement Award

The Scientific Achievement Award was instituted by the National Delegates Board in 1989 to recognize outstanding contributions in the context of activities in aerospace science and technology or aerospace systems applications. Candidates, proposed by the various AGARD elements, must have made significant contributions to activities sponsored by AGARD during the preceding four years. The Award was accompanied by a Medal and a scroll.

Recipients of the Scientific Achievement Award were:

1990: Air Vice Marshall John Ernsting (United Kingdom)
Air Commodore James D.Jones (United Kingdom)
1991: M. Yves Brault (France)
Col. James R.Hickman (United Kingdom)
1992: Prof. K.C.Yeh (United States)
1993: Dr. Peter Hamel (Germany)
Prof. Hans Försching (Germany)
1994: Prof. L.Fottner (Germany)
1995: Prof. A.S.Ûçer (Turkey)
1996: Mr. Frederick N.Stoliker (United States)
Prof. William S.Saric (United States)

C. AGARD Staff Award

At the time when the Scientific Achievement Award was instituted, the National Delegates Board also decided that official recognition of the work of AGARD staff members at Headquarters at Neuilly-sur-Seine, was desirable. The Director was to propose nominees to the chairman of AGARD. Such proposals would be endorsed by the National Delegates Board.

Recipients of the Staff Award were:

1989: Ms. Paulette Scopes (Panel Secretary)
1990: Ms. Alice Guérillet (Panel Secretary)
1991: Techn. Sergeant Bernard Abinader (Security & Registry Service)
1992: M. Jaques Maillet (Automatic Data Processing)
1993: M. François-Paul Bolleré, M. Jean-François Ribaud, M. Claude Dresch, M. Guy Monnerie, M. Jean-Louis Mézières (AGARD Security Guards)
1994: Col. Paul Brandenburg (Chief Military Committee Studies Division/Chief Administration & Finance)
1995: Ms. Anne-Marie Rivault (Panel Secretary)

ANNEX 3 MEMBERSHIP OF THE STEERING COMMITTEE 1965-1997

Chairmen:			
W.P.JONES	UK		1965-1967
F.LIED	NO		1967-1970
Th.BENECKE	GE		1970-1973
A.H.FLAX	US		1973-1976
F.R.THURSTON	CA		1977-1979
A.M.LOVELACE	US		1980-1982
O.H.GERLACH	NL		1982-1985
G.MADELUNG	GE		1986-1988
R.K.GEIGER	US		1988-1991
J.B.SCOTT-WILSON	UK		1991-1994
M.I.YARYMOVYCH	US		1994-1997
Members:			
H.L'ESTOILE	FR		1965-1966
J.McLUCAS	(US)	NATO/ASGSA	1965-1966
H.DAVIES	UK		1965-1969
E.GIBOIN	(FR)	NATO/IS	1967-1968
I.THOMAS	(UK)	SACLANT	1967-1968
W.VON BAUDISSIN	(GE)	SHAPE	1967-1968
H.A.RODRIGO	(NE)	NATO/IMS	1967-1969
R.SCHALL	(GE)	NATO/ASGSA	1967-1969
F.ROSS	(US)	Dir. AGARD	1967-1970
J.GERARDIN	FR		1967-1971
J.F.BARLOW	(US)	SACLANT	1968-1969
P.R. VON BUTLER	(GE)	SHAPE	1968-1969
J.E.KEYSTON	(CA)	NATO/IS	1968-1973
HANES	(US)	SHAPE	1969-1970
P.HUFTON	UK		1969-1972
A.P.DART	(UK)	SACLANT	1970-1971
L.S.LIGHTNER	(US)	SHAPE	1970-1971
A.H.FLAX	US		1970-1973
A.J.MARX	NL		1970-1973
G.RANDERS		NATO/ASGSA	1970-1973
P.J.SYMONS	(BE)	NATO/IMS	1970-1973
M.I.YARYMOVYCH	(US)	Dir. AGARD	1970-1973
C.FOUNTAIN	(UK)	SACLANT	1971-1972
A.VIALATTE	FR		1971-1977
J.R.S.GERARD PEARSE	(UK)	SACLANT	1972-1973
N.COLES	UK		1972-1974
R.SHAEFER	(US)	SHAPE	1972-1974
L.BROGLIO	IT		1973-1975
K.G.HAMON	(UK)	SACLANT	1973-1975
G.SCHÖNER	(GE)	NATO/IS	1973-1975
O.BLICHNER	(NO)	Dir. AGARD	1973-1976
G.HENON	(BE)	NATO/IMS	1973-1976

N.ÖZDAS	(TU)	NATO/ASGSA	1973-1979
F.R.THURSTON	CA		1973-1979
Th.BENECKE	GE		1974-1976
A.W.BRASWELL (US)	SHAPE		1974-1977
W.J.CHARNLEY	UK		1975-1977
T.KROG	NO		1975-1979
O.H.GERLACH	NL		1975-1979
R.J. NAHRA		SACLANT	1975-1987
A.H. FLAX	US		1975-1976
R.LAWSON	(US)	NATO/IMS	1976-1978
W.STRATHMANN	GE		1977-1978
J.J.MARTIN	US		1977-1979
R.KORKEGI	(US)	Dir. AGARD	1977-1979
R.BOSCHER	FR		1978-1981
J.TRIENES	GE		1978-1980
S.ALVEY	UK		1978-1979
W.H.GINN	(US)	SHAPE	1978-1979
K.MÜLLER	(GE)	NATO/IS	1978-1979
P.CAVENDISH	(UK)	NATO/IMS	1979-1981
J.BURNHAM	(UK)	Dir. AGARD	1979-1982
R.HERMANN	US		1980-1981
E.W.E.ROGERS	UK		1980-1981
U.FABI	IT		1980-1982
V.J.GEORGE	BE		1980-1982
J.H.AHMANN	(US)	SHAPE	1980-1981
J.B.WALSH	(US)	NATO/ASG(DS)	1980-1981
W.MEISEL	GE		1981-1988
D.J.HARPER	UK		1981-1983
J.J.A.DOUCET	(CA)	NATO/IMS	1981-1983
V.GARBER	(US)	NATO/ASG(DS)	1981-1982
F.J.BOURBON	PO		1981-1983
T.KROG	NO		1982-1985
J.GAY	FR		1982-1983
R.K.GEIGER	(US)	Dir. AGARD	1982-1985
A.G.KEEL	US		1982-1983
J.BROWN	(US)	SHAPE	1983-1984
T.E.COOPER	US		1983-1987
R.HENRY	FR		1983-1986
D.HUMPHRIES	UK		1983-1984
P.MITCHELL	(US)	NATO/IMS	1983-1984
R.BEARD	(US)	NATO/ASG(DS)	1984-1987
M.KORKOLIS	(GR)	NATO/IMS	1985-1987
R.PEAT	(US)	SHAPE	1985-1987
E.W.E.ROGERS	UK		1985-1986
D.SCHOFIELD	CA		1985-1987
I.C.STATLER	(US)	Dir. AGARD	1985-1987
J.E.GREEN	UK		1986-1987
V.GUNTELBERG	DE		1986-1989
J.A.van der BLIEK		Dir. AGARD	1987-1991

P.CHEVALLIER	FR		1988-1990
F.W.ARMSTRONG	UK		1988-1991
J.J.WELCH	US		1988-1992
R.B.BREIVIK	(UK)	SACLANT	1988-1990
M.A.NELSON	(US)	SHAPE	1988-1990
M.MATTINGLY	(US)	ASG/DS	1988-1991
A.J.MELO COREIA	(PO)	IMS	1988-1991
H.ROBYNS DE SCHNEIDAUER	BE		1989-1991
G.MADELUNG	GE		1989-1990
P.RUNGE	GE		1989-1990
B.M.SPEE	NL		1989-1990
P.SYMONS	(UK)	SACLANT	1989-1991
J.HEYDEN	GE		1990-1994
M.LAMY	FR		1990-1994
A.V.ROGERS	(US)	SHAPE	1990-1992
P.MERRILL	(US)	ASG/DS	1991-1993
G.OLIVERO	IT		1991-1993
E.STAI	(NO)	IMS	1991-1994
G.VAN DIEST	BE		1991-1992
A.J.WENNERSTROM	(US)	Dir. AGARD	1991-1994
J.C.CALVAO BORGES	PO		1992-1995
R.JONES	UK		1992-1993
R.E.PEDERSON		SACLANT	1992-1995
ASS. SECR. USAF	US		1992-1995
E.KLIPPENBURG	NO		1993-1994
M.EARWICKER	UK		1993-1997
R.BEARD	(US)	ASG/DS	1993-1996
N.B.KEHOO	(US)	SHAPE	1993-1995
N.HOLME	NO		1994-1997
J.WEYLAND	GE		1994-1995
G.BONNEVALLE	FR		1994-1997
G.B.FERRARI	(IT)	IMS	1994-1997
J.H.WILD	(GE)	Dir. AGARD	1994-1997
A.H.FLAX	(US)	HON. VICE-CHAIRMAN	1995-1997
K.PEEBLES	CA		1995-1997
M.HARTL	GE		1995-1997
D.ALTENA	NL		1995-1997
A.DE ALDEIA PORTELA	PO		1995-1997
L.GUITART	SP		1995-1996
J.MATTICE	US		1995-1996
M.P.GRETTON	(UK)	SACLANT	1995-1996
D.VINDAKIS	(US)	SHAPE	1995-1997
N.W.RAY	(US)	ASG/DS	1996-1997
L.G.POCH	SP		1996-1997
D.C.DANIEL	US		1996-1997
R.G.SPRIGG	(US)	SACLANT	1996-1997

Secretaries:

F.J.READDY	US	1965-1966
C.SEVESTRE	FR	1967-1970
C.E.BORGEAUD	FR	1971-1972
H.A.HERTRICH	GE	1972-1973
P.BAMBERG	GE	1973-1974
J.H.WILD	GE	1974-1979
P.A.PRYOR	US	1980-1983
V.J.CLINE	US	1983-1986
W.M.BROWNING	US	1986-1990
T.W.REDMOND	US	1990-1993
P.L.BRANDENBURG	US	1993-1996
M.I.SHOEMAKER	US	1996-1997

ANNEX 4 MEMBERSHIP OF THE AEROSPACE APPLICATIONS STUDIES COMMITTEE (AASC) 1971-1997

Chairmen:		
J.B.SCOTT-WILSON	UK	1971-1973
J.DATHE	GE	1974-1976
J.C.WANNER	FR	1976-1978
R.MARGUET	FR	1978-1979
H.A.ZWEMER	US	1980-1983
C.COXHEAD	UK	1983-1986
P.EBELING	GE	1986-1990
D.VAFFIER	FR	1990-1991
A.MURASCHIGE	US	1991-1994
G.MARANI	IT	1994-1997
Members:		
J.DATHE	GE	1971-1980
P.V.BROWN	NATO/DSD	1971-1979
T.V.SOMERVILLE	UK	1971-1976
P.CONTENSOU	FR	1971-1972
L.HUMPHREY	NATO/IMS	1971-1972
F.TER BRAAK	SHAPE	1971-1975
J.C.WANNER	FR	1971-1978
G.KENT	US	1971-1974
R.MARGUET	FR	1973-1990
C.SELPH	NATO/IMS	1971-1976
VAN DE MORTAL	SHAPE	1973-1975
R.BARTH	GE	1973-1984
J.B.SCOTT-WILSON	UK	1971-1983
K.R.CHAPMAN	US	1974-1975
J.A.WELCH	US	1975-1979
J.F.GIEBEL	SHAPE	1975-1980
W.W.DUNN	US	1975-1976
A.WALKER	UK	1976-1978
D.COLLINS	NATO/IMS	1976-1978
J.C.TOOMAY	US	1976-1979
H.LANKHORST	NATO/IMS	1978-1982
D.J.WALTERS	UK	1978-1982
A.QUEINEC	FR	1979-1989
H.A.ZWEMER	US	1979-1984
N.BEER	US	1979-1980
R.ROSENBERG	US	1980-1985
G.A.M.BUSCO	IT	1980-1985
C.EPSTEIN	NATO/IS	1980-1982
H.SIMONS	SHAPE	1980-1982
O.SIELAFF	GE	1980-1984
B.J.LEMON	UK	1981-1982
C.COXHEAD	UK	1982-1986
G.ORTENZI	NATO/IS	1982-1987

P.SAVOIE	NATO/IS	1982-1985
J.WALKER	UK	1983-1984
W.GOODSON	US	1983-1985
H.VOS	SHAPE	1983-1984
R.K.BEACOM	US	1985-1987
R.E.CARR	US	1985-1988
P.EBELING	GE	1985-1990
M.R.KAMPHUIS	SHAPE	1985-1987
R.MORRISON	NATO/IMS	1985-1989
C.J.THOMSON	UK	1985-1986
V.CAMPORINI	IT	1986-1993
F.GÜNTHER	GE	1986-1997
W.I.McFARLANE	UK	1986-1994
H.L.SCHIEBSCHICK	STC	1986-1987
G.SCIANDRA	IT	1986-1990
L.F.EAST	UK	1987-1991
A.G.HICKS	UK	1987
P.A.KRAJECK	NATO/IS	1987-1997
J.MORRIS	UK	1987-1989
A.MURASHIGE	US	1987-1997
J.R.VOLPE	STC	1987-1989
F.VOGELPOEL	SHAPE	1988
R.M.ALEXANDER	US	1988-1989
J.DE HEYN	SHAPE	1989-1990
G.HARRISON	US	1989-1991
D.McNIERNY	NATO/IMS	1989-1992
J.MEINARDI	STC	1989-1995
P.A.MILLER	SACEUR	1989-1991
P.C.NORRIS	UK	1989-1991
M.BREITINGER	GE	1990-1997
P.CAZIN	FR	1990-1997
P.LANIER	SACLANT	1990-1993
H.RÜGGEBERG	GE	1990-1993
C.BARNES	UK	1990-1994
D.VAFFIER	FR	1990-1992
R.EBERHART	US	1991-1994
P.GUTTMAN	SACEUR	1991-1993
A.JARDON	SHAPE	1991-1995
A.J.M.McKEON	UK	1991-1993
F.MOLTENI	IT	1991-1997
T.FRANKS	IMS	1992-1997
F.LENNE	FR	1992-1994
F.B.CAMPBELL	US	1993-1994
J.MARANI	IT	1993-1997
G.A.MILLER	UK	1993-1994
K.G.SCHLABAUGH	SACLANT	1993-1997
I.G.SCHOLZ	GE	1993-1994
J.DARRICAU	FR	1994-1997
G.J.KNOPPE	GE	1994-1995

R.N.TYTE	UK	1994-1997
A.J.WILSON	UK	1994-1997
T.L.ALLEN	US	1995-1997
A.GIELIS	SHAPE	1995-1997
A.T.HUDSON	UK	1995-1997

Secretaries:

C.E.BORGEAUD	FR	1971-1977
G.BRON	FR	1977-1979
J.A.TOPP	GE	1980

Chiefs of the MCS Division (who also served as Secretaries from 1980):

W.LYNCH	US	1971-1974
G.DIMON	US	1974-1977
E.KEMLER	US	1977-1979
P.A.PRYOR	US	1979-1983
V.J.CLINE	US	1983-1986
W.M.BROWNING	US	1986-1989
T.W.REDMOND	US	1989-1992
P.BRANDENBURG	US	1992-1995
M.SHOEMAKER	US	1995-1997

ANNEX 5 AGARD PANEL MEMBERS

AEROSPACE MEDICAL PANEL (AMP)

Chairmen:

BERGERET P.	FR	1952-54	PERDRIEL G.	FR	1976-78
MACDONALD T.C.	UK	1954-56	HARTMAN B.O.	US	1978-80
EVRARD E.	BE	1956-59	BANDE J.	BE	1980-82
LOVELACE W.R.	US	1959-62	HOWARD P.	UK	1982-84
EVRARD E.	BE	1962-64	MAAT G.K.M.	NL	1984-86
deVRIES E.	NL	1964-65	JESSEN K.	DE	1986-88
ROXBURGH H.L.	UK	1965-67	BATES C.	US	1988-90
LAUSCHNER E.A.	GE	1967-69	SANTUCCI G.	FR	1992-94
WHITESIDE T.C.D.	UK	1969-72	VOGT L.H.	GE	1992-94
CULVER J.F.	US	1972-74	VANDENBOSCH P.	BE	1994-96
FUCHS H.S.	GE	1974-76	ALNAES E.	NO	1996-97

Deputy Chairmen:

WHILLANS M.G.	CA	1955-57	PERDRIEL G.	FR	1974-76
MARGARIA R.	IT	1957-59	COOKE J.N.C.	UK	1976-78
YAKAL E.	TU	1959-60	BANDE J.	BE	1978-80
VOGT-LORENTZEN F.	NO	1960-61	HOWARD P.	UK	1980-82
GRANDPIERRE R.	FR	1961-62	MAAT G.K.M.	NL	1982-84
COROMBILIS P.	GR	1962-63	JESSEN K.	DE	1984-86
ROXBURGH H.L.	UK	1963-65	BATES C.	US	1986-88
LAUSCHNER E.A.	GE	1965-67	SANTUCCI G.	FR	1988-90
SCANO A.	IT	1967-68	VOGT L.H.	GE	1990-92
DOBIE T.G.	UK	1968-69	VANDENBOSCH P.	BE	1992-94
VIOLETTE F.	FR	1969-71	ALNAES E.	NO	1994-96
CULVER J.F.	US	1971-72	McMILLAN A.J.F.	UK	1996-97
FUCHS H.S.	GE	1972-74			

Executives:

ZINNEMANN G.	US	1952-57	VARENE P.	FR	1973-74
GREEN B.O.	US	1957-59	GUBERNALE A.	IT	1974-76
PETIPRIN F.R.	US	1959-63	MONESI F.	IT	1976-80
CHARTIER A.P.	US	1963-65	MULLANEY J.M.	UK	1980-83
ZINNEMANN G.	US	1965-66	CROWELL B.	CA	1983-87
GRUNHOFER H.	GE	1966-69	WINSHIP J.A.	CA	1987-90
PFISTER A.M.	FR	1969-71	LYLE B.	CA	1990-93
SMITH E.M.	UK	1971-73	POISSON R.	CA	1993-96

Panel Members:

ALBRECHT W.	GE	1960-70	BARTLEMA H.S.	NL	1970-73
ALNAES E.	NO	1980-97	BASKERVILLE F.W.	UK	1958-63
ALONSO-RODRIGUEZ C.	SP	1986-97	BASTIEN J.V.P.	FR	1971-82
ALVARES F.	PO	1982-84	BATES C.	US	1982-91
AMALBERTI R.	FR	1991-97	BECK E.P.	UK	1977-82
ANDERSEN H.T.	NO	1977-95	BENSON A.J.	UK	1974-91
ANDERSON G.K.	US	1991-94	BERGERET P.	FR	1952-63
ANDERSON I.H.	CA	1968-71	BERRY O.	US	1983-88
ANGIBOUST R.L.	FR	1978-82	BIESEMANS I.	BE	1993-97
ANTON D.	UK	1985-93	BIGGELAAR V.D.	NL	1989-89
ATKINSON D.W.	UK	1974-76	BILLINGS C.E.	US	1980-86
AUFFRET R.	FR	1974-91	BITSAKTSIS C.	GR	1991-93
AUSTIN F.H.	US	1979-80	BLES W.	NL	1996
AUSTIN R.B.	US	1958-61	BLIZZARD S .V.	CA	1980-82
AYDINALP N.	TU	1977-85	BOFF K.R.	US	1992-97
BALDES E.J.	US	1960-64	BOLLERUD J.	US	1967-70
BALDOCK N.	UK	1990-91	BORDIER A.	FR	1992-93
		1993-96	BORG A.	NO	1971-76
BANDE J.	BE	1971-97	BOSEER A.	US	1959-68
BARNES R.	CA	1985-88	BOURLOS D.	GR	1995-97

