
TO:

The Fluid Dynamics Panel of the NATO Advisory Group for Aerospace Research and Development (AGARD) is pleased to announce the presentation of the subject lecture series at the Air Force Museum, Wright-Patterson Air Force Base, Dayton, Ohio. The four day lecture series under the direction of Dr Hideo Yoshihara of The Boeing Company, will begin on 16 May 1983 and conclude 19 May 1983. Since this course is sponsored by the United States National Delegates for AGARD, there will be no charge, but registration is limited to citizens of the United States and NATO countries.

The enclosed material describes the program, agenda, and lists the distinguished speakers assembled from the United States, United Kingdom, France, Germany and the Netherlands. I think you will agree this Lecture Series provides a unique opportunity to share the expertise of these internationally recognized experts. The lecture series is structured to provide a state-of-the-art assessment of practical subsonic and transonic aerodynamic analysis and design techniques applicable to military and commercial aircraft. I strongly encourage the participation of aerodynamic specialists from your organization. The auditorium at the Air Force Museum is large enough that I do not anticipate it will be necessary to limit the number of attendees.

All travel arrangements, hotel accommodations, meals and refreshments will be the responsibility of the participants; early hotel arrangements are encouraged to assure accommodations.

Please copy and circulate this announcement and registration form in your organization. The Registration Form should be returned to the address indicated not later than 11 May 1983.

G. KEITH RICHEY
US Coordinator
AGARD Fluid Dynamics Panel

4 Atch
1. General Information
2. Agenda
3. List of Speakers
4. Registration Form
GENERAL INFORMATION

SUBSONIC/TRANSONIC AERODYNAMIC INTERFERENCE FOR AIRCRAFT

16-19 May 1983

The present course is a follow-up of an AGARD Fluid Dynamics Panel Symposium on Subsonic/Transonic Configuration Aerodynamics held in Neubiberg (Munich) in May 1980. As in the symposium, the emphasis of the present course is on the configuration optimization in the transonic regime where both military and commercial aircraft must cruise efficiently and where military aircraft must maneuver in an agile but stable manner. The course material has been updated and is presented in a more structured fashion emphasizing the fluid dynamic interference mechanisms that are the keys to the optimization. In addition, some aspects of subcritical interference are also covered including those arising in the takeoff and landing phase of the flight with high lift devices deployed.

The course has been divided into three parts. The first part (Lectures 1 to 5) forms background material describing the computational and testing tools. In describing the numerical methods, complex algebraic details are omitted whenever they distract from the essential features of the methods. The first part concludes with a review of the overall design process where the compromised gross features of the aircraft are evolved, based upon its overall performance requirements, which is the starting point for the optimization.

Lectures 6 to 14 cover the wide range of interference phenomena arising in the optimization of both military and commercial aircraft starting from the simple airfoil and wing and extending to the complete configuration. Lectures here are intentionally duplicative so that alternative approaches toward a given design goal can be covered.

The third part on the last day will cover advanced innovative interference concepts in aircraft design. Such subjects as powered lift, aeroelastic tailoring, control configured configurations, swept forward wings, variable geometry and novel weapons carriage will be among the topics to be discussed.

The course is designed to be of interest, not only to practising aerodynamicists, but equally to theoretical fluid dynamicists and to university lecturers.
AGENDA

Monday 16 May 1983

0845 Registration
0915 Welcoming address
0930 Introduction
    Dr. H. Yoshihara, The Boeing Company, Washington, USA
1030 Review: Inviscid computational methods.
    Dr. A. Jameson, Princeton University, USA
1230 LUNCH
1330 Computational methods for subsonic and transonic aerodynamic design.
    Mr. J. Slooff, NLR, Amsterdam, Netherlands
1530 Review: viscous interactions
    Dr. H. Yoshihara
1700 Question period.

Tuesday 17 May 1983

0900 Transonic airfoil development.
    Dr. R. Whitcomb, Consultant, USA
1030 Aerodynamic design for overall vehicle performance.
    Mr. I. Rettie, The Boeing Company, Washington, USA
1230 LUNCH
1330 Application of computational procedures in aerodynamic design.
    Mr. J. Slooff
1530 Transonic empirical configuration design process.
    Dr. R. Whitcomb
1700 Question period.

Wednesday 18 May 1983

0900 Transonic multi-component interference. An overview.
    Mr. A.B. Haines, Aircraft Research Association, Bedford, UK
1100 Transonic configuration design (airlift).
    Dipl.-Ing. G. Krenz, VFWGmbH, Bremen, Germany
1230 LUNCH
1330 Transonic configuration design (fighter)
    Mr. D.E. Shaw, British Aerospace Company, Preston, UK
1530 External stores interference.
    Mr. A.B. Haines

Thursday 19 May 1983

0900 Interface problems in aircraft design. An overview.
    Mr. I. Rettie
1000 Engine/airframe interference (Airlift).
    Dipl.-Ing. G. Krenz
1130 Engine/airframe interference (Fighter).
    Mr. D.E. Shaw
1230 LUNCH
1400 Innovative design concepts and the future.
    Mr. P. Poisson-Quinton, ONERA, France.
1530 Innovative design concepts and the future: panel discussion.
    Mr. A.B. Haines, Dipl.-Ing. G. Krenz, Mr. I. Retti, Mr. D.E. Shaw,
    Mr R. Whitcomb, Dr. G.K. Richey (includes audience question session).
1645 Closing remarks.
LECTURERS:

Mr. A. B. Haines
Chief Executive
Aircraft Research Association
Bedford, U.K.

Dipl. Eng. G. Krenz
Chief of Aerodynamics
Transport Division
Messerschmitt-Bolkow-Blohm GmbH
Bremen, Germany

Dr. A. Jameson
Professor
Princeton University
Princeton, U.S.A.

Mr. P. Poisson-Quinton
Director, International Cooperation
ONERA
Chatillon, France

Mr. I. H. Rettie
Chief, Aerodynamics Research and Development
Boeing Commercial Airplane Company
Seattle, U.S.A.

Mr. D. E. Shaw
Assistant Chief, Aerodynamics Department
British Aerospace Company
Preston, U.K.

Mr. J. Slooff
Chief, Theoretical Fluid Dynamics
NLR
Amsterdam, Netherlands

Dr. R. Whitcomb
Consultant (Formerly Chief Eight Foot Transonic Wind Tunnel, NASA/Langley Research Center)
Hampton, U.S.A.

Dr. H. Yoshihara
Engineering Manager
Boeing Military Airplane Company
Seattle, U.S.A.
REGISTRATION FORM

AGARD FLUID DYNAMICS PANEL LECTURE SERIES

Subsonic/Transonic Aerodynamic Interference for Aircraft
16-19 May 1983
Air Force Museum, Wright-Patterson AFB
Dayton, Ohio

Cost of Lecture Series: None

Course Coordinator: DR G. KEITH RICHEY (513)255-7329
Air Force Wright Aeronautical Laboratories (FS)

PLEASE ENROLL ME FOR THE AGARD LECTURE SERIES

NAME:

ORGANIZATION:

U.S. CITIZEN: YES  NO (If NO, State Country of Citizenship)

ADDRESS:

PHONE NUMBER:

RETURN THIS FORM TO THE FOLLOWING ADDRESS BY 11 MAY 1983:

AGARD LECTURE SERIES
ATTENTION: MRS. GUYTON
AFWAL/FS
WRIGHT-PATTERSON AFB OH 45433
SUBJECT: REQUEST FOR AUTHORIZATION TO USE THE SERVICES OF U.S. CONSULTANTS IN THE 1983 VKI LECTURE SERIES PROGRAMME

Dear Dr Flax

I am writing to you concerning the participation of:

1. Dr MUNGUR in VKI Lecture Series No. 5

2. Professor A JAMESON
   57 Hemlock Circle
   Princeton, New Jersey 08540
   - Mr. I RETTIE
     Boeing Company, M/S 79-93
     P.O. Box 3707
     Seattle, Washington 98124

   - Dr R WHITCOMB
     46 Lakeshore Drive, Apt. 1B
     Hampton, Virginia 23666

   - Dr YOSHIHARA
     Boeing Company, M/S 3N-19
     P.O. Box 3707
     Seattle, Washington 98124

in the FDP Special Course on "Subsonic/Transonic Interference" to be given at the VKI, in Brussels 2-6 May 1983, and as a Short Course at Wright-Patterson Air Force Base, 16-20 May 1983.
MEMO FOR: Dr. Whitcomb

Your participation in UKI Lecture Series #7 has been approved by the U.S. National Delegation. Attached is a copy of the approval for your records.

#7 AGARD has been notified.

Hope you have a good trip!

George C. Radic, Major, USAF
US National Coordinator for AGARD
MEMORANDUM FOR DR. FLAX

SUBJECT: Approval of AGARD Consultant Mission (US Citizens) - ACTION MEMORANDUM

AGARD requests the services of US civilians under the Consultant and Exchange Program (Atch 1).