BRADY J.A.	US	1988-92
BRAZ DE OLIVEIRA F.M.C.	PO	1995-97
BRIGHT E.B.	UK	1964-67
BROOKS C.	CA	1986-93
		1996-97
BURCHARD E.C.	GE	1978-89
BURDEN C.A.	CA	1988-89
BURGERS P.I.C.J.	NL	1989-95
BURTON R.	US	1992-97
CAMPBELL P.A.	US	1957-59
CANTONI J.G.	FR	1964-69
CARRE R.	FR	1985-88
CARTER D.I.	US	1973-75
CASTELO-BRANCO N.	PO	1993-95
CHASE B.	US	1982-84
		1987-90
CHASE N.B.	US	1972-75
CHEVALERAUD J.	FR	1978-81
CHIMONAS E.	GR	1989-91
		1993-97
CHRISTOPOULOS N.	GR	1972-76
CHRISTY R.L.	US	1957-58
CLARKE N.P.	US	1972-79
CLEMENT J.	BE	1979-87
CLERE J.M.	FR	1990-97
COLIN I.	FR	1969-85
COLLEY I.H.	UK	1966-74
COLUMELLA F.	IT	1962-68
COOKE J.N.C.	UK	1975-78
COONS D.O.	CA	1958-59
CORKINDALE K.G.G.	UK	1970-72
COROMBILIS P.	GR	1956-57
		1962-63
CULVER J.F.	US	1970-75
CURRAN P.	US	1982-85
D'AMELIO R.	IT	1985-93
DALAKOS K.	GR	1986-96
DALTON C.I.	US	1995-97
DASKALOPOULOS C.	GR	1991-97
DAUMANN F.J.	GE	1980-84
		1989-97
DAVIES J.W.	UK	1982-90
DAVIES J.	UK	1992-97
DAVIS J.G.	US	1986-88
de MENESES J.H.L.	PO	1970-74
de VRIES E.	NL	1959-65
DEGER S.	TU	1984-95
DELAHAYE R.	FR	1978-86
DENGIZ C.	TU	1985-87
DETTOR C.	US	1976-79
DIAMANTOPOULOS C.	GR	1992-97
DINC H.	TU	1967-76
DISMUKES J.C.	US	1989
DOBIE T.G.	UK	1967-72
DOLGIN D.L.	US	1992-97
DOPPELT F.	US	1986-90
DUMAN C.	TU	1958-60
DURNFORD S.J.	UK	1991-92
		1995-97
EBELING E.	GE	1978-80
EGE R.	TU	1961-67
ENTRUDO A.J.	PO	1989-95
ERNSTING J.	UK	1980-90
EVRARD E.	BE	1952-86
FALLON P.F.	US	1979-83
FASSOLD R.W.	CA	1977-89
FIRTH J.L.	UK	1992-95
FLICKINGER D.	US	1958-61
FLION A.	BE	1986-91
FRESE F.J.	US	1963-67
FUCHS H.S.	GE	1968-77
GAGGE A.P.	US	1951-57
GARCIA-ALCON J.L.	SP	1993-97
GELL C.F.	US	1958-60
GIANNOPOLOUS C.E.	GR	1970-72
		1976-77
		1980-81
GIBBONS W.	US	1984-89
GIBERT A.P.P.	FR	1971-75
GILAS K.	GR	1977-82
GLAISTER D.H.	UK	1977-80
		1990-94
GOIS J.N.G.	PO	1974-83
GOURTSOYANNIS N.	GR	1982-84
GRAEBER R.C.	US	1989-90
GRAHAM-CUMMING H.	UK	1996
GRANDPIERRE R.	FR	1960-77
GRANT H.	UK	1995-96
GREEN N.D.C.	UK	1994-97
GRUNHOFER H.	GE	1970-79
HAAKONSON N.H.	CA	1977-78
HAIN R.E	US	1989-97
HARK W.H.	US	1970-72
HARMS D.	GE	1985-93
HART S.G.	US	1991-97
HARTMAN B.O.	US	1972-80
HICKS R.J.	CA	1980-87
HILDEBRANDT J.	GE	1985-90
HOLBROOK G.	UK	1982-87
HOOGERHEIDE J.	NL	1964-70
HOUGHTON O.	US	1986-88
HOUK W.	US	1983-89
HOWARD P.	UK	1970-73
		1978-85
HOWITT J.S.	UK	1962-64
HUGHES E.	US	1986-88
HULME A.	UK	1988-91
HURRELL F.C.	UK	1977
HUXTER R.H.	CA	1979-80
IAMPIETRO P.F.	US	1975-83
IRELAND R.G.	US	1971-77
IVAN D.J.	US	1995-97
JENKINS E.	US	1985-87
		1991-93
JESSEN K.	DE	1978-90
JOHANSEN T.S.	DE	1987-97
JONES T.N.	US	1988-92
JONES W.L.	US	1966-78
JONGBLOED J.	NL	1957-67
KACAGOZOGLU H.	TU	1978
KARNEY W.	US	1988-95
KARSTENS A.I.	US	1959-64
KLEIN K.E.	GE	1971-91
KNAPP S.C.	US	1979-82
KOCH C.	IT	1976-82
KOLLING Th. B.	NL	1965-76
KONSTANDOULAS J.	GR	1992-93
KONTARATOS A.N.	GR	1980-83
KUKLINSKI P.	GE	1987-97
KUSH G.S.	US	1975-79

LABARTHE P.R.	FR	1952-63
LAGARDE D.	FR	1993-97
LANDOLT J.P.	CA	1978-97
LANDRAIN A.	BE	1970-71
LANDRY R.F.	US	1993-97
LANGHOFF J.	GE	1982-91
LANSBERG M.P.	NL	1965-73
LAUSCHNER E.A.	GE	1964-76
LAY M.F.	NL	1957-59
LAZAROU G.	GR	1996
LEACH W.G.	CA	1970-76
LEGER A.	FR	1988-97
LEWIS J.H.	UK	1959-63
LOMONACO T.	IT	1952-76
LORENTZEN-VOGT F.	NO	1952-64
LOVELACE W.R.	US	1957-64
LUNN A.	DE	1953-64
LYONS T.J.	US	1995-97
MAAT G.K.M.	NL	1979-91
MACKIE W.A.N.	UK	1974-76
MAIA DIAS C.A.	PO	1995-97
MAIDMENT G.	UK	1994-97
MALECKI G.S.	US	1979-85
MALONE R.S.	US	1967-70
MARAMENOS S.	GR	1986-92
MARGARIA R.	IT	1952-68
MARRETT W.C.	US	1960-64
MARSHALL B.R.	CA	1989-92
MARTIN E.B.	UK	1963-66
MASDRAKIS G.	GR	1992-93
MATECZUN A.J.	US	1992-96
McARTHUR W.J.	CA	1976-77
McCAULEY G.F.	CA	1992-95
McGUIRE E.J.	UK	1973-74
McIVER R.G.	US	1974
McNAIR J.J.	UK	1972
MELO COELHO F.	PO	1984-89
MENU J.P.	FR	1990-97
MERCIER A.	FR	1960-69
MERRY R.	UK	1995-97
METGES P.	FR	1984-88
MEURERS K.	GE	1994-97
MILHERICO J.N.	PO	1962-64
MOHR G.C.	US	1980-85
MONEY K.E.	CA	1976-85
MOORTHAMERS R.	BE	1970-73
MOREIRA M.F.	PO	1990-93
MYHRE G.	NO	1991-97
MYHRE K.	NO	1989-90
NAGEL C.	US	1986-88
NEEL H.	US	1962-63
NELSON D.G.M.	CA	1958-64
		1965-70
NEYE W.	GE	1983-86
NICHOLSON A.N.	UK	1975-79
		1993-97
NICHOLSON C.B.	UK	1957-58
NIKIPHORAKIS I.	GR	1957
NISSEN W.	GE	1980-85
NUHOGLU I.	TU	1987-89
NUTTALL J.B.	US	1967
NYBY O.	NO	1964-71
O'NEILL H.	CA	1992-97
OHSLUND R.K.	US	1978-82
OKSUZ A.	TU	1994-97
OLIVARIUS B.	DE	1964-71
OOSTERVELD W.J.	NL	1976-97
ORD J.W.	US	1981-85
OTTO W.R.	US	1963-66
PANAGIOTOPOULOS A.	GR	1981-82
PATEE J.C.	US	1995-97
PAXINOS O.	GR	1994-97
PERDRIEL G.	FR	1970-83
PERRY I.C.	UK	1968-72
PHOEBUS C.P.	US	1954-57
PINGANNAUD P.	FR	1981-82
POLISTENA S.	IT	1971-76
POLIZZI di SORRENTINO A.	IT	1969-74
POLLARD J.P.	US	1960-78
PONGRATZ H.	GE	1993-97
POPPLOW J.	CA	1982-84
PORCU S.	IT	1992-97
POWELL T.J.	CA	1964-65
PRICE D.	US	1982-88
PRICE T.J.G.	UK	1971-75
PSIMENOS G.	GR	1984-87
PURNELL G.V.	UK	1979-81
RAMACCI C.A.	IT	1974-83
RHEMREV N.A.V.	NL	1970-76
RIBEIRO N.P.	PO	1993-97
RIOS TEJADA F.	SP	1990-97
RÖDIG E.	GE	1991-97
ROOD G.M.	UK	1995-97
ROTONDO G.	IT	1974-93
ROXBURGH H.L.	UK	1964-72
RUFF S.	GE	1959-71
SANTUCCI G.	FR	1984-93
SARIKAYALAR U.	TU	1994-97
SAVASAN K.	TU	1990-97
SCANO A.	IT	1965-76
SCHROEDER E.	DE	1990-97
SCHWENDER G.E.	US	1989-92
SEIGNEURIC A.	FR	1988-97
SEKER N.	TU	1986-88
SEZER H.	TU	1982-86
SHAMBUREK R.H.	US	1966-70
SHANAHAN D.F.	US	1994-97
SIMPSON E.C.	UK	1978-80
SINGER H.	PO	1984-90
SIOMOPOULOS G.	GR	1987-91
SMIT J.	NL	1992-95
SOYGUT M.	TU	1975-80
STAACK K.	GE	1979-82
STATHOYIANNIS E.	GR	1986-88
STAVROPOULOS J.	GR	1977
STEELE-PERKINS A.P.	UK	1991-93
STEENDIJK C.A.	NL	1976-78
STEWART W.K.	UK	1952-55
STIGELMAN W.H.	US	1989-93
STOOT C.J.	UK	1996-97
TALBOT I.M.	US	1964-67
TANGNEY J.	US	1989-95
TAYLOR G.P.	US	1995-97
TAYLOR M.G.	CA	1959-60
		1964-68
TEPPER M.L.	CA	1978-79
TERZIOGLU	TU	1963-66
THORNE R.G.	UK	1966-75
THORNTON R.	UK	1992-95

THORSEN K.	DE	1971-77	VOGT L.H.	GE	1982-97
TIELEMANS W.C.M.	NL	1995-97	VOORLUIJS B.	NL	1993-96
TIMBAL J.	FR	1982-90	WARD C.L.	US	1975-76
TOLHURST G.C.	US	1968-71	WHILLANS M.G.	CA	1952-61
TRIBEL S.	BE	1971-78	WHITE C.S.	US	1952-55
TSIGOS A.	GR	1977-79	WHITESIDE T.C.D.	UK	1966-75
TSOURAS	GR	1985-86	WICKETT J.C.	CA	1956-58
URQUIA S.	SP	1985-89			1960-68
VAN DE CASTEELE J.	BE	1979-82	WIGGIN N.J.B.	CA	1961-64
VAN NORREN D.	NL	1995-97	WILSON J.S.	UK	1957-59
VAN WULFFTEN PALTHE P.	NL	1957-64	WISE H.G.	US	1970-71
VANDENBOSCH P.	BE	1982-97	WOODWARD D.P.	US	1972-83
VARELA J.J.	PO	1957-61	WURFLER P.	GE	1958-64
		1963-70	YAKAL F.	TU	1952-61
VASTESAEGER J.P.	BE	1996-97	YALUG O.	TU	1989-90
VERSELE G.	BE	1974-78	YATROMANOLAKIS N.	GR	1982-85
VERSTEEG J.	NL	1990-93	YELLAND A.C.	CA	1971-77
VIEILLEFOND H.	FR	1982-90	ZACHER H.	GE	1990-94
VIOLETTE F.	FR	1964-77	ZINNEMANN G.	US	1971-73
VISSOULIS H.	GR	1982-83			

SHAPE Ex-Officio:

BARKER C.C.	1956	PACE T.A.	1970-74
Méd. Gén. DWAL	1963-64	PELEGRIN M.	1963-64
GREILING G.	1964-67	POWEL W.H.	1957-59
HALL W.F.	1956	RIDDICK D.G.B.	1974-77
LABARTHE P.R.	1959-63	SEYMOUR-PRICE D.	1967-70

AFCENT Ex-Officio:

BROWNE W.E.	1971-72	KRIBEL A.	1965-68
EILERMAN Col	1969-71	LAUSCHNER E.A.	1961-63
KLOTZ A.	1964-65	LLEWELYN A.J.	1963-64

AVIONICS PANEL (AVP)

Chairmen:

LEES R.J.	UK	1957-59	TIMMERS H.A.T.	NL	1977-79
RECHTIN E.	US	1959-61	VOGEL M.	GE	1979-81
DIEMINGER W.	GE	1961-63	BRAULT Y.	FR	1981-83
ENDRESEN K.	NO	1963-65	DIAMOND F.	US	1983-85
COULMY D.	FR	1965-67	HUNT G.	UK	1985-87
BOSMAN D.	NL	1967-69	MACPHERSON R.	CA	1987-89
GNAVI F.	IT	1969-71	KLEMM R.	GE	1989-91
GABELMAN I.	US	1971-73	MASCARENHAS J.M.B.G.	PO	1991-93
VOLES R.	UK	1973-75	HOMER P.	US	1993
BLOOM J.N.	CA	1975-77			

Deputy Chairmen:

RECHTIN E.	US	1957-59	TIMMERS H.A.T.	NL	1975-77
DIEMINGER W.	GE	1959-61	VOGEL M.	GE	1977-79
ENDRESEN K.	NO	1961-63	BRAULT Y.	FR	1979-81
COULMY D.	FR	1963-65	DIAMOND F.	US	1981-83
BOSMAN D.	NL	1965-67	HUNT G.	UK	1983-85
GNAVI F.	IT	1967-69	MACPHERSON R.	CA	1985-87
GABELMAN I.	US	1969-71	KLEMM R.	GE	1987-89
VOLES R.	UK	1971-73	MASCARENHAS J.M.B.G.	PO	1989-91
BLOOM J.	CA	1973-75	CORBISIER F.	BE	1991-93

Executives:

LAIRMORE G.	US	1957-61	CATILLER J.B.	US	1978-82
DUKES E.F.	US	1961-65	RUSSELL T.B.	US	1982-85
FANNIN W.E.	US	1966-67	STRATTON M.V.	US	1985-88
SMITH C.M.	US	1968-71	CLAY J.	US	1988-91
ROSS W.W.	US	1971-73	SAUTTER F.C.	US	1991-92
OGG N.R.	UK	1973-76	CARIGLIA R.	IT	1992-93
CARRUTHERS D.G.	US	1976-78			

Panel Members:

ALEXANDER S.N.	US	1957-67	CROVELLA L.	IT	1981-93
ALTAY T.	TU	1984-87	CYMBALISTA J.	FR	1993-93
AMDAL O.J.	NO	1969-71	DAMASIO L.F.B.	PO	1992-93
ANAGNOSTAKIS E.	GR	1991-92	DANSAC J.	FR	1985-93
ANDERSEN J.P.	US	1974-79	DARRICAU J.	FR	1981-84
ANDERTON H.L.	US	1970-73	DAVIES D.H.	UK	1972-73
ANDRADE P.J.E.M.	PO	1987-91	DEWINTER J.	BE	1990-93
ANDRIANOS E.	GR	1990-93	DI MARTINO B.	IT	1991-93
ARGOUDELIS N.	GR	1981-82	DIAMOND F.I.	US	1975-85
ARKOUMANEAS E.	GR	1977-78	DIEMINGER W.	GE	1958-63
ARNOLD H.D.	US	1969-70	DIOKMETZIDIS J.	GR	1981-82
ATAMAN A.	TU	1960-63	DOGUSOY Y.	TU	1967-73
		1969-85	DOPING-HEPENSTAL L.L.	UK	1989-93
BAKKEN P.M.	NO	1985-93	DOREY J.	FR	1983-93
BALDI T.	IT	1964-66	DORSIMONT A.E.	BE	1959-71
BALL W.F.	US	1976-84	DOVEB.L.	US	1978-86
BARAY M.	TU	1987-93	DUBOIS B.	BE	1979-83
BARRE P.	FR	1977-79	EASTWOOD E.	UK	1960-63
BART J.	US	1987-92	EKRE H.	NO	1966-89
BAYKAL N.	TU	1991-93	ENDRESEN K.	NO	1960-65
BECHER P.	GE	1989-93	ESPOSITO D.	IT	1985-91
BELL C.A.	UK	1960-73	FISH R.W.	UK	1965-71
BERGER C.	FR	1972-80	FOURURE O.	FR	1992-93
BERNALDO DE QUIROS D.J.G.	SP	1993-93	FOUSE G.T.	US	1971-75
BERTRAIS J.	FR	1968-77	FREEDMAN J.	US	1968-79
BLOOM J.N.	CA	1967-78	GABELMAN I.	US	1963-75
BOSMAN D.	NL	1960-93	GAFFAROGLU S.	TU	1983-84
BRAULT Y.	FR	1974-85	GAGGIN D.V.	US	1986-93
BREIEN T.	NO	1972-79	GARNIER G.	FR	1992-93
BRENNAN T.J.	US	1991-92	GEORGOPOULOS C.	GR	1983-85
BRICE J.M.	FR	1986-90	GERHARDT L.	US	1979-85
CAMBI P.	IT	1958-65	GHICOPOULOS F.	GR	1980-86
CANEI P.	BE	1964-71	GIORDANI E.	IT	1969-74
CANTRAINE G.	BE	1972-78	GNAVI F.	IT	1966-71
CARLIER M.	FR	1974-78	GRATEPANCHE H.	FR	1979-82
CARPENTIER M.	FR	1967-74	GRAVES G.B.	US	1973-76
CELLETTI L.	IT	1974-86	GUDMANDSEN P.E.	DE	1968-88
CESTRONE C.	IT	1991-93	GUIOT R.	FR	1986-91
CETINER E.	TU	1963-66	GULUT Y.	TU	1977-78
CHADEAU A.	FR	1984-85	GUMAS A.	GR	1981-82
CHISHOLM R.O.R.	UK	1963-66	HAAKONSEN O.P.	NO	1971-72
CHRISSOCHOIDIS A.	GR	1985-88	HABAYEB A.R.	US	1973-76
CINCIOGLU M.	TU	1987-90	HALL C.D.	UK	1991-93
CLIPPEL A. de	BE	1958-61	HAMILL T.G.	UK	1992-93
COLOMBANI P.	FR	1957-61	HAYES R.J.	US	1968-69
COOPER C.W.	UK	1972-81	HEFFERNAN G.A.	US	1972-73
CORBISIER F.	BE	1982-93	HEIEN A.	NO	1958-60
CORDFIR J.	FR	1968-71	HERMAND P.	BE	1961-63
CORRAZZA G.	IT	1966-70	HOIVIK L.	NO	1979-90
		1978-82	HOMER P.B.	US	1987-93
COULMY D.	FR	1963-69	HOWELL W.E.	US	1986-93
COULSHED W.F.	UK	1958-64	HUNT G.	UK	1980-92
COX J.W.	CA	1957-64	INCE A.N.	TU	1982-92
CREMONESI A.	IT	1967-78	JACKSON F.W.	UK	1986-90