I have attached the standard Availability Form, Biography, and Summary of Lectures for

Atch 2: Richard T. Whitcomb
NASA Langley Research Center
Mail Stop 359
Hampton, Virginia 23665

RECOMMENDATION

That this mission request be approved.

APPROVE: 

DISAPPROVE:

COMMENT:
Dr. Whitcomb is a retired NASA Langley employee, being funded through the AGARD Consultant and Exchange Program for this activity. Although his participation was processed as a non-Government consultant, his papers are based on work performed while at Langley. It was agreed, therefore, that the papers would be cleared by NASA rather than through the Air Force.

Papers appear suitable for presentation at AGARD meeting.

Peggy P. Christian
LD-2/Peggy P. Christian
Date, Feb. 4, 1983
REPt.V TO
DEPARTMENT
OF
THE
AIR FORCE
HEADQUARTERS
UNITED STATES AIR FORCE
WASHINGTON, D.C. 20330
15 NOV 1982

To: Dr. R. Whitcomb
46 Lakeshore Drive
Apt 1B
Hampton, Virginia 23666

1. I have received unofficial notification that you will participate in the subject program. Since VKI is funded by NATO, your participation must be approved by the US authorities. I am writing to inform you of the required US approval process so that you can plan ahead and last minute panics can be avoided.

2. Once I receive the official NATO request for your services, I will ask you to provide a biography, summary of your presentation (approximately 500 words), an Availability Form and Disclosure Certificate (which you will be sent to complete) and copies of your presentation. The copies of your presentation will not have to be in final format but must be legible.

3. Since your participation is sponsored by the US Government, any technical information you wish to disclose (oral, visual or documentary) must be cleared by the USAF. If you plan to use material previously cleared or the material has been clearly published in the public domain, only one copy (with references included) and proof of clearance (if appropriate) will be necessary. If the material you wish to present is newly authored or any portion of the work supporting the material is sponsored by the US Government, you will need to provide eight copies.

4. Please note that it can take up to 45 days to obtain approval of the US Representatives to VKI and to clear your presentation material (there is no way to expedite the process). Also, NATO will not issue you a contract or a travel advance until they are notified from this office that the necessary approval and clearances have been obtained. Therefore, it will be incumbent on you to assure we receive your inputs in a timely fashion. I might suggest, if possible, you start preparing some of the needed material now in anticipation of the official request for your services.

5. If you have any questions or need assistance, please call me or my assistant, Margaret Enterkin, at 202-695-5293. We are here to assure your trip to VKI in Brussels, Belgium, is successful and will be glad to hear from you.

GEORGE C. RADIC, MAJOR, USAF
US National Coordinator for
AGARD
To: Lecturers for VKI/AGARD Short Course on
"Subsonic/Transonic Aerodynamic Interference
for Aircraft" 2-6 May, 1982

The official VKI program has just been printed and
I take pleasure in enclosing two copies for your use.

I wish to remind you that the deadline date for
the submission of your manuscript is 15 February 1983.
Send it to AGARD, attention R.H. ROLLINS II.

Instructions for the preparation of your manuscript
were sent to you by AGARD some time ago.

Merry Christmas and Happy New Year; see you in May at
the VKI!

Sincerely,

John F. WENDT
Professor

cc: R.H. ROLLINS II
G.K. RICHEY

Enclosures: 2
NAME OF CONSULTANT: Richard T. Whitcomb  
NATIONALITY: U.S.A.  
DATE AND PLACE OF BIRTH: Feb. 21, 1921, Evanston, IL  
BUSINESS: TITLE: Distinguished Research Associate  
AFFILIATION: NASA Langley Research Center  
ADDRESS: NASA - Langley Research Center  
Mail Stop 359  
Hampton, VA 23665  
TELEPHONE: (804) 865-2631  
TELEX: 823-405  
PERSONAL ADDRESS:  
46 Lakeshore Drive, Apt. 1B  
Hampton, VA 23666  
TELEPHONE: (804) 838-0077  
TYPE OF MISSION:  
<table>
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<th>Check one</th>
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<tr>
<td>INDIVIDUAL CONSULTANT MISSION</td>
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<td>SHORT COURSE</td>
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<td>SPECIAL COURSE</td>
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PERIOD OF AVAILABILITY: May 1 - May 6, 1983  
MISSION OBJECTIVE(S): Present two lectures in special course entitled  
"Subsonic/Transonic Aerodynamic Interference for Aircraft"  
LOCATION(S): von Karman Institute for Fluid Dynamics,  
1640 Rhode-Saint Genese, Belgium  
DATE: January 20, 1983  
SIGNATURE: Richard T. Whitcomb  
TO OBTAIN THE REQUIRED U.S. "MISSION" APPROVAL:  
Please complete this form and send it WITH  
a) Biography, and  
b) Summary (about 500 word) of proposed discussions  
TO: HQ USAF/RD-I, AGARD Coordinator, Washington, DC 20330  
(Tel. 202-695-5293)
All AGARD contributors must obtain any necessary clearances before submitting their contributions to AGARD; these clearances may relate to security, proprietary or industrial rights and/or copyright, and are required for contributions to all AGARD meetings or publications.