JACOBSEN M.	GE	1975-93	PAPADOFRANGAKIS E.	GR	1985-90
JUAN CEBRIAN R.	SP	1990	PAPATHOFRAGAKIS M.	GR	1983-85
KALAYÇIOGLU U.	TU	1993-93	PEEBLES K.	CA	1979-81
KAMBAS P.	GR	1982-84	PEROT G.	FR	1961-63
KAZANCI H.	TU	1987-92	PILOT DE COLIGNY G.	FR	1957-61
KAZOKOGLU A.	TU	1978-82	RAVELLI G.	IT	1970-78
KENNIS F.	BE	1971-82	RECHTIN E.	US	1958-67
KEONJIAN E.	US	1962-74	ROSE K.	NO	1986-93
KESICI B.	TU	1987-90	RONTANI B.	FR	1987-93
KEYDEL W.	GE	1984-93	ROUGHTON D.	UK	1987-88
KILPATRICK D.D	US	1967-69	ROUSSEL E.J.	FR	1959-74
KLEMM R.	GE	1981-93	RUGGE H.	US	1992-93
KNUTSEN K.	NO	1978-79	RYLES J.G.	US	1976-86
KORONAIOS M.	GR	1989-92	SAKELLARIOU P.	GR	1986-87
KOTRONIS A.	GR	1986-87			1991-93
KRUEGER C.H.	US	1987-93	SALLADA W.F.	US	1970-72
KUNY W.	GE	1982-88	SAMSON P.	FR	1984-91
KUTCHMA E.	US	1984-87	SCHIOTZ H.	NO	1974-79
LA ROSA G.	FR	1979-80	SCHULZE E.	GE	1967-69
LAIRMORE G.	US	1962-63	SCRIMSHAW F.	UK	1959-62
LAMBRAKIS M.	GR	1981-86	SELER Y.	TU	1958-63
LANG L.M.	US	1961-71	SPRINGER H.	GE	1969-75
LANGILLE R.G.	CA	1964-65	STANZIANO A.	US	1966-67
LARTIGUE N.	FR	1986-87	STETTE G.	NO	1978-85
LASSITER E.M.	US	1986-91	STRINGER F.S.	UK	1972-80
LAVANT J.T.	US	1963-65	SUETA T.J.	US	1971-85
LE BOITEUX H.	FR	1957-66	TAAGHOLT J.	DE	1972-93
LEES R.J.	UK	1957-71	TABER J.E.	US	1961-65
LEGAC J.Y.	FR	1979-84	TAILLET J.	FR	1974-83
LEYSIEFFER H.	GE	1973-75	TARHAN B.	TU	1991-93
LIED F.	NO	1957-60	TEZER A.	FR	1976-80
LITTLE R.	UK	1993-93	TIMMERS H.A.T.	NL	1970-93
LOUCHART M.	FR	1963-68	TOKER C.	TU	1979-87
LUEG H.	GE	1967-82	TOUNIS C.	GR	1972-75
MACE W.D.	US	1975-78	TZIRITAS M.	GR	1993-93
MACKINTOSH I.W.	UK	1981-85	ULBRICHT G.	GE	1957-72
MACPHERSON R.W.	CA	1981-93	UZER T.	TU	1965-71
MAESTRINI R.	IT	1966-78	VAFIADES P.	GR	1976-79
MAGINI P.	IT	1961-65	VAGNARELLI F.	IT	1968-93
MARQUES J.D.M.	PO	1989-93	VALLEY E.	US	1957-69
MARTIN-RICO C.	SP	1987-93	VAN BLADEL J.	BE	1973-78
MASCARENHAS J.M.B.G.	PO	1979-93	VAN KEUK G.	GE	1975-81
MAVROKOUKOULAKIS N.	GR	1987-93	VANDENBRANDEN W.	BE	1983-89
MEEK J.	CA	1965-67	VAROL N.	TU	1980-82
MORAITIS S.	GR	1958-72	VILLA G.	IT	1957-65
MOREAU C.	FR	1979-84	VLAHOPOULOS N.	GR	1982-86
MOREAU R.	FR	1967-74	VOGEL M.	GE	1973-83
NAGLAK L.A.	US	1990	VOLES R.	UK	1960-90
NAVARRO M.	SP	1991-93	VON WEILER J.L.W.C.	NL	1958-73
NIELSEN O.	DE	1957-60	WARIN Y.	FR	1981-85
NORDLUND R.	US	1966-71	WEBB E.L.	CA	1957-59
ODDO G.S.	IT	1982-83	WEDAN R.	US	1969-74
OLESEN J.	DE	1968-72	WEISS M.	US	1979-82
ONYORU Y.	TU	1972-75	WHALLEY J.	UK	1984-86
ORANC H.	TU	1974-75	WIECKHORST F.	GE	1969-73
OZBEK H.	TU	1979-80	WILDE K.	GE	1958-67
OZKAYA A.	TU	1990-93	WILLMER R.H.	UK	1962-64
OZKER T.	TU	1963-66	WIRT R.L.	US	1987-93
PALAS G.	GR	1980-82	YANNUZZI E.	US	1984-88
PALIGU Z.	TU	1992-93	YAZGAN B.	TU	1975-76
PALUG S.	TU	1990-91	YOUNG G.M.	US	1984-86
PAMPOUCAS T.V.	GR	1987-93	YUNGUL D.	TU	1976-78

SHAPE Ex-Officio:

CLARCK R.G.	1959-60	LEPPLA R.G.	1960-63
ISRAELEN O.A.	1960-69	PELLEGRIN M.	1964-66
KNIERIM G.	1963-64		

AFCENT Ex-Officio:

HYND W.R.B.	1965-68	LLEWELYN A.I.	1962-65

AFNORTH Ex-Officio:

TABOR M.	1965-66		

STC Ex-Officio:

LORON R.G.	1957-67	BERGMAN C.E.	1979-83
SCHELLHOSS Th. H.	1964-66	SCHIEBSCHICK H.L.	1983-86
BURGESS J.S.	1971-76	GARTNER O.H.	1986-90
MIRMAN I.R.	1976-79	PRUNSCH H.R.P.	1990-93

ELECTROMAGNETIC WAVE PROPAGATION PANEL (EPP)

Chairmen:

LIED F.	NO	1957-58	HALLEY P.M.	FR	1975-77
NEWMAN P.	US	1958-62	ALBRECHT H.J.	GE	1977-79
VASSY E.	FR	1962-64	AARONS J.	US	1979-81
ANASTASSIADES M.	GR	1964-65	BELROSE J.	CA	1981-83
BURGESS B.	UK	1966-68	BLYTHE J.	UK	1983-85
PAGHIS I.	CA	1968-69	SOICHER H.	US	1985-87
DAVIES K.	US	1969-71	GOUTELARD C.	FR	1987-89
HOLT O.	NO	1971-73	VISSINGA H.	NL	1989-91
RANZI I.	IT	1973-75	RICHTER J.H.	US	1991-93

Deputy Chairmen:

VASY E.	FR	1960-62	AARONS J.	US	1977-79
ANASTASSIADES M.	GR	1962-64	BELROSE J.	CA	1979-81
BURGESS B.	UK	1964-66	BLYTHE J.	UK	1981-83
PAGHIS I.	US	1966-68	SOICHER H.	US	1983-85
HOLT O.	NO	1969-71	GOUTELARD C.	FR	1985-87
RANZI I.	IT	1971-73	VISSINGA H.	NL	1987-89
HALLEY P.M.	FR	1973-75	RICHTER J.H.	US	1989-91
ALBRECHT H.J.	GE	1975-77	HÖHN D.	GE	1991-93

Executives:

SMITH C.R.	US	1968-71	RUSSELL T.B.	US	1982-85
ROSS W.W.	US	1971-73	STRATTON M.V.	US	1985-87
OGG N.R.	UK	1973-76	BRUNELLI P.A.	IT	1987-89
CATILLER J.B	US	1978-82	CARIGLIA R.	IT	1990-93

Panel Members:

AARONS J.	US	1973-82			1969-85
ALBRECHT H.J.	GE	1969-93	AUDONE B.	IT	1989-93
ALTAY T.	TU	1988-90	AZZARONE R.	IT	1985-90
ANAGNOSTOU D.	GR	1989-91	BELROSE J.S.	CA	1976-93
ANASTASSIADES M.	GR	1957-58	BENSON R.F.	US	1988-93
ARIKAN H.Z.	TU	1985-89	BLACKBAND W.T.	UK	1958-62
ARNBACK J.	NL	1985-87	BLAMONT J.E.	FR	1958-62
ATALAR A.	TU	1988-93	BLYTHE J.H.	UK	1973-88
ATAMAN A.	TU	1960-65	BOESVELD A.	NL	1988-91

BOITHIAS L.	FR	1979-88	LARSEN T.R.	NO	1974-82
BOSSY L.	BE	1982-93	LE BOITEUX H.	FR	1957-66
BROWN G.	US	1993-93	LIED F.	NO	1957-59
BURGESS B.	UK	1963-88	LISBONIS M.	FR	1979-80
CANNON P.S.	UK	1988-93	MAKIOS V.	GR	1978-83
CASSARA' A.	IT	1985-93	MAVROKOUKOULAKIS N.	GR	1981-87
CHECCACI P.	IT	1977-80	MENDES A.S.	PO	1967-83
CHRISTOPHE F.	FR	1985-93	MORAITIS S.N.	GR	1967-72
CIRIT A.	TU	1977-78	NADAR O.	TU	1993
CLIFFORD S.	US	1989-93	NANIA G.A.	IT	1982-85
COIMBRA DOS SANTOS.	PO	1987-90	NEESSEN J.T.	NL	1982-85
COLIN L.	US	1987-88	NEUBAUER F.R.	NL	1961-66
COYNE V.J.	US	1976-86	NEWMAN P.	US	1960-73
CRAIG K.	UK	1991-93	NICOLET M.	BE	1958-86
CRESCIMBEN F.I.	IT	1990-92	NICOLIS J.	GR	1986-87
CROSIGNANI B.	IT	1985-93	NIELSEN O.	DE	1957-60
CUTOLO M.	IT	1961-93	NORBURY J.R.	UK	1988-92
DARNELL M.	UK	1989-93	OLESEN J.K.	DE	1968-72
DASIOS G.	GR	1993-93	OLIVER N.J.	US	1957-60
DAVIES K.	US	1964-79	ORANÇ H.	TU	1975-88
DE VOOGT A.H.	NL	1958-60	OTT R.H.	US	1991-93
DELLOUE J.	FR	1963-69	OZBAKI K.	TU	1974-79
DIEMINGER W.	GE	1958-64	PAGHIS I.	CA	1964-72
DOGUSOY Y.	TU	1967-74	PALMER F.	CA	1993
DOMINICI P.	IT	1977-78	PALMER F.H.	CA	1981-86
DOREY J.	FR	1982-83	PAPAIONNOY N.	GR	1974-75
DRUMMETER L.	US	1976-79	PAPAPASCHALIS A.	GR	1991-93
FAWE A.E.	BE	1972-78	PAPET-LEPINE J.	FR	1988-92
FER A.	TU	1982-84	PATRICIO J.F.	PO	1983-93
FERREIR A.	PO	1964-67	PETERSON A.M.	US	1961-63
FISCHER K.E.	GE	1986-89	PEZZANO I.	IT	1992-93
FLOOD W.	US	1989-93	PICCA D.	IT	1991-93
FUERXER P.	FR	1983-93	PITTS T.G.	US	1986-89
GHICOPOULOS B.	GR	1985-88	POIRIER J.L.	US	1988-91
		1990-93	RANZI I.	IT	1965-77
GLAZIER J.	UK	1957-59	RASMUSSEN J.E.	US	1986-92
GOLD J.M.	UK	1988-89	REDER F.	US	1965-68
GOUTELARD C.	FR	1982-93	REILLEY E.	US	1961-64
GUDEN S.	TU	1991-93	REMY C.	FR	1983-85
GUDMANDSEN P.E.	DE	1968-89	RICHTER J.H.	US	1986-93
HAGN G.H.	US	1989-91	RISHBETH H.	UK	1965-73
HALLEY P.	FR	1963-78	ROBERTS L.W.	US	1973-79
HIZAL A.	TU	1981	ROGGE J.	NL	1990-93
		1983-85	ROTHER D.	GE	1984-93
HODARA H.	US	1974-86	ROUSEL E.J.	FR	1959-66
HÖHN D.	GE	1987-93	RUSH C.M.	US	1986-89
HOLT O.	NO	1967-74	RYBNER J.	DE	1958-67
HUBERSON	FR	1981-83	SANJURJO NAVARRO R.	SP	1992-93
HUMBY A.M.	UK	1959-64	SCHEGGI A.M.	IT	1981-88
IASELLI P.	IT	1980-83	SCHMERLING E.R.	US	1978-87
INCE A.N.	TU	1982-88	SCHWEICHER E.	BE	1990-93
JORGE AFONSO A.	PO	1990-93	SEGURA A.A.	SP	1987-90
JUILLERAT R.	FR	1983-85	SEZGIN A.	TU	1985-88
KARABELAS C.	GR	1972-73	SKAUG R.	NO	1982-93
KASSNER F.	GE	1982-85	SOICHER H.	US	1974-88
KATELOUZOS D.	GR	1986-89	SPITZ E.	FR	1974-93
KIRIAFINIS P.	GR	1993-93	SPRENKELS C.	BE	1978-90
KOSSEY P.	US	1992-93	STENERSEN K.	NO	1985-88
KOTRONIS A.	GR	1992-93	STOKKE K.	NO	1988-93
KRIEZIS D.	GR	1986-91	TAAGHOLT J.	DE	1972-93
LAMMERS U.	US	1991-93	TACCONI G.	IT	1989-93
LAMPERT E.W.	GE	1979-84	THRANE E.	NO	1964-67
LANDMARK B.	NO	1960-63	TOKER C.	TU	1988-93
LANGE-HESSE G.	GE	1966-81	TORUN E.	TU	1990-93
LANUSSE A.	FR	1992-93	TSAVDARIS M.	GR	1983-85

TSIGARAS A.	GR	1991-92	VLACHOS S.	GR	1988-93
TSOMOKOS A.	GR	1991-92	VLAHAKIS G.	GR	1989-93
TSOUKIAS J.	GR	1980-81	VOGE J.P.	FR	1957-72
TULUNAY Y.	TU	1985-93	WANG G.	NO	1970-85
TURKYILMAZ M.	TU	1991-93	WARREN E.S.	CA	1972-76
UTLAUT W.F.	US	1980-86	WETZEL L.B.	US	1970-76
UZER T.	TU	1965-66	WHITE M.B.	US	1979-86
VAN DER VORST A.	BE	1972-93	WYMAN G.	UK	1991-93
VAN DIJL B.	NL	1967-78	XANTHOUDAKIS D.	GR	1976-78
VASSY E.	FR	1958-69	YEH K.C.	US	1984-93
VIDDELEER J.	NL	1979-81	ZELDERS F.	NL	1991-93
VISSINGA H.	NL	1985-93			

SHAPE Ex-Officio:

DAVID P.	1961-62

STC Ex-Officio:

WILLE H.	1959-60	SEPP H.	1978-87
WILLIAMS H.P.	1963-67	YAVUZ D.	1987-93
INCE A.N.	1968-78		

ARFA Ex-Officio:

BEHM E.W.	1971-74	CAVALIERE M.	1984-87
TALLET A.J.	1974-77	FITSIMONS T.	1985-90
SIMONCELLI M.	1977-79	LISEC E.	1990-93
WEIS J.H.	1980-84		

FLIGHT MECHANICS PANEL (FMP)
[FLIGHT VEHICLE INTEGRATION PANEL (FVP) from 1994]

Chairmen:

RIDLEY J.L.	US	1952-55	RENAUDIE J.F.	FR	1978-80
MARX A.J.	NL	1955-58	BALMER R.J.	UK	1980-83
WOOD A.D.	CA	1958-60	SINCLAIR S.R.M.	CA	1983-85
DICKINSON R.P.	UK	1960-63	HAMEL P.	GE	1985-86
CIAMPOLINI G.	IT	1963-65	FILISETTI A.	IT	1986-88
AIKEN W.S. Jr	US	1965-67	A'HARRAH R.C.	US	1988-90
DOETSCH K.H.	GE	1967-69	DUC J.-M.	FR	1990-92
LECOMTE P.	FR	1969-71	CAMPOS L.	PO	1992-94
SCOTT-WILSON J.B.	UK	1971-74	WÜNNENBERG H.	GE	1994-96
STATLER I.C.	US	1974-76	TOMLINSON B.	UK	1996-97
MAX H.	GE	1976-78			

Deputy Chairmen:

HUFTON P.A.	UK	1952-55	RENAUDIE J.F.	FR	1976-78
DAVIES H.	UK	1955-57	BALMER R.J.	UK	1978-80
DICKINSON R.P.	UK	1957-60	SINCLAIR S.R.M.	CA	1980-83
CIAMPOLINI G.	IT	1960-63	HAMEL P.	GE	1983-84
AIKEN W.S. Jr	US	1963-65	FILISETTI A.	IT	1984-86
DOETSCH K.H.	GE	1965-67	A'HARRAH R.	US	1986-88
LECOMTE P.	FR	1967-69	DUC J.-M.	FR	1988-90
SCOTT-WILSON J.B.	UK	1969-71	CAMPOS L.	PO	1990-92
McGREGOR D.M.	CA	1971-73	WÜNNENBERG H.	GE	1992-94
STATLER I.C.	US	1973-74	TOMLINSON B.	UK	1994-96
MAX H.	GE	1974-76	McERLEAN D.	US	1996-97

Executives:

DRISCOLL J.J.	US	1952-54	WASICKO R.J.	US	1971-75
WILLAUME R.A.	FR	1954	HAMILTON B.I.L.	UK	1975-76
SCHULD E.P.	US	1954-58	STRANGROOM D.A.	UK	1976-79
WOIDA J.A.	US	1958-61	WILCOCK T.	UK	1979-82
DETHMAN I.H.	US	1961-64	LAWFORD J.A.	UK	1982-84
GIESEMAN E.R. Jr	US	1964-66	TORODE H.A.	UK	1984-87
GEHL G.	GE	1966-68	FOSTER M.K.	UK	1987-94
WOLKER L.	GE	1968-71	WHEATLEY J.B.	US	1994-97

Panel Members:

A'HARRAH R.C.	US	1982-90	CERZA G.	IT	1952-58
AASS H.	NO	1953-55	ÇETIN T.	TU	1994-97
ABBINK F.J.	NL	1989-93	CHOPLIN J.	FR	1992-97
ACER M.	TU	1985-87	CHRISAITIS D.	GR	1957-61
ADOLPH C.E.	US	1985-90	CIAMPOLINI G.	IT	1958-78
AGNEESSENS D.	BE	1979-97	ÇIVICI I.	TU	1994-97
AIKEN W.S. Jr	US	1962-77	COLE W.R.	CA	1962-63
AKMANDOR S.	TU	1987-91	COLUMBA F.	IT	1952-58
ALEMDAROGLU N.	TU	1994-97	COTE F.	FR	1985-90
ALIAS G.	IT	1958	CREASEY R.F.	UK	1973-76
ALTINOK T.	TU	1996-97	CREEDON J.	US	1994-97
ANASTASIADIS P.	GR	1988-93	CREUTIN G.	FR	1987-90
ANDERSON R.O.	US	1980-85	CURIS B.	FR	1980-83
ANDREWS H.	US	1974-78	CZINCZENHEIM J.	FR	1972-91
APPLEFORD J.K.	UK	1991-95	D'AUTUME J.	FR	1990-97
ARMSTRONG N.A.	US	1975-77	DANIEL D.C.	US	1991-93
ASENJO J.L.	SP	1987-89	DAVY P.	FR	1952-54
ASTOLFI M.	IT	1991-97	de BUEGER	BE	1958-60
ATKIN A.F.	UK	1957-60	de CLERK P.	BE	1967-78
BAILLIE S.H.	CA	1988-97	de la FOYE C.	FR	1980-83
BALMER R.J.	UK	1975-83	DE LEEUW J.H.	CA	1992-97
BAMIHAS N.	GR	1990-93	DELHAYE J.	BE	1960-70
BATES G.P. Jr	US	1972-80	DICKINSON R.P.	UK	1957-64
BEAWAIS H.	GE	1959-63	DIETZ W.O.	US	1979-84
BEEBE J.	US	1961-71	DILEK S.	TU	1984-88
BEKAS G.	GR	1996	DOETSCHE K.H.	GE	1963-78
BELCHER G.	UK	1994-97	DOYLE G.B.	US	1953-54
BELL A.	UK	1984	DRAKOS A.	GR	1985
BERKOW J.J.	US	1956-63	DUC J.M.	FR	1974-95
BERNIER P.	FR	1977-79	DUDDY R.R.	UK	1955-57
BERNOTAT R.	GE	1969-71	ELLS R.G.	CA	1966-70
BIANCHI E.	IT	1958-69	ERGENC M.	TU	1974-76
BISMUT M.	FR	1963-67	ERTONGUR R.	TU	1979-83
BJOERNSTAD H.E.	NO	1953-59	FACCA G.	IT	1969-78
BLAKE B. B.	US	1993-97	FANIS N.	GR	1993-95
BLENK H.	GE	1956-63	FILISETTI A.	IT	1979-93
BOCK G.	GE	1956-61	FOCH F.	FR	1955-56
BOKEAS S.	GR	1987	FOCH J.	FR	1960-61
BORGMAN D.	US	1987-92	FORESTIER J.	FR	1969-80
BORTIGNONI I.	IT	1958	FOUCHE M.H.	FR	1987-97
BRACKEY T.A.	US	1995-97	FRAGOYANNIS G.	GR	1979-81
BRANDT-MOELLER P.N.	DE	1952-69	FRISTACHI G.	IT	1990
BRITTON J.W.	UK	1979-83	FUSSI A.	IT	1969-82
BROUGH J.N.	CA	1959-62	GALLAGHER G.	US	1986-90
BRUNING H.	GE	1963-71	GERADIN M.	BE	1978-97
BRYDER W.	UK	1983	GERLACH O.H.	NL	1967-81
BUHRMAN J.	NL	1964-81	GIKAS Z.	GR	1987-97
CADWALLADER R.	UK	1996-97	GOKTAY R.	TU	1981
CAMPOS L.M.B. da C.	PO	1980-97	GONDET J.F.	FR	1996
CANEILL P.	FR	1981-83	GOUGH M.N.	US	1954-63
CARDOSO A.M.S.	PO	1989-97	GREENE L.P.	US	1964-76
CARTER E.S. Jr	US	1972-79	GUENOD R.	FR	1957
CAYOT J.	US	1980-84	GÜL S.	TU	1991-93