National requirements for clearance may vary, and it is the responsibility of contributors to comply with relevant national regulations, and to ensure that this form is, if necessary, signed by an appropriate national authority. As a service to authors, certain national rules and the addresses of certain national authorities, as known to AGARD, are given overleaf.

**PROPRIETARY/COPYRIGHT CLEARANCE**

It is hereby certified that (insert title of presentation/manuscript) "TRANSONIC AIRFOIL DEVELOPMENT AND "TRANSONIC EMPIRICAL CONFIGURATION DESIGN PROCESS" by (insert names of all authors) RICHARD T. WHITCOMB

is approved for [presentation at an AGARD meeting and for] publication by AGARD as UNCLASSIFIED/NATO RESTRICTED/NATO CONFIDENTIAL/NATO SECRET*, and that there are no proprietary or copyright objections to such presentation and/or publication.

Date \[FEB. 3, 1983\] Signature: R.T. WHITCOMB (SENIOR) AUTHOR

**SECURITY CLEARANCE**

This space must be EITHER signed and/or stamped by the appropriate national authority OR, if clearance by a national authority is not required, deleted and initialled by the (senior) author.

The above contribution is released for [presentation and for] publication by AGARD as UNCLASSIFIED/NATO RESTRICTED/NATO CONFIDENTIAL/NATO SECRET*

Signature: Peggy P. Christian Stamp: UK & US PLEASE SEE OVER

Date \[FEB. 4, 1983\]

Name: Peggy P. Christian NASA Coordinator for AGARD

AGARD USE ONLY

Panel/Activity Pub Reference
REQUEST FOR SERVICES FROM NATO ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT (AGARD)

To,

Dr. R. Whitcomb
46 Lakeshore Drive
Apt 1B
Hampton, Virginia 23666

1. AGARD requests your services (Atch 1) for one of the "Consultant and Exchange Program Missions" described in Atch 2. If you are not available, please let me know immediately.

2. If you are available, please complete the "Availability Form" (Atch 3), attach your biography and an unclassified summary of your proposed presentations (approximately 500 words) and return them to me immediately. I will then obtain the required AGARD US National Delegate approval for your "mission." If you are not a US citizen, I will request approval from your country through AGARD.

3. Because your "mission" is sponsored by the Air Force, any technical information you wish to disclose (oral, visual or documentary) must be cleared by the US Government prior to your participation (see Note 2 on Atch 2). Please complete the attached "Information Disclosure Certificate for AGARD" (Atch 4) and return it to me, along with eight copies, of your proposed verbage, lecture notes, handouts or manuscripts, as soon as possible. If the material has been cleared before or is clearly in the public domain, you need provide only one copy with a listing of references. Since we have received this request extremely late, the normal lead times described in Atch 2 do not apply.

4. It is imperative that I receive the information discussed in the preceding paragraphs no later than 45 days prior to your "mission". Time is required to obtain US National Delegate approval and to clear both your summary and presentation material for public release. Recognizing that time is very short, we will do everything we possibly can to obtain the necessary approvals and clearances. However, AGARD will not issue you a final contract or travel orders until approval and necessary clearances have been obtained; so, we need your cooperation in submitting the requested information to us as soon as possible. Failure to submit items as required could result in your "mission" not being approved.

5. If you have any questions or need assistance, please call me or my assistant, Margaret Enterkin, at 202-695-5293. We are here to insure your "mission" is successful and will be glad to hear from you.