GUROGLU M.	TU	1978
GÜVENTÜRK A.B.	TU	1994-97
HAAKENSTAD G.	NO	1969-70
HAFER X.	GE	1964-73
HAGE R.E.	US	1964-67
HAMEL P.	GE	1972-97
HAMILTON B.I.L.	UK	1972-74
HAMILTON W.T	US	1970-78
HATJIANASTASIOU K.	GR	1982-84
HAUS F.C.	BE	1952-93
HERRERA J.	SP	1987-89
HILDEBRAND R.	US	1987-94
HILL N.E.	UK	1952-55
HOEG J.	US	1985-88
HOEHNE V.	US	1986-87
HOISETH H.Fr.	NO	1971-93
HONDROS D.	GR	1952-53
HORSFIELD W.D.	UK	1963-66
HOWELL A.B.	CA	1963-66
HUCHER M.	FR	1959-60
HULME K.F.	UK	1995-97
IDRAC J.	FR	1952-62
IFANTIS V.	GR	1985-87
INALHAN A.	TU	1985-90
INGER E.	TU	1984-85
INNOCENTI M.	IT	1994-97
JIMIS D.	GR	1996
JOHNSON E.G.	US	1969-71
KANSU Y.	TU	1954-67
		1978-82
KAYTEN G.G.	US	1979-86
KEY D.	US	1984-90
KJOLSETH P.	NO	1955-56
KLINEBERG J.M.	US	1978-79
KLOPFSTEIN G.	FR	1968-72
KNOWLES P.	UK	1987-88
KOHLMAN D.L.	US	1981-84
KOLEOGLU E.	TU	1977-78
KOTITSAS A.	GR	1983-91
KOVEN W.	US	1972-74
KRUPP L.	US	1961-62
LABARRERE M.	FR	1994-97
LAITONE E.	US	1984-87
LAMAR W.E.	US	1966-79
LANGDON G.	UK	1989
LEAN D.	UK	1969-78
LEBLANC G.	FR	1962-68
LECOMTE P.	FR	1956-59
		1963-72
LEKAS T.	GR	1996
LEVINE J.	US	1987-94
LEWIS R.B.	US	1978-83
LIACOS N.	GR	1980-82
LIVINGSTON W.H.	US	1958-61
LOJACONO E.	IT	1993-97
LOPEZ RUIZ J.L.	SP	1987-97
LYNN R.R.	US	1980-87
MABBERLEY J.	UK	1984
MARCHESE F.	IT	1987-93
MARCONI P.	IT	1975-85
MAREC J.P.	FR	1985-94
MARSH R.B.	UK	1960-63
MARTINEZ GARCIA J.J.	SP	1990-97
MARX A.J.	NL	1952-67
MARY F.	FR	1984-89
MASSEY C.	UK	1996-97
MATSIKAS S.	GR	1988-95
MATTHEWS N.O.	UK	1976-78
MAUTINO R.	IT	1962-85
MAX H.	GE	1972-79
McCORMICK B.	US	1987-97
McERLEAN D.P.	US	1992-97
McGREGOR D.M.	CA	1969-73
McKAY K.	UK	1989-93
MENGÜTÜRK M.	TU	1987-93
MERTSOY E.	TU	1982-83
METRES S.	US	1987-92
MIDTBO T.	NO	1958-60
MILLER R.H.	US	1964-74
MOELKER J.J.P.	NL	1978-82
MOOIJ H.A.	NL	1982-88
MOORHOUSE D.J.	US	1995-97
MULDER J.	NL	1982-97
NESSET H.	NO	1956-57
NICOLAI L.M.	US	1993-97
NORRIS E.J.	UK	1979-82
O'GARA J.F.	UK	1977-82
O'HARA F.	UK	1959-71
OZBAKI K.	TU	1967-73
ÖZGÖREN K.	TU	1993
PAGLIANETE F.J.	US	1980-81
PARRINI A.	IT	1986-93
PAYZE T.	TU	1987-90
PHILLIPS A.	US	1982-84
PIANKO M.	FR	1985-89
PITKIN B.	UK	1985
PLOURD W.	US	1963-64
POISSON-QUINTON Ph.	FR	1967-84
POLVE J.H.	US	1964-66
PONZI U.	IT	1975-85
PORTER E.M.	US	1962-63
QUAGLIOTTI F.	IT	1992-97
REID L.D.	CA	1985-90
RENAUDIE J.F.	FR	1962-88
RENDEL D.	UK	1953
RENIRIE L.T.	NL	1994-97
RICKERT W.	US	1952-54
RIDLEY J.L.	US	1952-55
ROBINSON M.R.	US	1991-92
ROBINSON P.	UK	1969-72
RUGIENIUS A.V.	CA	1962-70
RUSSEL R.A.	US	1990-95
SACHS C.	GE	1978-97
SALOMON A.	FR	1995-97
SATTERFIELD L.M.	US	1956-58
SAUNDERS T.	UK	1983-84
SCHÄNZER G.	GE	1979-97
SCHUMANN H.G.	GE	1957-59
SCOTT-WILSON J.B.	UK	1966-75
SELLA F.	IT	1986-97
SELMER R.J.	US	1954-56
SHEVELL R.S.	US	1974-80
SHIELDS R.T.	UK	1965
SIEWERT R.F.	US	1979-84
SINCLAIR S.R.M.	CA	1975-90
SIRINIAN M.	IT	1979-82
SMITH N.J. III	US	1963
SÖZEN A.	TU	1996-97
STATHAKOPOULOS D.	GR	1988-95
STATLER I.C.	US	1972-83

STEPHENSON T.E.	CA	1952-53	ULUG F.	TU	1954-59
STOLIKER F.N.	US	1974-82	van DOORN J.T.M.	NL	1983-97
STRATIGAKIS M.	GR	1954-57	VAN NORMAN C.	US	1995-97
SULLY P.R.	CA	1982-94	van OOSTEROM T.	NL	1960-77
TANRIKULU O.	TU	1994-97	VIDOS P.	GR	1985-93
TEZEL A.	TU	1982-87	VILLALTA A.A.	SP	1987-97
THEODASSIADES D.F.	GR	1953	WALKER D.	UK	1984-90
THEOPHILOU M.	GR	1991-92	WANNER J-C.	FR	1973-77
TISCHLER M.	US	1991-97	WEISSMAN C.C.	US	1966-71
TOMLINSON B.	UK	1993-97	WESESKY J.L.	US	1972-74
TRESSET J.	FR	1989-97	WILLIAMS W.C.	US	1959-66
TUCKER J.	UK	1985-88	WOOD A.D.	CA	1953-82
TUSTER E.	NO	1952-53	WOODFIELD A.	UK	1985-92
TYLER D.	UK	1991-95	WÜNNENBERG H.	GE	1980-97
UÇAR N.	TU	1991-93	YANGOS P.	GR	1961-83

AFCENT Ex-Officio:

LLEWELYN A.I.	UK	1962-63	HYND W.A.B.	UK	1964-68

FLUID DYNAMICS PANEL (FDP)

Chairmen:

HALL A.A.	UK	1952-54	HARTZUIKER J.P.	NL	1975-77
ROY M.	FR	1954-56	JONES J.L.	US	1977-79
ABBOTT I.H.	US	1956-58	ORLIK-RÜCKEMANN K.J.	CA	1979-81
NICHOLSON L.F.	UK	1958-59	MONNERIE B.	FR	1981-83
MACPHAIL D.C.	CA	1959-61	ROBERTS L.	US	1983-85
SCHLICHTING H.	GE	1961-63	SACHER P.W.	GE	1985-87
KURZWEG H.H.	US	1963-65	PECKHAM D.H.	UK	1987-89
LEGENDRE R.	FR	1965-67	McCROSKEY W.J.	US	1989-91
COX R.N.	UK	1967-69	SLOOFF J.W.	NL	1991-93
SEARS W.R.	US	1969-71	DUJARRIC C.	FR	1993-95
NAPOLITANO L.G.	IT	1971-73	ÇIRAY C.	TU	1995-97
KUCHEMANN D.	UK	1973-75			

Deputy Chairmen:

ROY M.	FR	1952-54	HARTZUIKER J.P.	NL	1975
ABBOTT I.H.	US	1954-56	JONES J.L.	US	1975-77
NICHOLSON L.F.	UK	1956-58	ORLIK-RÜCKEMANN K.J.	CA	1977-79
MACPHAIL D.C.	CA	1958-59	MONNERIE B.	FR	1979-81
THURSTON F.R.	CA	1959-60	ROBERTS L.	US	1981-83
SCHLICHTING H.	GE	1960-61	SACHER P.W.	GE	1983-85
KURZWEG H.H.	US	1961-62	PECKHAM D.H.	UK	1985-87
LEGENDRE R.	FR	1962-65	MCCROSKEY W.J.	US	1987-89
COX R.N.	UK	1965-67	SLOOFF J.W.	NL	1989-91
SEARS W.R.	US	1967-69	DUJARRIC C.	FR	1991-93
NAPOLITANO L.G.	IT	1969-71	ÇIRAY C.	TU	1993-95
KUCHEMANN D.	UK	1971-73	CANTWELL B	US	1995-97
YAGGY P.F.	US	1973-75			

Executives:

DANE P.	US	1952-56	LAWFORD J.A.	UK	1972-75
SHARKOFF E.G.	US	1956-59	FISCHER M.C.	US	1975-78
ELLISON H.A.	US	1959-63	ROLLINS R.H.	US	1978-86
SKEMP S.C. Jr	US	1963-66	FISCHER M.C.	US	1986-89
BARTH R.	GE	1966-70	GOODRICH W.	US	1989-93
TOWNEND L.H.	UK	1970-72	MOLLOY J.K.	US	1993-97

Panel Members:

ABBOTT I.H.	US	1952-59
AKBABA R.	TU	1981
AKÇAY M.	TU	1980-88
		1994-97
AMES M.B. Jr	US	1959-74
ANTONATOS P.P.	US	1968-77
ATLI V.	TU	1990-94
AURIOL A.	FR	1967-79
BARCHE J.	GE	1972-77
BELIRGEN E.	TU	1967-71
BENGELINK R.L.	US	1992-97
BERGELES C.	GR	1988-90
BERNARD J.J.	FR	1980-91
BETZ A.	GE	1955-60
BIGNELL P.R.	UK	1984-93
BILLION E.	FR	1954-56
BJØRNØ L.	DE	1979-87
BOEL J.	NL	1964-70
BOGDONOFF S.M.	US	1966-78
BONNET A.	FR	1988-97
BORE C.L.	UK	1969-84
BORSI, M.	IT	1993-97
BOUDREAU A.	US	1993-96
BOUIS X.	FR	1993-97
BOUSQUET J.	FR	1991-94
BOWERS D.L.	US	1987-94
BRADLEY R.G.	US	1987-92
BROGLIO L.	IT	1952-69
BROWN C.E.	US	1981-84
BRUN E.	FR	1962-73
BUCCIANTINI G.	IT	1981-93
BUONGIORNO C.	IT	1969-79
BÜYÜKMIHCI K.	TU	1979-83
CAMPBELL J.F.	US	1987-90
CAMPBELL W.C.	CA	1963-65
CANTWELL B.	US	1990-97
CAPELIER C.	FR	1980-93
CARRIERE P.	FR	1958-84
CELENS E.	BE	1979-87
CHAFFOIS H.	FR	1952-54
CHAN L.	CA	1991-97
CHURCH P.B.	CA	1971-80
ÇIRAY C.	TU	1980-97
CLARKSON C.D.S.	UK	1992-97
COLIN P.E.	BE	1959-77
CORDIER D.	FR	1995-97
CORRAL GARCIA R.	SP	1994-97
COURSIMAULT A.	FR	1975-80
COUTINHO A.A.M.	PO	1971-78
COX R.N.	UK	1961-70
DECONINCK H.	BE	1990-97
DECUYPERE R.	BE	1987-97
DICKSON R.	UK	1960-63
DIETZ R.O.*	US	1971-80
DILEK S.	TU	1979-83
DOBBINGA E.	NL	1954-70
DOETSCH K.H.	US	1969-71
DUJARRIC C.	FR	1981-97
DURAND G.	FR	1983-86
ECER A.	TU	1975-77
EKEN A.	TU	1985-88
ELLINGTON D.	CA	1973-84
ELSENAAR B.	NL	1988-97
EMZIVAT G.	FR	1987-89
ERDMANN E.	NL	1964-72
ERIM M.Z.	TU	1978-89
ERTURK F.	TU	1988-94
ESSERS J.A.	BE	1982-97
EULA A.	IT	1952-54
EVAGELOU P.	GR	1981
EWALD B.	GE	1991-97
FAINEKOS E.	GR	1989
FALCAO A.F. de O.	PO	1979-97
FANNELOP T.K.	NO	1973-80
FAYOL P.	FR	1990-92
FRAGOGIANNIS G.	GR	1979-82
FRAGOYANNIS K.	GR	1975-76
FRANGHOYIANNIS G.	GR	1970
GAGLIARDI F.	IT	1982-86
GEORGANTOPOULOS B.	GR	1985-88
		1993-97
GERMAIN P.	FR	1956-60
GERSTEN K.	GE	1969-91
GIKAS Z.	GR	1986-87
GINOUX J.J.	BE	1964-90
GODFRIND P.	BE	1961-69
GOETHERT B.H.	US	1960-67
GOLIA C.	IT	1992-97
GRANDUM Ø.	NO	1994-97
GRAVES R.A.	US	1986-89
GREEN J.E.	UK	1978-81
		1986-89
GÜL S.	TU	1994-97
HALL A.A.	UK	1952-54
HARNEY D.J.	US	1968
HARTZUIKER J.P.	NL	1970-87
HAUS F.C.	BE	1952-63
HERRING P.G.C.	UK	1993-97
HINDELANG F.J.	GE	1969-79
HOLLANDERS H.	FR	1994-97
HOLT D.R.	UK	1989-92
HORNUNG H.	GE	1983-88
HUFTON P.A.	UK	1959-66
HVEDING D.	NO	1952-64
ISMAILOGLU H.	TU	1966-79
JACQUOTTE O.P.	FR	1994-97
JIMENEZ J.	SP	1987-97
JOHANNESEN N.H.	DE	1959-61
JONES J.L.	US	1974-80
JONES W.P.	UK	1955-64
JOUTY R.	FR	1992-95
KAKATSIOS Ch.	GR	1987
KARHAN K.	TU	1969-77
KAYNAK U.	TU	1988-97
KIENAPPEL K.	GE	1988-95
KILGORE R.A.	US	1984-86
KIND R.J.	CA	1991-97
KLOUMAN F.	NO	1964-77
KORKEGI R.H.	US	1969-76
KÖRNER H.	GE	1989-97
KOSMAS S.	GR	1994-95
KOSMIDIS E.	GR	1987
KRENZ G.	GE	1980-82
KÜCHEMANN D.	UK	1965-76
KURZWEG H.H.	US	1953-74
KUSHMAN K.L.	US	1987-92
KUTLUK T.	TU	1985-86
LACAU R.	FR	1994-97

LAROCCA F.	IT	1990-92	PUCHE T.M.	SP	1987-97
LARSEN P.S.	DE	1971-97	PURTELL L.P.	US	1995-97
LASCHKA B.	GE	1976-93	QUINN B.	US	1978-81
LASTER M.L.	US	1980-86	RAINBIRD W.J.	CA	1963-70
LAUVER D.C.	US	1974-78	REED H.L.	US	1995-97
LEBOUCHER G.	FR	1963-66	REFSLUND K.	DE	1957-81
LECOMTE P.	FR	1960-63	RESHOTKO E.	US	1981-89
LEE G.H.	UK	1957-61	RICHEY G.K.	US	1976-86
LEGENDRE R.	FR	1954-76	ROBERTS H.	UK	1957
LEKAKOS K.	GR	1990-92	ROBERTS L.	US	1980-85
LEKOUDIS S.	US	1989-94	RODRIGUEZ M.	SP	1992-97
LEYNAERT J.	FR	1984-93	ROGERS E.W.E.	UK	1973-75
LIBBY P.A.	US	1960-73	ROSHKO A.	US	1984-89
LIEPMANN H.W.	US	1974-83	ROSSER P.D.	UK	1965-69
LIEVENS C.J.	FR	1970-75	ROY M.	FR	1954-61
LUKASIEWICZ J.	US	1962-68	RUIZ-CALAVERA L.P.	SP	1988-97
MACPHAIL D.C.	CA	1952-71	RUSSO G.P.	IT	1992-97
MALAVARD L.	FR	1952-54	RUSSO V.	IT	1990-97
MALMUTH D.	US	1995-97	SABETTA F.	IT	1990-97
MARION J.D.	FR	1995-97	SACERDOTE U.	IT	1962-90
MARSCHNER B.	US	1964-67	SACHER P.W.	GE	1980-97
MASURE B.	FR	1986-97	SANDERS J.	US	1996-97
MATTIOLI E.	IT	1969-82	SARIC W.	US	1989-94
McCARTER B.	CA	1970-71	SCHLICHTING H.	GE	1955-75
McCROSKEY W.J.	US	1974-84	SCHMIDT W.	GE	1986-90
McKINNEY L.W.	US	1981-83	SCHMITZ F.H.	US	1985-86
MEIER G.E.A.	GE	1992-97	SEARS W.R.	US	1960-72
MICHAEL K.	GR	1984-85	SEDDON J.	UK	1959-73
MIRABELLI A.	IT	1976-80	SEDNEY R.	US	1963-67
MONGE F.	SP	1989-97	SELEGAN D.R.	US	1993-97
MONNERIE B.	FR	1977-95	SENTÜRK N.	TU	1985-87
MORAITIS	GR	1957-58	SIDERIDIS G.	GR	1989-93
MORGADO C.M.	PO	1963-71	SIEGEL D.S.	US	1979-82
MORICE P.	FR	1995-97	SIMON J.	SP	1987-97
MOYERS F.	US	1952-54	SINNOTT C.S.	UK	1961-64
MUYLAERT J.M.	BE	1990-97	SLOOFF J.W.	NL	1984-96
NORSTRUD H.	NO	1980-97	SMITH D.J.L.	UK	1981
NAPOLITANO L.G.	IT	1960-91	SMOLDEREN J.J.	BE	1963-89
NAUMANN A.	GE	1955-72	SMYRLIS H.	GR	1995-97
NICHOLSON L.F.	UK	1954-59	SPEE B.M.	NL	1973-83
NICOLO G.B.	IT	1955-60	STATHAKOPOULOS D.	GR	1996-97
NORSTRUD H.	NO	1980-97	STEKETEE J.A.	NL	1965-94
OHMAN L.H.	CA	1979-90	STERNBERG J.	US	1960-64
ONORATO M.	IT	1981-97	TAYLOR J.L.	NO	1964-71
ORLIK-RÜCKEMANN K.J.	CA	1974-96	TEMPLIN R.J.	CA	1957-63
OSKAM B.	NL	1996-97			1970-74
OZGUR C.	TU	1967-79	THERY C.	FR	1978-94
OZKAN N.	TU	1988-92	TIJDEMAN H.	NL	1982-86
PANARAS A.G.	GR	1967-79	TRUCKENBRODT E.	GE	1960-69
		1993-97	TSANGARIS S.	GR	1992-97
PANDOLFI M.	IT	1976-79	TZOURAS K.	GR	1970-75
PANKHURST R.C.	UK	1964-77	ULUG F.	TU	1955-63
PAPADIMITRIOU	GR	1958-62	UNSAL N.	TU	1957-59
PAPAILIOU D.	GR	1986-93	USTUNDAG M.	TU	1991-94
PAPANIKAS D.	GR	1978-79	VALENSI J.	FR	1962-77
PECKHAM D.H.	UK	1981-89	van der MAAS H.J.	NL	1952-65
PERSEN L.N.	NO	1966-86	VAN INGEN J.L.	NL	1972-97
PETERSEN H.	DE	1959-61	VANCAMBERG Ph.	FR	1991-94
PETRIDIS D.	GR	1990-94	VARETTI M.	IT	1984-89
PILOS A.	GR	1984-85	VERGNE M.	FR	1981-84
PLATIS N.	UK	1975-78	VERRIERE J.	FR	1984-90
POLHAMUS E.C.	US	1978-81	VILLE B.	FR	1967-70
POLL D.I.A.	UK	1990-97	VINT A.	UK	1984-88
POPE G.G.	UK	1975-78	VRETTOS C.	GR	1954-58
PROHASKA C.W.	DE	1963-70	WAGNER B.	GE	1990-97

WHITEHEAD R.A.	US	1983-89	YOSHIHARA H.	US	1977-85
WILD J.	US	1952-54	YOUNG A.D.	UK	1965-90
WILLIAMS L.J.	US	1990-97	YTREHUS T.	NO	1985-97
WILSON R.E.	US	1960-74	YU Y.H.	US	1995-97
WOODWARD D.	UK	1989-97	ZACHARIAS A.	GR	1984-85
YAGGY P.F.	US	1968-74	ZONARS D.	US	1968-77
YAZICI A.K.	TU	1984			

Ex-Officio:

DIETZ R.O.*	1968-70	LLEWELYN A.J.	1962-65
HYND R.B.	1965-68	NELSON W.C. (Panel Editor)	1955-68

* Mr R.O.DIETZ was an ex-officio member as Director of the von Karman Institute from 1968 to 1970, and was appointed a member representing the US in 1971.