George C. Radic
GEORGE C. RADIC, Major, USAF
US National Coordinator for AGARD

4 Atch
1. AGARD Request
2. Mission Descriptions
3. Availability Form
4. Info Disclosure Certificate
NAME OF CONSULTANT: Richard T. Whitcomb

DATE AND PLACE OF BIRTH: Feb. 21, 1921, Evanston, IL

BUSINESS: TITLE: Distinguished Research Associate

AFFILIATION: NASA Langley Research Center

ADDRESS: NASA - Langley Research Center
Mail Stop 359, Hampton, VA 23665

PERSONAL: ADDRESS: 46 Lakeshore Drive, Apt. 1B, Hampton, VA 23666

TYPE OF MISSION: INDIVIDUAL CONSULTANT MISSION

PERIOD OF AVAILABILITY: May 1 - May 6, 1983

MISSION OBJECTIVE(S): Present two lectures in special course entitled "Subsonic/Transonic Aerodynamic Interference for Aircraft"

LOCATION(S) (If identified): von Karman Institute for Fluid Dynamics,
1640 Rhode-Saint Genese, Belgium

DATE: January 20, 1983

SIGNATURE: Richard T. Whitcomb

TO OBTAIN THE REQUIRED U.S. "MISSION" APPROVAL:
Please complete this form and send it WITH
a) Biography, and
b) Summary (about 500 word) of proposed discussions

TO: HQ USAF/RD-I, AGARD Coordinator, Washington, DC 20330
(Tel. 202-695-5293)
### DESCRIPTION OF AGARD MISSIONS FOR POTENTIAL U.S. CONSULTANTS

(AGARD Consultant & Exchange Program)

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<td><strong>DESCRIPTION</strong></td>
<td>Presentation of lectures</td>
<td>Presentation of lectures by a team of up to 7 speakers.</td>
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<td><strong>PUBLICATION</strong></td>
<td>No AGARD publication.</td>
<td>AGARD publication issued prior to presentations and distributed within NATO nations. Speakers must provide AGARD a cleared manuscript four months in advance.</td>
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REPLY TO
ATTN OF:

SUBJECT: Request for Services from NATO Advisory Group for Aerospace Research and Development (AGARD)

To: Dr. R. Whitcomb
46 Lakeshore Drive
Apt 1B
Hampton, Virginia 23666

1. AGARD requests your services (Atch 1) for one of the "Consultant and Exchange Program Missions" described in Atch 2. If you are not available, please let me know immediately.

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George C. Radic, Major, USAF
US National Coordinator for
AGARD

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2. Mission Descriptions
3. Availability Form
4. Info Disclosure Certificate
AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT
NORTH ATLANTIC TREATY ORGANIZATION

AVAILABILITY FORM FOR POTENTIAL U.S. CONSULTANTS TO AGARD

NAME OF CONSULTANT ........ Richard T. Whitcomb ........ NATIONALITY U.S.A.

DATE AND PLACE OF BIRTH ....... Feb. 21, 1921, Evanston, IL

BUSINESS TITLE ........ Distinguished Research Associate

AFFILIATION .......... NASA Langley Research Center

ADDRESS .......... NASA - Langley Research Center

Mail Stop 359
Hampton, VA 23665

TELEPHONE (804) 865-2631
TELEX 823-405

PERSONAL ADDRESS .......... 46 Lakeshore Drive, Apt. 1B
Hampton, VA 23666

TELEPHONE (804) 838-0077

TYPE OF MISSION (Check one) INDIVIDUAL CONSULTANT MISSION
SHORT COURSE LECTURE SERIES (q: 7)
SPECIAL COURSE OTHER (Specify)

PERIOD OF AVAILABILITY ........ May 1 - May 6, 1983

MISSION OBJECTIVE(S) .......... Present two lectures in special course entitled
"Subsonic/Transonic Aerodynamic Interference for Aircraft"

LOCATION(S) (If identified) .......... von Karman Institute for Fluid Dynamics,
1640 Rhode-Saint Genese, Belgium

DATE ........ January 20, 1983

SIGNATURE ........ Richard T. Whitcomb

TO OBTAIN THE REQUIRED U.S. "MISSION" APPROVAL:
Please complete this form and send it WITH
a) Biography, and
b) Summary (about 500 words) of proposed discussions

TO: HQ USAF/RD-I, AGARD Coordinator, Washington, DC 20330
(Tel. 202-695-5293)
SUBSONIC/TRANSonic AERODYNAMIC INTERFERENCE FOR AIRCRAFT

Monday 2 May 1983

0900 Registration and Welcoming Address
0930 Introduction
   H. Yoshihara, Boeing Company
1000 Coffee Break
1030 Review: Inviscid Computational Methods
   A. Jameson, Princeton University
1200 Lunch
1330 Subsonic/Transonic Inverse (Design) Methods
   J. Slooff, NLR
1500 Coffee Break
1530 Review: Viscous Interactions
   H. Yoshihara, Boeing Company

Tuesday 3 May

0900 Transonic Airfoil Development
   R. Whitcomb, Consultant USA
1000 Coffee Break
1030 Overall Aerodynamic Design Considerations
   I. Rettie, Boeing Company
1200 Lunch
1330 Subcritical Methods and Wing Design Process
   J. Slooff, NLR
1500 Coffee Break
1530 Transonic Wing/Fuselage: Empirical Design Process
   R. Whitcomb, Consultant USA
Wednesday 4 May

0900   Transonic Multi-component Interference
        A. B. Haines, ARA
1000   Coffee Break
1030   Transonic Configuration Design (Airlift)
        G. Krenz, VFW
1200   Lunch

Thursday 5 May

0900   Transonic Configuration Design (Fighter)
        D. E. Shaw, British Aerospace Company
1000   Coffee Break
1030   External Stores Interference
        A. B. Haines, ARA
1200   Lunch
1330   Interference Problems in Aircraft Design
        I. Rettie, Boeing Company
1430   Engine/Airframe Interference (Airlift)
        G. Krenz, VFW
1530   Coffee Break
1600   Engine/Airframe Interference (Fighter)
        D. E. Shaw, British Aerospace Company

Friday 6 May

0900   Innovative Design Concepts and the Future
        P. Poisson-Quinton, ONERA
1000   Innovative Design Concepts and the Future: Panel Discussion
        A. B. Haines, G. Krenz, I. Rettie, D. E. Shaw, and R. Whitcomb
1100   Coffee Break
1130   Final Discussions
1230   Lunch
Dick Whitcomb's desk is one of those tired-looking battleship gray affairs about six feet long, four feet deep and completely lined around three sides with stacks of paper, documents and books, leaving him with a three-by-three-foot space in the middle for calculations and ready reference. It is the desk of a man whose principal work is done in the mind or on a nearby scrap of paper; whose idea of the moment can be quickly examined by comparing it with the latest data on air flow or by adjourning to the wind tunnel down the hall.

Dr. Richard Travis Whitcomb is, at 59, a legendary NASA aerodynamicist. Under glass on a low table behind his desk sit three of the most coveted awards in his profession: the Collier Trophy, awarded to him in 1955 for the Area Rule, an ideal which revolutionized supersonic flight; the National Medal of Science, presented to him by President Nixon in 1973 for various aeronautical discoveries and inventions; and the Wright Brothers Memorial Trophy, a glittering silver model of the Wright Flyer mounted atop a piece of quarts, which was also given to him for significant public service to aviation.

The owner of the trophies and the comfortable desk is a man who looks as distinguished—even when relaxed—as the citations make him out to be. To look him in the face is to greet the powerful effect that his immense, riveting blue eyes, snow white hair and sharply-honed intellect have on the uninitiated. He is flight theory personified, a textbook reference in the flesh, a man whose stately appearance and engaging, friendly manner overwhelms the externals of a small burn hole on his shirt, an open collar, the trouser wrinkles of a lifelong bachelor, and the manner of a man much more concerned with transonic air flow than with washing the car.

He retired from Langley on February 29, but will continue to use his functional deck-cum-library for another three months as a special consultant. It is not the same desk at which he sat with his feet propped up in December 1951 and had a flash of inspiration which resulted in the Area Rule. He and his co-workers in the Transonic Aerodynamics Branch don't even use the same eight-foot wind tunnel anymore: the original slotted-throat tunnel, the first of its kind anywhere and the one for which a team of Langley researchers (Dick Whitcomb among them) won the 1951 Collier Trophy has been replaced by an improved tunnel. It too operates at transonic (across the speed of sound) speeds in an eight-foot-wide test section, and is commonly called "Whitcomb's Tunnel."

This location and continuity of his research remain unchanged. He has never worked professionally anywhere else except on the shore of the Back River in Hampton, Virginia, surrounded by other landmark wind tunnels from the days of
NASA's progenitor, the National Advisory Committee for Aeronautics, within easy hearing distance of supersonic fighters, which he made practical, as they wheel above Langley Air Force Base right next door.

A 1943 Fortune Magazine article convinced Whitomb to apply for a job at what was then the Langley Memorial Aeronautical Laboratory. "This was the place to come for applied research," he said. Since then he has spun a brilliant career about the heights of three landmark ideas, all of which worked, all of which were tinkered with in the same sister tunnels, all of which were radical departures from conventional aerodynamic theory and all of which couldn't have come at a better time.

The first of his coups was the Area Rule, which came to him, "like a flash of light," at a time when the Air Force was trying, without great success, to achieve practical supersonic flight in the early 1950's. The only Mach (speed-of-sound) flight had been with rockets, which are not practical for airplanes.