GUIDANCE AND CONTROL PANEL (GCP)

Chairmen:

WRIGLEY W.	US	1965-69	HOWELL G.C.	UK	1980-82
ROBINSON H.G.R	UK	1969	VAUGHN R.S.	US	1982-84
LEONDES C.T.	US	1969-72	ONKEN R.C.	GE	1984-86
SORG H.	GE	1972-74	PEEBLES K.A.	CA	1986-88
BENOIT A.	BE	1974-76	van den BROEK P.Ph	NL	1988-90
OSTGAARD M.A.	US	1976-78	STEAR E.B.	US	1990-92
KANT P.	NL	1978-80	LEEK S.	UK	1992-93

Deputy Chairmen:

FRAEIJS DE VEUBEKE B.	BE	1965-68	VAUGHN R.S.	US	1980-82
ROBINSON H.G.R.	UK	1968-69	ONKEN R.C.	GE	1982-84
LEONDES C.T.	US	1969	PEEBLES K.A.	CA	1984-86
SORG H.	GE	1970-72	van den BROEK P.Ph.	NL	1986-88
BENOIT A.	BE	1972-74	STEAR E.B.	US	1988-90
SUGERMAN L.R.	US	1974-76	LEEK S.	UK	1990-92
KANT P.	NL	1976-78	RAMAGE J.K.	US	1993
HOWELL G.C.	UK	1978-80			

Executives:

READDY F.J.	US	1965	de CHASSEY J.C.	FR	1978-80
STUDABAKER W.A.	US	1966-69	HELIOT B.M.	FR	1980-85
MOUNT C.D.	US	1969-72	CARRE P.	FR	1985-86
TAILLE A.L.	FR	1972-75	ROCHER A.	FR	1986-88
CAVENEL M.H.	FR	1975-78	MOUHAMAD M.	FR	1988-93

Panel Members:

AKDUMAN M.T.	TU	1981-93	BAYINDIR H.	TU	1985-86
ALBRECHT H.J.	GE	1967-69	BELCHER G.	UK	1992-93
ALBRITTON W.P. Jr	US	1981-88	BENAS P.	GR	1986-87
ALDERS G.J.	NL	1985-93	BENOIT A.	BE	1970-93
ALENQUER L.M.	PO	1991-93	BISMUT M.	FR	1967-89
ALEXANDER W.H.	UK	1966-72	BOGUS S.	TU	1982-84
ALVES-VIEIRA A.	PO	1979-93	BONNEVALLE G.	FR	1967-69
AVÇIOUGLOU N.	TU	1988	BONNEVIE G.	FR	1983-89
BAĞÇIOGLOU R.	TU	1991-93	BOOZER D.D.	US	1990-93
BARDAL J.	NO	1991-93	BORSTAD A.J.	NO	1987-91
BARON C.	UK	1970-76	BOUSQUET G.	FR	1966-69
BASSARAS A.	GR	1984-85	BRESOLIN A.	FR	1993
BATMAÇA S.	TU	1980-93	BRIGHT C.W.	CA	1987-91
BATTAGLIA M.	IT	1993	BRODERSEN E.	NO	1973-76

BUENAVIDA H.	FR	1991-93	KANT P.	NL	1965-87
BUFFUM R.S.	US	1985-87	KARYDIS P.	GR	1987-90
BUSCO M.	IT	1968-86	KAZAKOGLU A.	TU	1983-85
BUTLER G.F.	UK	1991-93	KENNIS F.	BE	1971-78
BUTLER S.	US	1992-93	KING A.D.	UK	1990-93
CADO M.	FR	1969-71	KLEIN Ch.	FR	1980-82
ÇAKIROGLU O.	TU	1979-82	KNAUSENBERGER G.E.	US	1969-74
CALDEIRA AIRES J.M.	PO	1987-91	KOLBERG K.	NO	1967-70
CANAEI P.	BE	1965-71			1991-93
CANAFOGLIA-VENTURINI G.	IT	1981-86	KOTRONIS A.	GR	1991-92
CANNON R.H.	US	1969-71	KROGMANN UK	GE	1978-93
CAPLAIN P.J.	FR	1982-84	KURZHALS P.R.	US	1974-79
CAPRA L.	IT	1979-84	LABARRERE M.	FR	1992-93
CARPENTIER J.	FR	1965-71	LAMBRAKIS M.	GR	1978-80
CHAILLOT B.	FR	1987-93	LAMY M.	FR	1967-71
CHIVERS-WILSON A.A.	CA	1965	LECERF G.	FR	1969-72
COUPEZ J.J.E.	BE	1986-90	LEEK S.	UK	1984-93
COVELLI D.	IT	1975-77	LEONDES C.T.	US	1966-80
CUNNINGHAM T.	US	1990-93	LEPAS C.	GR	1984-85
DE DONCKER J.	BE	1979-82	LIANG D.F.	CA	1991-93
DE FRANCESCO S.	IT	1966-74	LOPEZ GOMEZ F.J.	SP	1991
DEMICCO A.	IT	1986	LOURTIE P.	PO	1979
DEVEAUX J.	FR	1980-81	MANARINI G.	IT	1975-80
DILLIWAY R.B.	US	1971-75	MANEY C.T.	US	1971-76
DIONNE J.G.G.	CA	1978-80	MAZZETTI B.	IT	1984-93
DOUKAS I.	GR	1991-93	McIVER D.E.	US	1983-88
DUFFY R.A.	US	1966-68	METAXAS P.	GR	1986
DUNN R.	UK	1986-89	METZDORFF G.	GE	1969-77
ECONOMOPOULOS M.	GR	1983-86	MORAUD J.L.	FR	1993
ELLIOTT Ch.T.	US	1978-86	MURINO P.	IT	1981-93
EROL H.	TU	1967-79	NASIOUDIS S.	GR	1993
ERTONGUR N.	TU	1977-80	NIELSEN L.S.	DE	1980-83
EVANGELOU P.	GR	1981-82	NIEMELA J.	US	1987-93
FASOIS D.	GR	1993	NORTON D.W.	US	1966-67
FELLOWS J.K.	UK	1983-86	ONKEN R.C.	GE	1977-93
FERRAND M.	FR	1984-86	ORAL O.	TU	1988-93
FRAEIJS DE VEUBEKE B.	BE	1965-76	OSTERN F.A.	NO	1973-78
FRISTACHI G.	IT	1990-93	OSTGAARD M.A.	US	1972-84
GALANOPOULOS G.	GR	1987	PALSSON T.	IC	1988
GARRIGA C.A.	SP	1987-93	PAPADOULIS K.	GR	1988
GAY F.M.	US	1988	PEEBLES K.	CA	1978-88
GEORGOUDIS T.	GR	1986	PELEGRIN M.J.	FR	1978-92
GERHARDSEN T.	NO	1977-90	PERBERT M.	FR	1971-72
GIORDANO G.	FR	1984-86	PHOTOPOULOS P.	GR	1981
GREENSPAN S.	US	1975-78	PICHOUD D.	FR	1972-84
GUIBAUD A.	FR	1969-71	PICIRILLI I.	IT	1968-75
GUIBERT L.	FR	1987-93	POLLATOS A.	GR	1981-85
HALLINGSTAD O.	NO	1982-90	POWLEY M.	UK	1973-78
HAALAND S.	US	1988-93	RADET H.	FR	1973-91
HAUS F.C.	BE	1965-93	RAMAGE J.K.	US	1983-93
HELPS K.	UK	1990-93	REDIESS H.A.	US	1979-82
HEURTLEY J.C.	US	1980-82	ROBINSON H.G.R.	UK	1965-69
HOEY R.G.	US	1985-87	ROSSIGNOL O.	FR	1981-83
HOLLINGTON J.L.	UK	1978-89	SALOMON A.	FR	1991-93
HOLLISTER W.M.	US	1978-86	SAMARAS E.	GR	1975-76
HONDUR Y.	TU	1978-80	SANDELIN J.	US	1990-92
HOOD R.V.	US	1990-93	SANTOS GENTO J.	SP	1987-90
HOWELL G.C.	UK	1976-83	SANZ-ARANGUEZ P.	SP	1987-93
ILDIZ E.	TU	1985-93	SARIOGLU M.K.	TU	1969-81
ILIOPOULOS T.	GR	1991	SCHEIBE H.R.	US	1987-88
INNOCENTI M.	IT	1993	SCHECK F.X.	FR	1990-93
IOSIFIDES M.	GR	1979-81	SCHJETNE A.	NO	1977-80
JAEGER B.	FR	1990-91	SCHMIDT G.T	US	1987-90
JOHANSEN H.K.	NO	1970-72	SCHOLZ M.	GE	1967-69
JONES R.W.	UK	1986-90	SCHWEIZER G.	GE	1967-73

SENNEVILLE J.B.	FR	1984-93	URBAN L.J.	US	1976-84
SERRANO J.	SP	1990-93	URING T.	FR	1991-93
SEZGIN A.	TU	1990-93	USTA M.	TU	1977-78
SHEPHERD J.T.	UK	1979-91	UZAN C.	FR	1993
SIMON C.J.	SP	1989-93	van den BROEK P.Ph.	NL	1973-93
SMESTAD T.	NO	1981-82	VANDECASTELLE B.	FR	1975-80
SMITH C.A.M.	CA	1967-76	VASUTH J.C.	FR	1973-74
SOLBAKKEN A.	NO	1965-72	VAUGHN R.S.	US	1978-86
SORG H.	GE	1969-93	VERCELLI L.	IT	1965-74
SPATHOPOULOS Th.	GR	1978-90	VOURIS K.	GR	1990
STARLING R.J.	UK	1989-90	WEDAN R.W.	US	1976-80
STATHAKOPOULOS D.	GR	1993	WHITAKER H.P.	US	1968-77
STEAR E.B.	US	1981-93	WHITFIELD G.	UK	1967-77
STUBBERUD A.R.	US	1993	WILLEMS P.Y.	BE	1970-78
SUGERMAN L.R.	US	1966-76	WILLIAMS W.P.	US	1977-81
SULLIVAN F.J.	US	1966-74	WINICK A.B.	US	1972-75
THEODOROU N.J.	GR	1984-85	WINTER H.	GE	1986-93
THISTLE W.G.	CA	1976-77	WRIGLEY W.	US	1965-69
THORENSEN O.	NO	1971-73	YUKSEL O.	TU	1981-87
TSITSILONIS L.	GR	1986-91	ZIMET E.	US	1988-93
ULGÜR M.M	TU	1969-81			

MISSION SYSTEMS PANEL (MSP)

Chairmen:

RAMAGE J.K.	US	1994-96	WINTER H.	GE	1996-97

Deputy Chairmen:

WINTER H.	GE	1994-96	CUNNINGHAM T.	US	1996-97

Executives:

MOUHAMAD M.	FR	1994	FORTABAT P.	FR	1994-97

Panel Members:

ALDERS G.J.	NL	1994-97	DOUKAS I.	GR	1994-97
ALENQUER L.M.	PO	1994-97	EREN M.	TU	1994-97
ALVES VIEIRA A.L.	PO	1994-97	FLEEMAN G.	US	1996-97
ANDREAS R.D.	US	1994-97	FOURURE O.	FR	1994-97
BARDAL J.	NO	1995-97	GARNIER G.	FR	1994-97
BARLOW J.C.	UK	1994-97	GARRIGA LOPEZ C.A.	SP	1994-97
BATTAGLIA M.	IT	1994-95	GRAGERA TORRES J.	SP	1996-97
BAYKAL N.	TU	1994-97	GULTEKIN N.	TU	1994-97
BECHER P.	GE	1994-97	HALL C.D.	UK	1994-97
BENOÎT A.	BE	1994-97	HAMILL T.G.	UK	1994-95
BERNALDO DE QUIROS D.	SP	1994	HATZIVASILIOU F.	GR	1994-95
BORAT O.	TU	1994-97	HELPS K.A.	UK	1994-97
BURROWS B.	UK	1996-97	HOLCOMB L.	US	1996-97
BUTLER G.F.	UK	1994-95	HOMER P.B.	US	1994-97
BUTLER S.	US	1994-96	HOOD R.V.	US	1994-95
CASTALDI T.	US	1994-95	JACOBSEN M.	GE	1994-97
CESTRONE C.	IT	1994-97	KAVAL M.	TU	1994-97
CROVELLA.L.	IT	1994-97	KECHAGIAS K.	GR	1996-97
CUNNINGHAM T.B.	US	1994-97	KING A.D.	UK	1994-96
CUTHBERT R.G.	UK	1996-97	KIRIAFINIS P.	GR	1994-97
CYMBALISTA J.	FR	1994-97	KROGMANN UK	GE	1994-97
DEANS K.	UK	1996-97	LACOMME P.	FR	1994-95
DEWEY D.E.	US	1994-97	LEEK S.	UK	1994
DONMEZ Z.	TU	1994-96	LIANG D.F.	CA	1994-95
DOPPING-HEPPENSTAL L.L.	UK	1994-95	LITTLE R.	UK	1994-95

MARTIN-RICO C.	SP	1994-97	RUGGE H.	US	1994-97
MATEO-PALACIOS A.	SP	1994-97	SANZ-ARANGUEZ P.	SP	1994-97
MAZZETTI B.	IT	1994-97	SENNEVILLE J.B.	FR	1994-97
MORAUD J.L.	FR	1994-96	SERGENT P.	FR	1996-97
MOURA MARQUES D.	PO	1994-97	SERRANO-MARTINEZ J.B.	SP	1994-97
NADAR O.	TU	1996-97	SIMON CALERO J.	SP	1994-97
NASIOUDIS S.	GR	1994-95	SORG H.	GE	1994-97
NEUMAN D.D.	US	1994-97	SOYLEMEZ E.	TU	1994-97
NIEMELA J.	US	1994-97	SPADARO V.	IT	1996
OBERTI B.	FR	1994-97	SPATHOPOULOS T.	GR	1996-97
ONKEN R.C.	GE	1994-97	STUBBERUD A.R.	US	1994-97
OTT L.	US	1995-97	TIMMERS H.A.T.	NL	1994-97
PAMPOUCAS T.V.	GR	1994-97	URING T.	FR	1994-96
POGGIALI M.	IT	1996-97	van den BROEK P.Ph.	NL	1994-97
RAMAGE J.K.	US	1994-97	WINTER H.	GE	1994-97
REID G.E.	UK	1995-97	ZIMET E.	US	1994-97
ROSE K.	NO	1994-97			

PROPULSION AND ENERGETICS PANEL (PEP)

Chairmen:

SURUGUE J.	FR	1952-54	PIANKO M.	FR	1975-77
MULLINS B.P.	UK	1954-56	WINTERFELD G.	GE	1977-79
DUCARME J.	BE	1956-58	DUNHAM J.	UK	1979-81
PENNER S.S.	US	1958-61	COVERT E.E.	US	1981-83
FABRI J.	FR	1961-63	HIRSCH Ch.	BE	1983-85
LUTZ O.	GE	1963-65	WITTENBERG H.	NL	1985-87
CASCI C.	IT	1965-67	MACMILLAN W.	CA	1987-89
FERRI A.	US	1967-69	RAMETTE P.	FR	1989-91
HEWSON C.T.	UK	1969-71	UÇER A.S.	TU	1991-93
GLASSMAN I.	US	1971-73	HENDERSON R.E.	US	1993-95
JAARSMA F.	NL	1973-75	HENNECKE D.K.	GE	1995-97

Deputy Chairmen:

MULLINS B.P.	UK	1952-59	WINTERFELD G.	GE	1975-77
DUCARME J.	BE	1954-56	DUNHAM F.	UK	1977-79
PENNERS S.S.	US	1956-58	COVERT E.E.	US	1979-81
FABRI J.	FR	1958-61	HIRSCH Ch.	BE	1981-83
LUTZ O.	GE	1961-63	WITTENBERG H.	NL	1983-85
CASCI C.	IT	1963-65	MACMILLAN W.	CA	1985-87
FERRI A.	US	1965-67	RAMETTE P.	FR	1987-89
HEWSON C.T.	UK	1967-69	UÇER A.	TU	1989-91
CHAUVIN J.	BE	1969-70	HENDERSON R.E.	US	1991-93
GLASSMAN I.	US	1970-71	HENNECKE D.K.	GE	1993-95
JAARSMA F.	NL	1971-73	FLETCHER R.	UK	1995-97
PIANKO M.	FR	1973-75			

Executives:

COLCHAGOFF G.D.	US	1952-53	HAGERTY R.P.	UK	1967-72
BAKER K.W.	US	1953-56	CATILLER J.B.	US	1972-76
HORRIDGE R.M.	US	1956-60	KRENGEL J.H.	GE	1976-79
HART F.F.	US	1960-63	RIESTER E.	GE	1979-89
ROBIE E.A.	US	1963	GRUBER G.	GE	1989-91
READDY F.J.	US	1963-64	RIESTER E.	GE	1991-93
LUPOLD Ch.	FR	1964-67	TONN P.	GE	1993-97

Panel Members:

ACHTIDAS A.	GR	1970	ACURIO J.	US	1975-84
		1975-81	ALGUN F.	TU	1985-91

ALIOTTI P.	FR	1987-90
ALPAUGH R.T.	US	1971-73
ANDREWS E.G.D.	UK	1966-68
ATKINSON P.J. Jr	US	1964-71
AYDIN MAKINA F.	TU	1973-78
BARDON M.	CA	1991-97
BARRERE M.L.	FR	1969-79
BASOULIS G.	GR	1985-87
		1993-94
BASTING W.J.	NL	1957-60
BATTISTI A.	IT	1993-97
BAXTER A.D.	UK	1957-60
BAYLEY F.J.	UK	1976-80
BAYSAK H.	TU	1982-97
BECKSTEAD M.V.	US	1986
BERARD J.	FR	1980-83
BESSER H-L.	GE	1992-97
BETIN B.P.	FR	1969
BILL R.C.	US	1987-93
BLICHNER O.	NO	1953-60
BOBULA G.	US	1992-97
BOTNAN J.I.	NO	1986-93
BOUSSIOS A.	GR	1981
		1984-87
BRENNAN M.	CA	1966-70
BREUGELMANS F.	BE	1980-97
BRINDISINO L.	IT	1990-93
BROICHHAUSEN K.	GE	1990-97
BROUGHTON J.W.	CA	1952-64
BROWNLEE W.G.	CA	1968-70
BUONGIORNO C.	IT	1979-85
BUSH I.H.	US	1978-85
BUSSI G.	IT	1976-79
BÜYÜKMIHÇI K.	TU	1977
		1984
CAKALOZ T.	TU	1978
CAMERON I.R.	CA	1960-68
CAPETTI A.	IT	1953-70
CARRIER C.	CA	1991-94
CASANDJIAN G.	FR	1976
CASCI C.	IT	1959-97
CAZIN P.	FR	1986-92
CHAMBEL M. de M. G.	PO	1991-97
CHANTERAC L.	FR	1991-94
CHAUVIN J.	BE	1968-79
CHAUVIN J.	FR	1981-96
CHEVALIER J.F.	FR	1969-95
CIFONE A.J.	US	1994-97
COCHETEUX J.	FR	1981-82
COLBOURNE D.E.	UK	1987-89
COLLADAY R.S.	US	1980-82
COLOMBANI P.	FR	1961-69
CORBACIOGLU I.	TU	1988-91
CORNET H.	FR	1986-88
COTTINGTON R.V.	UK	1994-97
COUTURIER R.	FR	1992-97
COVERT E.E.	US	1976-84
COY J.J.	US	1985-86
CRISPIN B.	GE	1978-92
CROSS D.H.E.	CA	1964-69
CRUTTENDEN A.	UK	1982-87
CULICK F.	US	1976-85
		1994-97
DAWTON D.I.	UK	1967-71
DE LUCA L.	IT	1984-97
DE WOLF W.B.	NL	1988-97
DERR R.L.	US	1989-95
DETTMERING W.	GE	1969-77
DINI D.	IT	1966-97
DONGUY P.	FR	1993-97
DUBARRY-BARBE R.	FR	1963-65
DUCARME J.	BE	1952-79
DUNHAM J.	UK	1971-82
DUNNING J.E.P.	UK	1957-59
EATOCK H.C.	CA	1993-94
ERALIAN N.	TU	1960-64
ERALP O.C.	TU	1996-97
EREL C.	TU	1994-97
ETCHEVERS O.	FR	1994-97
EVANS R.	CA	1996-97
FABRI J.	FR	1952-69
		1975-86
FAYOL P.	FR	1992-94
FEIS N.	NL	1960-67
FERRI A.	US	1957-75
FIDAN S.	TU	1991-93
FLETCHER R.S.	UK	1981-97
FORDE M.	NO	1984-94
FOTTNER L.	GE	1983-97
FRAGA CUEVAS E.	SP	1987-93
FUHS A.E.	US	1969-77
GABRIS E.A.	US	1987-88
GAGLIARDI L.	IT	1982-86
GARWOOD K.R.	UK	1987-97
GERSTEIN M.	US	1954-64
GILBERT L.M.	US	1981-89
GIORGIERI L.	IT	1964-82
GLASSMAN I.	US	1964-79
GODFRIND P.	BE	1961
GOKÇE B.	TU	1982-87
GÖNEN	TU	1980-83
GOULIOS G.	GR	1978-85
GUILLEMIER R.	FR	1988-90
GÜNES E.	TU	1992-97
HAGERTY R.P.	UK	1959-67
HARANG L.	NO	1952-53
HARGIS C.B. Jr	US	1971-74
HAYASHI R.	CA	1978-81
HENDERSON R.E.	US	1985-95
HENNECKE D.K.	GE	1975-97
HERON R.	UK	1978-80
HETHERINGTON R.	UK	1981
HEWSON C.T.	UK	1966-71
HILL R.J.	US	1994-97
HIRSCH C.	BE	1977-97
HOST S.E.	NO	1970-75
HOULIS T.	GR	1958-70
HVEDING R.	NO	1952-53
IMAMOGLU F.	TU	1978-80
INGER E.	TU	1977
		1979-83
		1994-97
JAARSMA F.	NL	1967-77
JACKSON A.J.B.	UK	1975-83
JACQUES R.	BE	1971-95
JAMISON R.R.	UK	1960-66
JAUMOTTE A.	BE	1958-86
JOHNSON E.G.	US	1972-75
JOHNSON H.W.	US	1978-80
JOST W.	GE	1955-63

JOURNEAU A.	FR	1973-82
KARADIMAS G.	FR	1996-97
KATIRÇIOGLU Y.	TU	1994-97
KENNY D.P.	CA	1990-92
KESKIN I.	TU	1967-72
KOTARAKOS A.	GR	1996-97
KOTSIOPOULOS P.	GR	1990-97
KRISTOFERSEN G.	NO	1975-85
KROG T.	NO	1960-72
KUENTZMANN P.	FR	1993-97
LAFON A.	FR	1994-97
LAMBROU A.	GR	1954-70
LAMICQ P.	FR	1987-89
LAMY J.	FR	1952-54
LANE R.J.	UK	1969-75
LAZALIER G.	US	1994-97
LEBOEUF F.	FR	1996-97
LEFEBVRE A.H.	UK	1957-61
		1972-76
LICHTFUSS H.	GE	1986-90
LUSSEYRAN P.	FR	1990-97
LUTZ O.	GE	1955-71
MACIOCE E.	IT	1959-64
MACISAAC B.D.	CA	1995-97
MACMILLAN W.L.	CA	1980-89
MANCINI E.	IT	1952-53
MAOLI G.	IT	1962-93
MARBLE F.E.	US	1952-64
MARTINO A.A.	US	1978-86
MARTLEW D.	UK	1983-87
MATHIOUDAKIS K.	GR	1996-97
MATSIKAS S.	GR	1990-92
MAY I.W.	US	1992-95
MAZARAKOS G.	GR	1994-97
MEAUZE G.	FR	1987-97
MELLOR A.M.	US	1980-86
METOCHIANAKIS M.	GR	1982-87
MEYER C.	FR	1988-91
MEYER L.G.	US	1994-97
MITCHELL J.G.	US	1976-87
MITCHELL N.A.	UK	1983-87
MONNOT G.	FR	1972-73
MONTI R.	IT	1967-97
MONTLIBERT J.L.	FR	1983-84
MORENO LABATA G.	SP	1993-97
MOSES C.	US	1987-94
MOURANCHE D.	FR	1978-81
MOWILL R.J.	NO	1969-72
MULERO VALENZUELA M.	SP	1987-97
MULLINS B.P.	UK	1952-57
NAGEY T.F.	US	1962-70
NATALE O.	IT	1990-93
NETZER D.	US	1987-94
NINA M.N.R.	PO	1979-97
O'BRIEN W.	US	1992-97
OATES G.C.	US	1985-86
OHAIN H. von	US	1966-71
PAGONIS J.	GR	1988-95
PANAGAKIS G.	GR	1993-97
PAPAILIOU D.	GR	1978-85
PAPAILIOU K.	GR	1986-92
PARKER W.G.S.	UK	1955-57
PAVLIDIS A.	GR	1970-75
PENNER S.S.	US	1952-68
PESCE-RODRIGUEZ R.	US	1996-97
PETRE M.	FR	1981-83
PIANKO M.	FR	1965-86
PSAROUDAKIS P.	IT	1996-97
PUCCI P.F.	US	1978-80
QVALE B.	DE	1971-97
RAMETTE P.	FR	1982-96
RAMPY J.M.	US	1992-94
RECK G.M.	US	1988-92
REFSLUND K.	DE	1957-72
REKOS N.F.	US	1968-77
REYDELLET D.	FR	1980-86
REYNOLDS R.A.	CA	1969-76
RIPOLL J.	FR	1972-79
RODI F.	IT	1984-89
RODRIGUEZ MARTIN D.M.A.	SP	1994-97
ROSEN C.C.	US	1982-85
ROSEN R.	US	1985-86
ROTHROCK A.M.	US	1956-64
RUDEN P.	GE	1957-69
RUDNITSKI D.M.	CA	1986-97
RUSSO C.	US	1995-97
SALVA MONFORT J.	SP	1989-97
SALVATORE G.	IT	1966-74
SANCHEZ-TARIFA C.	SP	1987-97
SANDRI R.	CA	1964-69
SANDSMARK N.	NO	1980-82
SARAVANAMUTTOO H.I.H.	CA	1982-91
SCHADOW K.	US	1995-97
SCHOLTZ N.K.H.	GE	1970-74
SEN N.	TU	1996-97
SEROVY G.K.	US	1987-93
SEZER V.	TU	1992-93
SEZGEN H.	TU	1964-77
SIMPSON E.C.	US	1971-77
SIRINIAN M.	IT	1975-78
SIRINOGLOU A.	GR	1994-95
SKOE I.H.	NO	1982-84
		1991-97
SMITH D.	CA	1989-90
SMITH R.E.	US	1986-91
SOLLIEN I.	NO	1994-97
SOTIROPOULOS C.	GR	1970-71
SOUFFLET P.R.M.	FR	1959-63
STANLEY R.E.	NO	1973-75
STATHATOS X.	GR	1986
STRØM G.	NO	1975-81
STRØM S.	NO	1976-81
		1984-92
SURUGUE J.	FR	1952-74
TITS E.	BE	1961-78
TORELLA G.	IT	1991-97
TOSUN A.	TU	1978-81
TOULOUMENIDIS V.	GR	1985-90
TUTUNSATAR S.	TU	1991-93
TUZUNALP O.	TU	1972-84
UÇER A.S.	TU	1978-95
UĞUZ U.	TU	1984
ULUVAR S.	TU	1985-95
VAILHE L.	FR	1984-86
VERGNE M.	FR	1984-86
VIALATTE A.	FR	1954-59
VINCI C.	IT	1989-97
VLEGHERT J.P.K.	NL	1978-89
WAGNER H.G.G.	GE	1962-69
WAGNER W.W.	US	1987-94

WAY D.	UK	1990-94	WHYTE R.B.	CA	1964-86
WAZELT F.	GE	1975-82	WILKINSON R.F.	CA	1959-60
WEIDHUNER D.D.	US	1961-68	WINTERFELD G.	GE	1972-87
		1973-76	WITTENBERG H.	NL	1973-87
WEISS R.	US	1988-94	ZELLER B.M.	FR	1983-91
WENNERSTROM A.J.	US	1976-85	ZIEMIANSKI J.	US	1992-95
WEYER H.	GE	1988-97	ZWIKKER C.	NL	1952-57
WHITEHOUSE A.	UK	1989-97			

SENSOR AND PROPAGATION PANEL (SPP)

Chairmen:

HÖHN D.	GE	1994-96	CHRISTOPHE F.	FR	1996-97

Deputy Chairmen:

CHRISTOPHE F.	FR	1994-96	CANNON P.S.	UK	1996-97

Executives:

CARIGLIA R.	IT	1994	DEL DUCA G.	IT	1994-97

Panel Members:

ALBRECHT H.J.	GE	1994-96	KOSSEY P.A.	US	1994-97
ANDREOTTI A.	IT	1996-97	KOUTAKOS P.	GR	1995-97
AUDONE B.	IT	1994-97	LAMMERS U.	US	1994-97
ÅSEN W.	NO	1996-97	LANUSSE A.	FR	1994-97
BOSSY L.	BE	1994-96	MACPHERSON R.W.	CA	1994
BOUCHARDY A-M.	FR	1996-97	MANCINI P.L.	IT	1994-96
BROWN G.	US	1994-97	MAVROKOUKOULAKIS N.	GR	1994-97
CANAVERO F.	IT	1996-97	MURINO P.	IT	1994-97
CANNON P.S.	UK	1994-97	NADAR O.	TU	1994-97
CHRISTIANSEN R.S.	US	1995-97	NITSCH J.	GE	1995-97
CHRISTOPHE F.	FR	1994-97	NORLAND M.	NO	1994-97
COUDERC G.	FR	1994-96	OZSU M.	TU	1996-97
CRAIG K. H.	UK	1994-97	PALMER F.	CA	1994
CROSIGNANI B.	IT	1994-97	PETERS M.A.G.	NL	1994-97
DAMASIO L.F.B.	PO	1994-96	PEZZANO I.	IT	1994-97
DARNELL M.	UK	1994-96	RICHTER J.H.	US	1994-97
DASSIOS G.	GR	1994-97	ROGGE J.	NL	1994-97
DELOGNE D.P.	BE	1996-97	SANJURJO NAVARRO R.	SP	1994-97
DÖNMEZ K.	TU	1996-97	SCHWEICHER E.	BE	1994-97
ENTRADAS SALVADA J.A.	PO	1996-97	SPITZ E.	FR	1994-97
FERNANDEZ ALVARO D.M.	SP	1994-97	STAVROULAKIS P.	GR	1995-97
FUERXER P.	FR	1994-97	STOKKE K.	NO	1994-96
GHICOPOULOS B.	GR	1994-97	TAAGHOLT J.	DE	1994-97
GOMEZ R.B.	US	1995-97	TACCONI G.	IT	1994-97
GONZALEZ BERNALDO			TOKER C.	TU	1994-95
DE QUIROS J.	SP	1994-97	TOOTH A.R.	UK	1995-97
GOUTELARD C.	FR	1994-97	TORUN E.	TU	1994-97
HÖHN D.	GE	1994-97	TZIRITAS M.	TU	1994-95
HYDER A.K.	US	1995-97	UZAN C.	FR	1994-97
JORGE AFONSO A.	PO	1994-97	VAN DE CAPELLE A.	BE	1994-96
KALAYCIOGLU U.	TU	1994-97	VAN LIL E.	BE	1996-97
KARYOT T.B.	TU	1994-97	VISSINGA H.	NL	1994-95
KEYDEL W.	GE	1994-97	WYMAN G.	UK	1994-97
KLEMM R.	GE	1994-97	YASAR E.	TU	1994-97

SHAPE Ex-Officio:

PRUNSCH H.R.P.		1994-95

STC Ex-Officio:

YAVUZ D.	1994-97

ARFA Ex-Officio:

ELLIOTT M.	1994-97

STRUCTURES AND MATERIALS PANEL (SMP)

Chairmen:

BROGLIO L.	IT	1955-57	de JONGE J.B.	NL	1978-80
THURSTON F.R.	CA	1957-60	COUPRY G.	FR	1980-82
RHODE R.V.	US	1960-63	WALLACE W.	CA	1982-84
VAN DER NEUT A.	NL	1963-66	HEATH W.G.	UK	1984-86
MASON N.H.	UK	1966-68	SANTINI P.	IT	1986-88
PROMISEL N.E.	US	1968-70	FÖRSCHING H.	GE	1988-90
BARRETT A.J.	UK	1970-72	VENNERI S.	US	1990-92
GAYMANN T.	GE	1972-74	LABOURDETTE R.	FR	1992-94
KEARNS T.F.	US	1974-76	SENSBURG O.	GE	1994-96
HARPUR N.F.	UK	1976-78	POTTER R.	UK	1996-97

Deputy Chairmen:

THURSTON F.R.	CA	1955-57	de JONGE J.B.	NL	1977-78
BOLLENRATH F.	GE	1958-60	CARVALHINHOS H.J.G.	PO	1978-79
VAN DER NEUT A.	NL	1960-63	COUPRY G.	FR	1979-80
MASON N.H.	UK	1963-65	KICIMAN M.O.	TU	1980-81
MILLER W.B.	US	1965-66	WALLACE W.	CA	1981-82
MAZET R.	FR	1966-67	HEATH W.G.	UK	1982-84
SCHEPISI G.	IT	1967-69	SANTINI P.	IT	1984-86
BARRETT A.J.	UK	1969-70	FÖRSCHING H.	GE	1986-88
GUCER D.	TU	1970-71	VENNERI S.	US	1988-90
GAYMANN T.	GE	1971-72	LABOURDETTE R.	FR	1990-92
NIORDSON F.	DE	1972-73	SENSBURG O.	GE	1992-94
KEARNS T.F.	US	1973-74	PAIPETIS S.	GR	1994-96
HARPUR N.H.	UK	1974-76	OTTENS H.H.	NL	1996-97
DERUYTTERE A.	BE	1976-77			

Executives:

SMITH D.C.	UK	1955-59	WILLIS J.M.N.	UK	1976-82
BARRETT A.J. (acting)	UK	1959-60	DRANE D.A.	UK	1982-88
COOPER G.H.	CA	1960-67	McCONNELL M.C.	UK	1988-91
ISKIT T.	TU	1967-70	LYLE W. (acting)	CA	1991-92
BAMBERG P.K.	GE	1970-73	CARBALLAL J.M.	SP	1992-97
WAY E.R.	US	1973-76			

Panel Members:

AKAY T.	TU	1982-88	ASHLEY H.	US	1966-68
AKYÜREK T.	TU	1989	ASHLEY H.R.	UK	1966-68
		1991-97	ATKINSON R.H.	UK	1966-67
ALNIAK O.	TU	1995-97	AUVINET J.	FR	1977-92
ALPAN A.	TU	1956-58	BACHELET E.J.	FR	1988-91
ANASTASIOU S.	GR	1996-97	BAIRD R.B.	US	1974-78
ANKARA A.	TU	1982-85	BALLARD R.L.	US	1970-78
		1992-94	BARBAUX Y.	FR	1996-97
ANTONA E.	IT	1974-82	BARRETT A.J.	UK	1957-77
ARDIC S.	TU	1994-97	BARROIS W.	FR	1965-78
ARDUINI C.	IT	1974-81	BASCARY P.	FR	1984-85
ARMANDO P.	FR	1992-97	BERRISFORD R.S.	US	1973-79
ASBOLL K.	NO	1991-94	BOLIS E.	IT	1974-79

BOLLANI G.	IT	1969-80
BOLLENRATH F.	GE	1955-71
BRIGHT D.M.F.	UK	1980-85
BROGLIO L.	IT	1955-69
BUCKENS F.	BE	1967-82
BUNK W.	GE	1972-79
BURTE H.M.	US	1979-84
CAMPO E.	IT	1990-97
CARLSON R.M.	US	1979-84
CARTA F.O.	US	1979-84
CARVALHINHOS H.J.G.	PO	1970-96
CHAPPELL D.P.	US	1988-89
CHAUMETTE D.	FR	1987-97
CHESTA L.	IT	1981-97
CIANNETI E.	IT	1976-78
CLARK M.N.	CA	1981-85
COLLIER K.I.	US	1979-85
CONRADI L.A.	NO	1962-65
CORNAND J.P.	FR	1990-92
COSTA P.	FR	1980-97
COUPRY G.	FR	1969-87
COUTSOURADIS D.	BE	1983-94
COYLE J.	US	1994-97
CUNNINGHAM G.	UK	1990-91
CURBILLON M.	FR	1991-97
DAHL A.	NO	1967-70
DANIELI G.	IT	1965-74
DAT R.	FR	1987-89
DAUPHANT J.M.	FR	1996-97
DAWSON R.	UK	1977-78
de JONGE B.	NL	1970-88
de L'ESTOILE H.	FR	1958-59
De LUCCIA J.J.	US	1986-91
de VEUBEKE B.F.	BE	1956-76
DECHAENE R.	BE	1988-97
DELAEY L.	BE	1988-95
DENMAN G.L.	US	1985-91
DERUYTTERE A.	BE	1967-91
DEUTSCH G.C.	US	1969-78
DIMAROGONAS A.	GR	1989-90
DIMITRIOU B.	GR	1989-91
do NASCIMENTO J.	PO	1962-66
DORLEAC B.	FR	1956-65
DORUK M.	TU	1981-94
DOUILLET D.	FR	1966-69
DOWELL E.H.	US	1986-91
DUNSBY J.A.	CA	1976-80
DUPRE P.	FR	1956-58
DUVAUT G.	FR	1985-97
EBNER H.	GE	1955-65
ECONOMIDIS C.N.	GR	1990-93
EKSI B.	TU	1991-97
EL GAMMAL M.	FR	1974-79
ELBER W.	US	1987-94
ELLIS J.A.	US	1994-97
ENGERAND J.L.	FR	1986-87
ENGINOLOGLU T.	TU	1988-90
ERARSLANOGLU G.	TU	1996-97
EROL C.	TU	1974-78
EVANS G.	UK	1994-95
FAGUET J.	FR	1957-61
FANNER D.A.	UK	1980-85
FEHRENBACH J.M.	FR	1973-84
FENEKOS E.	GR	1981-84
FÖRSCHING H.	GE	1976-94
FOURNIER A.	BE	1977-81
FRANGANILLO A.	SP	1990-97
FREYMANN R.	LU	1981-95
FUENTE TREMPS E. de la	SP	1987-92
GALOTTO C.P.	IT	1967-77
GARBERG O.	NO	1969-72
GAYMANN T.	GE	1968-78
GDOUTOS E.E.	GR	1992-97
GHIOUROUKOS E.	GR	1981-84
GIAVOTTO V.	IT	1981-94
GLASER J.J.	CA	1986-92
GONCALO H.F.N.	PO	1988-97
GOSTELOW C.	UK	1991-96
GRABOWSKI L.	UK	1990-95
GRASSO A.	IT	1984-89
GRIMES C.K.	US	1969-74
GRISELLI A.	IT	1964-74
GRÜNINGER G.	GE	1980-92
GUÇER D.	TU	1967-81
GÜEMES GORDO A.	SP	1987-97
GÜNTHER G.	GE	1995-97
GUIMOND D.C.	CA	1987
GULER M.H.	TU	1978-79
		1983-87
HABRAKEN L.J.	BE	1971-81
HAGEN K.	NO	1971-72
HALL A.H.	CA	1955-76
HAMLIN H.	US	1964-67
HARPUR N.F.	UK	1973-80
HARRIS G.Z.	UK	1985-86
HARRIS L.A.	US	1979-84
HARRIS W.J.	US	1958-61
HASTINGS R.R.	CA	1990
HEATH W.G.	UK	1975-88
HELLE E.	NO	1964-69
HEULER P.	GE	1993-97
HIBBARD W.R.	US	1969-70
HOFF N.J.	US	1955-59
HOGGE M.A.	BE	1988-97
HÖNLINGER H.	GE	1994-97
HOUBOLT J.C.	US	1971-78
HUMBLE A.R.	UK	1992-97
HUSEBY G.	NO	1993-97
HUSMAN G.E.	US	1986-87
IGGLESIS J.	GR	1984-87
IMMARIGEON J.-P.A.	CA	1992-97
INCARBONE G.	IT	1959-81
JEAL R.H.	UK	1988-89
JOATTON R.	FR	1983-87
JOHANSEN K.W.	DE	1957-62
JUBÉ G.	FR	1975-83
KACPRZYNSKI J.J.	CA	1985-93
KAMOUN G.	FR	1988-89
KANELLOPOULOS D.	GR	1961-70
KARABATUR M.	TU	1983
KARAOGLAN N.	TU	1981-88
KEARNS T.F.	US	1968-80
KELLEY F.N.	US	1978
KENT H.M.	UK	1977
KERMANIDIS T.	GR	1978-81
KERRY F.A.	UK	1957-62
KESSLER W.	US	1987-94
KICIMAN M.O.	TU	1971-82
		1987-94
KILSHAW M.J.	UK	1991-94

KINSEY H.V.	CA	1955-76	NYSSEN C.	BE	1986-97
KJOLLESDAL H.	NO	1962-75	O'CONNELL R.F.	US	1984-91
KJOLSETH P.	NO	1956-58	ODDONE G.	IT	1986-94
KLINGER L.G.	US	1961-66	ODORICO J.	FR	1989-96
KLOUMAN F.K.	NO	1978-86	OLIVEIRA SAMPAIO A.A.	PO	1968-71
KOCHENDÖRFER R.	GE	1992-97	OLSEN J.J.	US	1976-87
KOFSTAD P.	NO	1969-72	ONAT E.T.	TU	1955-56
KOMPOTIATIS L.	GR	1988-97	OTTENS H.H.	NL	1989-97
KOWALEWSKI J.	GE	1965-68	OZBAYRAMOGLU M.	TU	1982-87
KUSSNER H.G.	GE	1958-72	PAIPETIS S.	GR	1981-97
KVERNES I.	NO	1979-87	PAPAKONSTANTINOU G.	GR	1990-95
LABOURDETTE R.J.	FR	1977-97	PAPAMANTELOS	GR	1979
LACHENAUD R.	FR	1960-67	PAROT A.	BE	1958-70
LASALMONIE A.	FR	1992-97	PAUL D.B.	US	1990-97
LASCHKA B.	GE	1973-76	PAX R.J.	SP	1991-94
LEACH J.S.L.	UK	1986-91	PERRIER H.	FR	1992-96
LEE J.R.	UK	1974-84	PERRON C.	CA	1993-97
LEFTHERIS B.	GR	1992-95	PERRY P.J.	UK	1986-89
LEMAITRE J.	FR	1974-77	PETERS F.	CA	1991-94
LEOMAND G.	FR	1965-75	PETERSON G.P.	US	1974-85
LEWIS D.	UK	1978-80	PETRIN C.L.	US	1986-91
LIACOS N.J.	GR	1980-81	PICKARD A.C.	UK	1990
LIEBOWITZ H.	US	1967-68	PINKNEY H.F.L.	CA	1981-84
LIOSIS G.	GR	1964	PINTADO FE J.M.	SP	1987-90
LIVINGS N.M.	UK	1995-97	PINTELAS G.	GR	1986
LOCATI L.	IT	1957-78			1989-91
LODGE C.G	UK	1981-84	PLANTEMA F.	NL	1960-67
LOEWY R.G.	US	1983-85	PORTALIS G.	GR	1982-86
LOIZAGA A.	SP	1994-96	POTTER R.T.	UK	1990-97
LOOIJE A.	NL	1989-92	POULIGNIER J.P.	FR	1965-74
LOVELACE A.M.	US	1966-73	PROMISEL N.E.	US	1959-71
LUYPAERT F.	BE	1973-77	REDONDO E.	SP	1987-97
LYNCH C.T.	US	1984-85	RHODE R.V.	US	1955-68
LYNG S.	NO	1975-78	RHODES A.N.	UK	1966-69
MACHERAS S.	GR	1996-97	RIPLEY E.L.	UK	1975-79
MAGRAMS S.J.	US	1964-66	ROBSON B.	UK	1978-80
MAR J.W.	US	1972-80	ROBYNS		
MARCHESE P.	IT	1990-97	de SCHNEIDAUER H.	BE	1970-73
MARCONI M.	IT	1976-78	RODERICK G.L.	US	1985
MARIOLI-RIGA Z.P.	GR	1992-97	RODRIGUEZ-VILLA A.	SP	1990-97
MARQUES VIDEIRA F.	PO	1966-68	RONALD T.M.F.	US	1991-97
MARQUEZ P.	SP	1994	ROTHER M.	GE	1988-93
MARTIN-HERNANDEZ J.M.	SP	1989-90	ROUSTAN J.	FR	1989-91
MARZATICO V.	IT	1982-86	ROWLAND K.A.	UK	1969-72
MASON N.H.	UK	1959-68	RUIZ MOLINA A.	SP	1986-88
MATHIEU M.	CA	1987-88	SOVOLD L.	NO	1973-78
MATULATIS J.	US	1961-66	SALAR D.	TU	1985-87
MAURER O.F.	US	1987-89	SALVETTI A.	IT	1977-97
MAWET R.	BE	1964-66	SAMPATH S.G.	US	1992-97
MAXWELL R.D.J.	UK	1982-85	SANCHIZ GARROTE E.	SP	1992-97
MAZET R.	FR	1955-74	SANCHO M.	FR	1987-90
MEIJER J.J.	NL	1997	SANDER G.J.	BE	1978-87
MERMILLOD J.P.	FR	1973-77	SANDSMARK N.	NO	1983-97
MEYER-JENS R.J.	GE	1976-81	SANTINI P.	IT	1975-97
MILLER W.B.	US	1955-69	SARI O.	TU	1988-90
MILONAKIS E.	GR	1995-96	SARICIMEN H.	TU	1977-80
MINGES M.L.	US	1987-94	SAVOYE A.	FR	1969-73
MOLYNEUX W.G.	UK	1979-82	SAXER R.K.	US	1974
MORAN S.D.	US	1994-97	SCHEPISI G.	IT	1958-74
MOURA BRANCO C.A.G.	PO	1991-97	SCHIPP J.	US	1959-64
MULLINS B.P.	UK	1967-74	SCHMIDT R.	US	1981-85
MYKYTOW W.J.	US	1969-75	SCHMIT L.A.	US	1981-82
MYRVOLD E.	NO	1979-87	SCHOERNACK W.	GE	1982-87
NAESS T.	NO	1973-82	SCHROLL J.	DE	1992-97
NIORDSON F.	DE	1962-86	SCOLARIS M.	IT	1985-97

KROG H.K.	NO	1980-82	SEARLE R.	UK	1990-92
TITTLBACH G.	GE	1982-83	COTTER G.	US	1992
WILDGOOSE N.	CA	1983-85	GUTIERREZ M.C.	SP	1992-93
BLADOS W.R.	US	1985-87	RYAN R.P.	US	1994
CUFFEZ A.	BE	1987-89	HÄGE H.	GE	1994-97
YANEZ A.	FR	1989-90			

Executives:

CONNELLY E.D.	US	1953-64	WHITEHEAD A.J.R	UK	1972-77
VANNUCCI A.G.	IT	1964-71	SHARP E.T.	UK	1977-85
GREENE P. (Acting)	UK	1971-72	HART G.W.	UK	1985-97

Panel Members:

ACHTIDAS A.	GR	1967-70	DI MARTINO G.	IT	1990-97
ACHTIDAS D.	GR	1978-82	DISCH A.	NO	1968-77
AKTAS Z.	TU	1981-88	DUNLOP W.W.	US	1959-61
ARKUN M.E.	TU	1992-97	DYER F.S.	US	1971-76
AUBREY F.G.	CA	1969-71	ECONOMIDIS Th.	GR	1991-94
AXIOTOPOULOU E.	GR	1984-89			1996-97
AYBAS O.T.	TU	1982-87	ERIC D.	TU	1967-68
BALBIS B.	IT	1956-62	ERKMEN E.	TU	1979-80
BARBAS D.	GR	1995-97	ERLENDSSON J.	IC	1988-93
BARBIERI F.	IT	1988-93	ERTE I.E.	TU	1984-87
BEATTIE A.P.	UK	1995-97	EVANS B.F.	CA	1969
BENLI O.	TU	1988-92	FAGAN F.K.	US	1956-58
BERNHARDT R.	GE	1975-93	de FAGET G.	FR	1956-61
BICI S.	TU	1994-97	FALCK S.	DE	1972-75
BIGGER C .	UK	1989-96	FORMENTINI P.	IT	1956-60
BLADOS W.R.	US	1982-91	FRENOT G.	FR	1953-60
BODLEY-SCOTT A.	UK	1977-78	FRESON M.	BE	1956-70
BOLKOL S.	TU	1988-94	GARCIA MORENO M.A.	SP	1993-94
BOSS VAN CHARANTE J.W.A.	NL	1994-96	GERVASI M.	IT	1984-86
BOTSARIS C.	GR	1984	GJERSVIK R.A.	NO	1986-97
BOUCHER H.M.	FR	1984-86	GOODE D.W.	UK	1976-83
BRANDRETH M.	CA	1987-96	GOULIOS G.N.	GR	1979-81
BRAUN H.	GE	1981-92	GRAHAM I.C.	UK	1983-87
BREAS G.M.	NL	1985-89	GRUTZMACHER E.	NL	1979-85
BREE R.	GE	1956-73	GUILLEMINET J.A.J.	FR	1979-83
BRUCE A.	UK	1979-83	GUTIERREZ M.C.	SP	1989-94
BURIAN K.	TU	1972-78	HACIPASAOGLU K.	TU	1996-97
CAGLAR B.	TU	1985-87	HÄGE H.	GE	1992-97
ÇAKIR S.	TU	1992-96	HALL A.A.	UK	1953-54
CARACCIOLO DI FORINO A.	IT	1977-79	HANSEN K.	GE	1970-81
CATHCART J.	CA	1987-89	HART G.W.	UK	1983-85
CHANDLER G.	US	1978-80	HAYLOR L.J.H.	UK	1957-64
CHEVALIER F.R.J	FR	1987-92	HERMANN T.A.	US	1991-97
CHIARUCCI G.	IT	1953-55	HESELTINE I.M.	CA	1983-86
CHRISTENSEN W.C.	US	1967-68	HINKLEY H.L.R.	UK	1969-71
		1972-74	HISINGER B.	DE	1989-93
COCKX A.	BE	1967-83	HOLLOWAY A.H.	UK	1954-69
von CONSBRUCH C.	GE	1970-77	HOOGENBERK P.J.	NL	1990-94
		1991-95	HUGHES J.M.	US	1991-96
CORREIA A.M.R.	PO	1987-97	IRONSIDE A.M.	CA	1959-72
COTTER G.	UK	1990-95	ISKECELI M.	TU	1962-66
COYNE J.G.	US	1976-83	JACKSON E.B.	US	1954-61
CRESPO H.G.	PO	1976-78	JENSEN N.H.	DE	1981-88
CUFFEZ A.	BE	1980-90	JONES A.C.	CA	1967-74
DAGGER W.P.	CA	1956-66	JORGE C.M.	PO	1981-89
DAY M.S.	US	1961-71	KARAKOSTAS D.	GR	1988-91
		1979-81	KARANDREAS P.	GR	1993-96
DEL REY A.	SP	1988-97	KAYA D.	TU	1974-90
DELEUZE M.D.	SP	1987-97	KENNEDY R.A.	CA	1954-59
DEXTER R.R	US	1956-69	KERTSOS D.	GR	1970-72

SELCUK E.	TU	1994-97	TÜRKDOGAN A.	TU	1991-97
SENSBURG O.	GE	1985-97	TZIMIS D.	GR	1987-95
SERTOUR G.	FR	1961-66	TZIRITAS A.	GR	1975-76
SERVENT MIRO R.	SP	1994-97	ÜÇISIK A.H.	TU	1985-94
SIGFUSSON T.	IC	1988-94	ULUG F.	TU	1956-57
SIGNORETTI S.	IT	1975-92	UNDA J.	SP	1995-97
SIMPSON D.L.	CA	1993-97	UTKA A.	TU	1963-66
SINGLEY G.T.	US	1987	VALLERANI E.	IT	1980-83
SKARPEDAS T.	GR	1985	VAN DER BIEST O.	BE	1995-97
SKINGLE C.W.	UK	1987-90	VAN DER HOEVEN W.	NL	1993-97
SMITH D.L.	US	1986	VAN DER NEUT A.	NL	1955-70
SPANOS A.	GR	1970-75	VAN LEEUWEN H.P.	NL	1967-89
		1977-81	VANTOMME J.	BE	1993-97
SØVOLD L.	NO	1973-78	VENNERI S.L.	US	1984-94
STARKE, Jr E.A.	US	1992-97	VIECHNICKI D.	US	1994-97
SULLIVAN T.E.	US	1967-73	VLASSIS S.	GR	1995-96
SURACE G.	IT	1996-97	WALDMAN J.	US	1987-97
SYMMONS R.W.	UK	1962-66	WALKER P.B.	UK	1955-56
TALLAN N.M.	US	1969-77	WALLACE W.	CA	1976-92
TAMER M.	TU	1967-71	WARD A.P.	UK	1990-92
TAYLOR S.	UK	1955-57	WATTERSON T.P.	UK	1990-94
TEMPLETON H.	UK	1955-57	WEDDEN P.R.	UK	1984-86
TENDEN S.	NO	1989-93	WELBURN S.	UK	1995-97
THEOCARIS P.	GR	1970-71	WOLFE M.O.W.	UK	1957-62
THEOFILOU M.	GR	1985-88	WRIGHT E.S	US	1980-85
THIELEMANN W.	GE	1964-75	YEGINOBALI A.	TU	1975-81
THLIVEROS P.	GR	1967-70	YIGIN A.	TU	1982-88
THORBY D.C.	UK	1984-89	YÜCEL A.	TU	1994-97
THURSTON F.R.	CA	1955-76	YURDABAKAN D.	TU	1988-90
TIJDEMAN H.	NL	1979-81	ZENNARO G.	IT	1994-97
TOMBOPOULOS P.	GR	1956-61	ZOCHER H.	GE	1979-93
TOVAR de LEMOS A.	PO	1979-92	ZWAAN R.J.	NL	1982-96
TSAKIRIS	GR	1984-85			

TECHNICAL INFORMATION PANEL (TIP)
[TECHNICAL INFORMATION COMMITTEE (TIC) from 1994]

Chairmen:

HALL A.A.	UK	1953-54	von CONSBRUCH C.	GE	1973-75
THORNE R.G.	UK	1954-55	SCHULER S.C.	UK	1975-76
JACKSON E.B.	US	1955-56	PRYOR H.E.	US	1976-78
KENNEDY R.A.	CA	1956-57	TAN A.S.T.	NL	1978-80
de FAGET G.	FR	1957-58	SAUTER H.E.	US	1980-83
HAYLOR L.J.H.	UK	1959-60	TITTLBACH G.	GE	1983-85
SCHULLER J.A.	NL	1960-61	WILDGOOSE N.	CA	1985-87
KLOPP J.H.	FR	1962-64	BLADOS W.R.	US	1987-90
DAY M.S.	US	1964-65	YANEZ A.	FR	1990-92
VESSEY H.F.	UK	1966-68	SEARLE R.	UK	1992
STOLK A.H.	NL	1968-71	COTTER G.	US	1992-94
JONES A.C.	CA	1971-73	RYAN R.P.	US	1994-97

Deputy Chairmen:

THORNE R.G.	UK	1953-54	STOLK H.A.	NL	1966-68
JACKSON E.B.	US	1954-55	MARDEROSIAN R.L.	US	1968-70
KENNEDY R.A.	CA	1955-56	JONES A.C.	CA	1970-71
de FAGET G.	FR	1956-57	von CONSBRUCH C.	GE	1971-73
HAYLOR L.J.H.	UK	1958-59	SCHULER S.C.	UK	1973-75
SCHULLER J.A.	NL	1959-60	PRYOR H.E.	US	1975-76
KLOPP J.H.	FR	1961-62	DISCH A.	NO	1976-77
VAN J.O.	US	1962-63	TAN A.S.T.	NL	1977-78
VESSEY H.F.	UK	1965-66	SAUTER H.E.	US	1978-80