"The X-1 had flown by that time," Whitomb said, "but that was with sheer brute force. That phrase--"the sonic barrier"--kept coming up, and we were thinking, "What are they talking about? Bullets go through the speed of sound all the time."

By mid-1951, Whitomb and others had been making fundamental studies of that problem for six months. The first tunnel capable of transonic speeds, the first of the two eight-foots, was keeping John Staeck and other Langley scientists busy churning out data no one had ever seen before. They had already found, to their puzzlement, that the sum of each component's drag (wings, fuselage, etc.) was less than what they were experiencing in the tunnel with an entire model. Models expected to fly supersonic in the tunnel wouldn't.

Then, in November and December of 1951, Whitomb was inspired by the premier aerodynamicist of the time, Adolf Busemann, who had designed the swept-back wing in 1935. At a Langley staff symposium in November, Busemann stood up to discuss his thoughts on the basic nature of transonic air flow. Whitomb had also been approaching the problem from a fundamental viewpoint, and was instantly caught up in Busemann's remarks.

"I was very impressed," he said. "Busemann had some very keen insights, and it was one of his intuitive thoughts, based on aerodynamic theory, that really got me going." Theory held that air flow around a wing involves an exact inverse proportion, in which the density of the air changes exactly as the rate of speed."

"This meant," Whitomb said, stage-whispering for effect, "that at Mach one, the mass, which is speed times density, cannot be increased. As Busemann said, it is 'a pipe-fitter's flow,' where the air passing over the wing and around the fuselage at near Mach one speeds cannot be compressed anymore, and as a result the effect of the airplane on air flow rapidly increases at the threshold of Mach one. This is the primary reason for large drag increases (the 'sonic barrier') at sonic speeds."
Back at his office, Whitcomb referred to shock wave pictures from the tunnel and grew even more agitated. "They were giving me fits," he said. "None of them looked as they should."

"And so I sat there at my desk, feet propped up, and suddenly it dawned on me, the basic idea of the Area Rule." The basic idea was as simple as giving the air someplace to go so it wouldn't push back on the wing. It was as simple as putting wings on a Coke bottle.

"I had a Coke bottle shape that day," he recalled. "Then, the next day, I arrived at a rule of thumb, a sort of basic principle: Transonic drag is a function of the longitudinal development of the cross-section area of the entire plane."

When the next symposium came, Whitcomb got up in the same forum from which he had gotten his inspiration and talked about his idea for 20 minutes. When he finished, there was only one person with the stature to address such monumental findings. Busemann rose and said, "Some people come up with half-baked ideas and call them theories. Whitcomb comes up with a brilliant idea and calls it a rule of thumb."

He was in. The name Area Rule, for cross-sectional area and rule of thumb, was applied at that meeting. "Now I had to go prove it," Whitcomb said.

He built a basic model, now in the Smithsonian Institution, on which he could modify fuselage shapes. One version, with an indentation in the fuselage equal in area drag to that of the wing, completely eliminated shock wave drag on the wing.

Whitcomb's experiments, highly classified at the time, made it possible for the United States to produce the first fleet of supersonic fighters. An F-102 which would not break the sound barrier before modification later went through Mach 1 while still climbing. "It was a classic before and after," he said.

In the interim between the Area Rule and his next major discovery, the supercritical wing, Whitcomb devoted himself to helping design a practical commercial supersonic aircraft: an SST. In the late 1950's Whitcomb and many other aeronautical experts attempted to devise a supersonic transport that would be efficient and competitive. In late 1963, NASA gave the major aircraft manufacturers contracts to analyse the various designs.

"Even though we had worked for years to reduce the drag, there was still lots of it," Whitcomb said. "The planes would need very powerful engines, and the companies said they would be too costly. This was a real disappointment. I didn't consider it progress when we came up with an airplane with that kind of cost. I felt as it I had wasted my time. So I got out of that area."

As became his pattern, Whitcomb marched right back to the basics and started over. With the Area Rule he had improved the ability of a supersonic aircraft to slice through the wall of air before it. With his next project, the supercritical wing, he would reduce the drag of aircraft operating at high subsonic speed by
reducing air friction and turbulence across an aircraft's major aerodynamic surface.

In 1964, when he began to contemplate the wing, his design was light years away from the familiar curves that had characterized airfoils since the 1930's. They had been more rounded on the top than bottom, a shape which caused lift. Yet Whitcomb was finding, in the course of three years of patient shaping with a file and precious weeks of wind tunnel time, that the flatter the wing got on the top, the nearer he came to a smoother flow.