KIROUAC G.	CA	1972-83	de PRATT A.J.	PO	1972-75
KLETSAS G.	GR	1976-78	PRIGENT R.V.	FR	1981
KLINTOE K.	DE	1975-81	PRYOR H.E.	US	1973-78
KLOPP J.H.	FR	1959-79	RAUTENBERG H.H.	GE	1957-70
de KOCK A.C.	NL	1957-65	REYMOND R.	FR	1986-87
KONTARATOS A.N.	GR	1979-83	RIBIERO J.B.	PO	1964-72
KORONIOS	GR	1995-96	RIEGELS F.W.	GE	1955-56
KOUNELIS K.	GR	1985-86	ROEPER Y.	FR	1969-80
KROG H.K.	NO	1978-82	ROM G.	NL	1954-57
LABELA F.C.	PO	1994-97	ROQUE A.G.B.	PO	1989-94
LACHEZE G.M.	FR	1981-84	ROSSI R.	IT	1985-88
LAPEYSEN E.T.H	BE	1984-86	RUA M.A.	PO	1961-65
		1992-97	RYAN R.P.	US	1991-97
LARUE R.	FR	1984-90	SALMON M.	FR	1961-78
LAVROFF O.	FR	1985-90	SAUTER H.E.	US	1974-84
LAWRENCE B.	US	1984-91	SCHRYER M.J.	CA	1989-97
LEACH O.M.	CA	1958-69	SCHULER S.C.	UK	1968-76
LECHMANN H.	GE	1964-72	SCHULLER J.A.	NL	1957-68
LEHMANN W.L.	US	1972-76	SEARLE R.	UK	1987-97
LETARTE M.J.A.	CA	1982-84	SEVESTRE C.	FR	1979-83
LHULLIER F.	FR	1984-97	SILVESTRO G.	IT	1961-62
LIAKAIS T.	GR	1982	SOLVBERG I.	NO	1983-86
LOWE J.A.	UK	1984-89	SOMENZI V.	IT	1962-67
LOWRY W.K.	US	1953-58	SOTIROPOULOS C.	GR	1972-75
LUSHINA L.N.	US	1981-82	STEARNS J.	US	1971
LUTTERBECK E.	GE	1959-70	STEGMAIER R.E.	US	1964-67
MAC LEOD A.	FR	1992-96	STERKEN J.	BE	1990-96
MARCONI P.	IT	1985-92	STOLK H.A.	NL	1964-75
MARDEROSIAN R.L.	US	1965-71	TAN A.S.T.	NL	1976-97
McCONNELL D.G.	US	1972-73	TANER S.	TU	1979-82
McIVOR R.	CA	1975-78	TERPSTRA C.P.M.	NL	1996-97
MEIER H.	GE	1990-91	THORNE R.G.	UK	1953-56
MELVILLE S.	FR	1955-68	TITTLBACH G.	GE	1977-90
MERIDA F.	SP	1996-97	TSIMPOGLOU F.	GR	1992-97
MICHEL J.	FR	1977-84	TUNCER N.	TU	1986-93
MINTZELAS T.	GR	1991-92	TYPALDOS C.	GR	1982-83
MOLHOLM K.N.	US	1985-91	ULUG F.	TU	1954-57
MORELLI G.	IT	1980-84	URUNDUL E.	TU	1983-92
MULLER J.F.	BE	1983-84	VALENSI E.	FR	1992-97
OHNSORG T.K.	US	1995-97	VANAUTRYVE G.M.	BE	1987-89
OLGUN T.	TU	1983-86	VANN J.O.	US	1961-63
ORTAC T.	TU	1958-61	VENAKI-MELINTZI I.	GR	1991-93
		1964-69	VESSEY H.F.	UK	1960-68
ORUN S.S.	TU	1972-73	VILLAIN J.	FR	1992-97
ÖZDIL A.	TU	1991-94	WALSHAW M.H.	UK	1992-95
PANHUYZEN R.E	NL	1976-79	WEIMER A.	US	1969-71
PAPADIMITRIOU S.	GR	1986-91	WENTE V.A.	US	1982-89
PAPAGERMANOS A.	GR	1992-93	van WESTERHOVEN W.J.	NL	1968-75
PAPAPASCHALIS A.	GR	1985	WIEGANDT C.	FR	1991-94
PASCHOS A.	GR	1991-92	WILDGOOSE N.	CA	1981-87
PATRINOU D.	GR	1985-97	WILKINSON M.R.C.	UK	1986-92
PAVLIDES A.	GR	1959-66	WOOSTER H.	US	1969-71
PEDROSO A.	PO	1979-81	WRIGHT R.C.	UK	1972-76
PIETSCHE E.	GE	1955-63	YANEZ A.	FR	1987-92
POERIO C.	IT	1966-76	ZIJLSTRA B.H.A.	NL	1990

Associate Members:

BETHELL J.P.	SACLANTCEN	1970-85	RENY J.G.	NATO (MAS)	1990-97
CAMERON R.	SACLANTCEN	1985	SHARP E.T.	STC	1972-77
GARDNER K.	NATO (DRS)	1991-97	THORPE P.	SACLANTCEN	1991-95
KETCHIN M.	STC	1979	WALKER C.	STC	1984-97
LEMCHE V.	NATO (DRS)	1989-91	WILLIS J.	STC	1968-72
POOL R.	STC	1980-83			

AGARD TECHNICAL PANELS
NUMBERS OF MEMBERS, BY PANEL, 1956-93

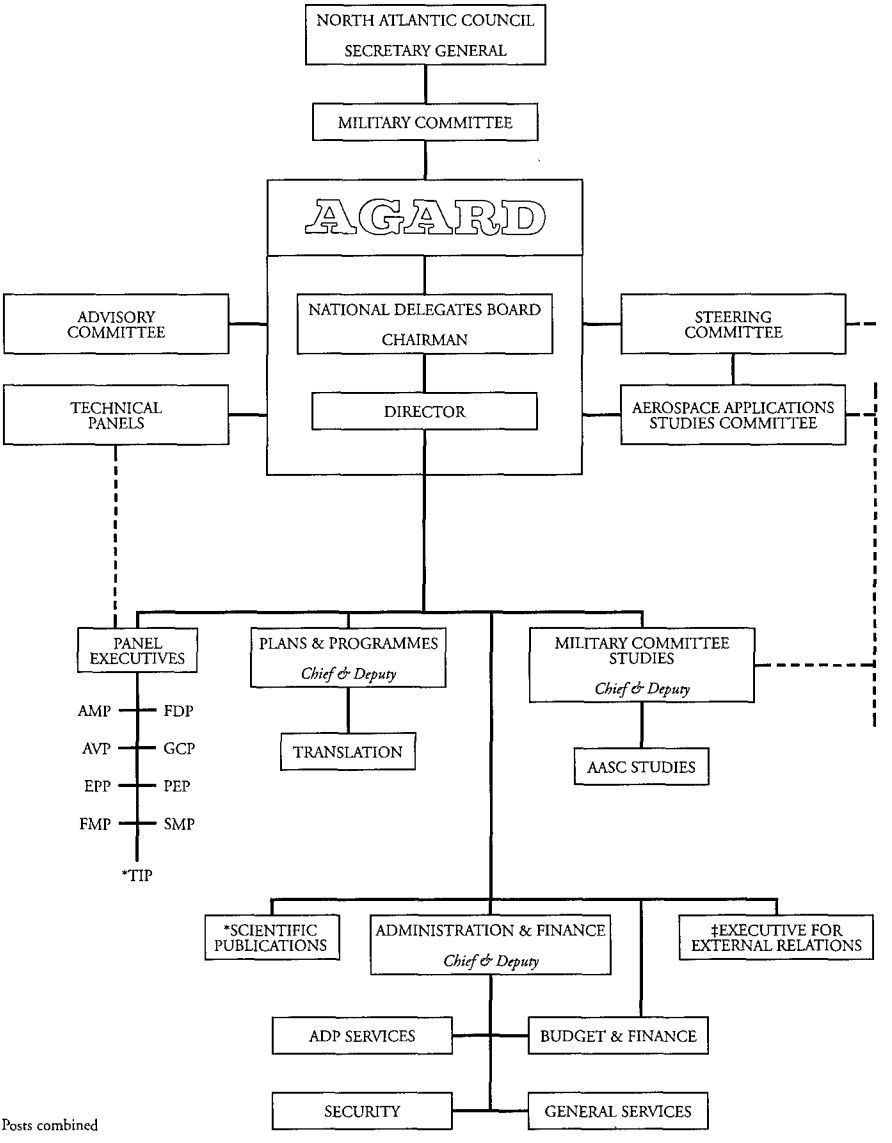
YEAR	AMP	AVP	EPP	FMP	FDP	GCP	PEP	SMP	TIP	TOTAL
1956	20			19	19		16	19	12	105
1957	20	14		19	24		21	22	16	136
1958	26	32		20	25		22	24	18	167
1959	26	37		21	25		26	29	21	185
1960	32	42		22	30		27	31	21	205
1961	32	49		23	35		28	33	22	222
1962	32	50		24	37		29	37	21	230
1963	36	55		31	39		33	40	22	256
1964	33	52		32	41		32	39	23	252
1965	33	54		30	42		32	38	23	252
1966	35	57		31	43	12	36	41	23	278
1967	38	50		32	47	24	38	43	24	296
1968	38	54		30	46	28	39	44	23	292
1969	40	60		31	47	28	40	44	23	313
1970	41	43	24	35	50	35	39	49	24	340
1971	44	44	24	35	48	35	39	49	24	342
1972	47	42	25	36	47	35	42	50	26	350
1973	47	42	27	37	47	37	41	49	26	353
1974	45	42	29	34	47	35	42	50	25	349
1975	45	41	32	37	47	34	42	52	26	356
1976	46	43	33	38	49	35	43	54	26	367
1977	48	43	34	39	50	35	48	56	26	379
1978	49	47	36	43	47	51	52	60	24	409
1979	45	50	34	43	50	48	52	61	28	411
1980	49	46	33	47	53	44	53	59	29	413
1981	48	51	36	48	53	44	57	62	30	429
1982	48	50	37	51	54	44	57	62	31	434
1983	50	46	42	46	53	40	55	62	35	429
1984	51	44	43	44	57	44	58	64	35	440
1985	51	46	45	46	59	44	61	68	36	456
1986	53	46	43	44	58	46	61	62	38	451
1987	53	47	43	47	55	46	57	68	36	452
1988	53	47	46	55	60	53	60	70	39	480
1989	50	47	47	55	60	48	61	75	40	483
1990	54	51	48	55	61	54	58	78	39	498
1991	57	52	51	52	62	55	62	78	44	513
1992	55	52	53	53	65	50	65	81	44	518
1993	58	51	51	54	67	54	65	75	43	518

PERIOD 1994-96

DATE	AMP	FVP	FDP	MSP	PEP	SPP	SMP	TIC	TOTAL
1994	61	54	65	67	67	55	76	36	481
1995	63	55	65	64	66	52	73	35	473
1996	66	56	65	61	57	58	74	33	470

ANNEX 6 AGARD ORGANISATION AND CHARTER

With minor variations, the chart below represents the structure of AGARD as it was for many years. The Charter that follows on the next page is the final one, approved by NATO's Military Committee in 1988.



*, ‡, Posts combined

ORGANISATION CHART AS IN 1987

CHARTER FOR THE ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT (AGARD)

Effective 1 March 1985
As authorized by North Atlantic Military Committee Document MC 143/2 (Final), dated 1 March 1985 and amended by Corrigendum No. 1, dated 26 July 1988.

SECTION I

LEGAL STATUS

1. The Advisory Group for Aerospace Research and Development (herein referred to as AGARD), located in Neuilly-sur-Seine, France, is a NATO subsidiary body established under the provisions of the Agreement on the status of the North Atlantic Treaty Organization, National Representatives and International Staff, signed in Ottawa on 20 September 1951 (herein referred to as the Agreement).
2. Subject to the provisions of the present Charter, the Agreement shall apply to AGARD. Consequently, AGARD, acting in the name of NATO, shall be entitled to perform such legal actions as are essential to its operation. Within these limits it shall have the capacity to:
   (a) Conclude contracts;
   (b) Institute legal proceedings and engage in administrative procedures;
   (c) Acquire and dispose of property.

SECTION II

DEFINITION

3. AGARD is a NATO Agency under the authority of the Military Committee consisting of:
   (a) A Board of National Delegates. The National Delegates Board (NDB) is composed of representatives of member nations;
   (b) A number of Panels and Committees approved by the Military Committee and composed of experts appointed by the National Delegates;
   (c) A technical and administrative staff whose number and composition is approved by the Military Committee.

SECTION III

MISSION

4. 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:
   (a) Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community;
   (b) Providing scientific and technical advice and assistance to the Military

Committee in the field of aerospace research and development (with particular regard to its military application);

(c) Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;

(d) Improving the cooperation among member nations in aerospace research and development;

(e) Exchanging scientific/technical information;

(f) Providing assistance to member nations for the purpose of increasing their scientific and technical potential;

(g) 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 as stipulated in Article 20 below.

SECTION IV

MILITARY COMMITTEE

5. AGARD will operate under the policy and guidance promulgated by the Military Committee. The general outline and scope of its annual Programme of Work, including the magnitude of the effort in different areas, will be recommended by the National Delegates Board and approved by the Military Committee.

6. Within the framework of this Charter, and in conformity with NATO policies and procedures, the Military Committee will be responsible for issuing guidance for the operation of AGARD. The National Delegates Board may propose changes in the guidance to the Military Committee.

SECTION V

AGARD NATIONAL DELEGATES BOARD (NDB)

7. The AGARD National Delegates Board constitutes the highest authority within AGARD. It is composed of one to three representatives from each member nation, officially appointed by their respective governments. The members of the National Delegates Board shall normally be highly qualified scientists or engineers having knowledge of defence research and development in the aerospace field in their respective countries. Each nation will have only one vote, regardless of the number of delegates. The Secretary General of NATO shall designate a representative to attend meetings of the National Delegates Board and other meetings as appropriate, as an ex-officio member. The Military Committee will be represented at all NDB Meetings.

8. The Chairman will be elected by the National Delegates Board for a term of three years with no extension possible. The AGARD Chairman conducts the work of the National Delegates Board. He takes all necessary measures to implement decisions taken by the National Delegates Board, initiates actions as required to fulfil the AGARD mission, and issues appropriate instructions to the Director of AGARD.

9. The National Delegates Board shall meet twice a year, or more frequently if necessary at the request of the Chairman.

10. The National Delegates Board shall in particular:
    (a) Elect its Chairman from among its members;
    (b) Establish guidelines for future programmes;
    (c) Review the current and projected work programmes including the Consultant and Exchange Programme, in accordance with the provisions of Articles 18, 19 and 20 below.
    (d) Propose to the Military Committee the establishment, as appropriate, of Panels, Committees and Ad Hoc Groups;
    (e) Provide the AGARD Panels, Committees, Ad Hoc Groups and Staff with policy guidance;
    (f) Ensure that all knowledge and information in the possession of NATO nations relevant to the work of AGARD are made available to AGARD to the maximum extent acceptable to those nations;
    (g) Examine AGARD's annual report to the Military Committee;
    (h) Designate, subject to Military Committee approval, the Director of AGARD;
    (i) Assist the Director of AGARD in the recruitment of a qualified technical and administrative staff;
    (j) Approve the AGARD By-Laws.
11. Special Committees as required for efficient operation of AGARD activities may be established as prescribed by Military Committee and National Delegates Board policy. Membership of these Special Committees and the Terms of Reference will be contained in the By-Laws to this Charter.

SECTION VI

AGARD DIRECTOR

12. The Director of AGARD is designated by the National Delegates Board, subject to Military Committee approval. He shall be appointed for a term specified by the National Delegates Board which must be consistent with NATO contractual policy. His term may be renewed at the option of the National Delegates Board. His contract shall be signed, at the request of the AGARD Chairman, by the Chairman of the Military Committee.
13. The Director will normally attend all meetings of the National Delegates Board and Special Committees without vote.
14. The Director supervises and directs the AGARD staff and, in particular, is responsible for:
    (a) Planning and conducting the activities of AGARD within the framework of the general policy and/or programme;
    (b) Carrying out the decisions of the National Delegates Board;
    (c) Approving the release of reports and studies promulgated in the name of AGARD;
    (d) Engaging the necessary personnel to fill positions within the approved ceiling;
    (e) Exercising either personally or through appropriate delegation the authority granted to him.

SECTION VII

PERSONNEL

15. The AGARD Technical and Administrative Staff will implement or support the approved programmes of AGARD. The AGARD staff will be drawn from NATO nations. It shall be composed of:

    (a) Personnel occupying established posts, who by virtue of Article 17 of the Ottawa Agreement constitute NATO International Personnel;

    (b) Military or civilian personnel assigned to AGARD by NATO nations on a non-reimbursable basis at the request of the AGARD Chairman with the approval of the Military Committee.

16. The personnel included in the categories defined in Article 15 above will benefit from the applicable provisions of the Ottawa Agreement.

17. The NATO Civilian Personnel Regulations shall apply to AGARD.

SECTION VIII

PROGRAMMES

18. AGARD's annual programme for the period 1st January to 31st December shall be established during the preceding year according to the following procedures:

    (a) The Director of AGARD will forward a comprehensive written statement of the projected AGARD work programme including any proposals of the individual nations or NATO bodies to the National Delegates Board; the Director will add to this statement his personal comments and suggestions;

    (b) The National Delegates Board will review and approve the work programme and will submit its recommendations to the Military Committee for its approval from a military viewpoint.

19. In framing its recommendations, the National Delegates Board will take into account, <i>inter alia<m>, the following considerations:

    (a) Whether the existing and proposed programmes are within the mission and capability of AGARD;

    (b) Whether AGARD is the appropriate body to conduct each part of the proposed programme;

    (c) Whether certain countries possess information on subjects of the proposed programme that may be available to AGARD within national security constraints;

    (d) Whether estimated item costs and the total programme cost of AGARD are reasonable. However, the recommendations of the National Delegates Board as a whole, or of certain members, shall not prejudge the responsibility of the Military Budget Committee (MBC) for the examination of AGARD's budget.

20. AGARD may, in accordance with the guidance referred to in Article 6 above, give scientific and technical assistance and provide consulting services in connection with national or NATO coordinated research and development programmes. Such actions are subject to Military Committee approval.

SECTION IX

FINANCIAL RULES

21. The budget of AGARD shall be financed in accordance with the cost-sharing formula appropriate to NATO peacetime military budgets.

22. The NATO Financial Regulations shall apply to AGARD.

23. In the framework of the NATO Financial Regulations:

    (a) The budget is prepared by the AGARD staff, reviewed by the National Delegates Board, and presented to the NATO Council (Military Budget Committee) through and by the NATO Financial Controller by 1st September, for the following calendar year, in the absence of such other date as may be set by the Finance Committee.

    (b) At the same time the AGARD budget will be transmitted to the Military Committee for examination from a military point of view prior to NATO Council approval.

    (c) The Military Budget Committee will report its recommendations on the AGARD budget to the North Atlantic Council for approval.

24. Financial control of AGARD will be exercised in conformity with the NATO Financial Regulations.

25. The external audit of the accounts of AGARD shall be carried out by the NATO Board of Auditors according to the NATO Financial Regulations.

SECTION X

SECURITY

26. In the framework of NATO Security Regulations:

    (a) When dealing with classified material, AGARD shall be bound by the NATO Security Regulations as set out in C-M(55) 15, reissued 31 July 1972, including all current and future Supplements and Amendments thereto, and by such other security rules approved or authorised by the North Atlantic Council as may apply.

    (b) In meeting his responsibility for the maintenance of security at AGARD, the Director will be guided by the current rules, regulations and instructions issued by the NATO Security Committee for the implementation of the NATO security system set forth in the document C-M(55)15, referred to in paragraph (a) above.

SECTION XI

COPYRIGHTS AND INFORMATION DISCLOSURE

27. Proprietary rights (including patent rights, copyrights and proprietary technical information) in any work carried out by a member of the AGARD Staff in the performance of his official duties shall be vested in NATO. As to the proprietary rights which might be developed by consultants and/or authors in the performance of their work, the Director of AGARD will ensure that contractual provisions similar to those used for members of the Staff are applied as far as practical. AGARD shall, on request, authorise any member nation to obtain patent or other protection as trustee for NATO on any of those proprietary rights vested in NATO under this article. Each member nation shall be entitled to a free licence to use any proprietary rights vested in NATO under this provision.

28. Proprietary technical information, including information concerning inventions belonging to NATO nations which has been disclosed to AGARD, or in the framework of meetings held under AGARD aegis, will be protected. Rules and procedures set up for NATO Committees and Working Groups, such as "General Guidance for NATO Armaments Committee Groups" (AC/74-D/860 (Revised) Part VIII, dated 30th June, 1964), and the "Council Resolution on Provisions for Setting Up an Ad Hoc Committee in the Event of Damage from Disclosure or Use of Inventions or Technical Information within the Framework of the North Atlantic Treaty Organization" (C-M(60)60, dated 2nd June, 1960) will apply, including all current and future Supplements and Amendments thereto, and such other rules approved or authorised by the North Atlantic Council.

SECTION XII

IMPLEMENTING MEASURES

29. Each NATO Government will, to the extent that its existing capabilities in the field of aerospace research and development permit, support the work of AGARD. In particular, each will make available to AGARD:

    (a) Such information as may be necessary to carry out the objectives of AGARD, consistent with its own national laws, regulations and practices with regard to the disclosure of such information;

    (b) Qualified personnel to serve as National Delegates, Panel, Committee and Ad Hoc Group Members and Experts;

    (c) Qualified personnel who are prepared to accept employment within the AGARD Staff.

30. This Charter entered into force on 1 March 1985, on which date MC143/1 (Final), the previous AGARD Charter dated 5 April 1971, was superseded and has since been amended by Corrigendum No.1 dated 26 July 1988.