He disdained the usual research system, which he described as "going through the chain of drawings, shops and all that sort of thing," and usually ended up filing the wind tunnel models himself. He did all of his own basic calculations, and with the time-tested trial-and-error method and the help of a team of researchers arrived in 1967 at the final overall airfoil shape.

When Langley was preparing to mount a supercritical wing on an F-8 jet, Whitcomb brought a cot to the tunnel during last-minute tests and lived there around the clock.

"When I've got an idea, I'm up in the tunnel," he said. "The eight-foot runs on two shifts, so you have to stay with the job sixteen hours a day. I didn't want to drive back and forth just to sleep, so I ended up bringing a cot out here."

When Whitcomb was leaving for the Dryden Flight Research Center in 1970 to see the supercritical wing fly, his team of engineers and technician gave him a four-foot wooden file, with advisements that it was just the thing for such a large model. Neil Armstrong, meeting Whitcomb in 1974, smiled and said, "Oh, the master filer."

From there it was on to winglets, elegant, upward curving wingtips which save about five percent of an airplane's fuel costs by reducing drag. Whitcomb says the oil embargo of 1973-74 was his inspiration for that design.

Now he is putting the finishing touches on two project which have kept him busy since 1975: improvements in wing and nacelle (engine housing) interference and the utilization of his supercritical wing as a natural way to induce laminar, or smooth, air flow for increased efficiency. When those projects are completed, so will be Richard Whitcomb's illustrious career.

But in retirement, Whitcomb does not intend to sit in a chair and rock. For some time now he has been teaching himself solid state physics, and converting the extra bedroom in his apartment into a laboratory and workshop. He won't say what he is working on in his spare time, other than to hint that it is energy-related and keeps him up late at night. But if he ever says it will work, his colleagues over the years will undoubtedly recommend belief.

His is an unbroken string of technical triumphs. He says it best himself: "I always wanted to have an impact. I did that."
15 June 1982

Dr. Richard Whitcomb
46 Lakeshore Drive Apt. 1B
Hampton, Virginia 23666

Dear Dick:

This is to confirm the telephone invitation for your participation in the AGARD/VKI Lecture Course on "Subsonic/Transonic Aerodynamic Interference for Aircraft" to be held in Brussels 2-6 May 1983 and in Dayton 16-20 May 1983. A lecture schedule is enclosed.

A contract covering your travel and per diem expenses will be sent to you at a later date. Also, Bob Rollins, AGARD Fluid Dynamics Panel Executive, whom you met in Neubiberg, will forward instructions to prepare the written version of your lectures. U.S. clearance procedures will probably require at least a preliminary version to be completed by approximately November 1982.

Thank you again for your participation which will be an important part of the Lecture Series. Regards.

Sincerely,

THE BOEING COMPANY

H. Yoshihara
Orgn. L-7120, M/S 3N-19
Telephone: (206) 773-6434

enc.
**REPORT OF FOREIGN TRAVEL**  
(To be submitted within 10 days after foreign travel is completed.)

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<th>PREPARED BY:</th>
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<td>Division Chief (Type Name)</td>
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**INSTRUCTIONS:** The following information should be included in the report:

1. Name of traveler
2. Names of countries and organizations visited and dates
3. Classification of visit
4. Brief report of visit, including key discussions, new technological areas discussed, and commitments
5. Name(s) and title(s) of individual(s) contacted
6. Documents given to contact(s)
7. Documents received from contact(s)
8. Action taken or contemplated to brief Langley or other NASA personnel on information derived from this trip
9. Additional codes (in NASA Hq block below) that should receive report

---

1. Dr. Richard T. Whitcomb
3. All meetings and visits were unclassified.
4. At the AGARD symposium gave several comments at the end of the formal presentations. No commitments were made. At ONERA had lengthy discussions on current state-of-the-art in transonic configuration aerodynamics with various members of the ONERA staff. No commitments were made.
5. At ONERA principal contact was Phillip Poisson Quinton.
6. No documents given.
7. Preprints of papers given at AGARD symposium were obtained.
8. None.
May 25, 1978

Dr. Richard T. Whitcomb
Head, Transonic Aerodynamics Branch
Langley Research Center
National Aeronautics and Space Administration
Langley Station
Hampton, Virginia 23665

Dear Dick:

It was a pleasure having you speak before the Smithsonian as the first Grierson Memorial lecturer. Your presentation was especially appropriate and thought-provoking. It was evident that your audience found the broad sweep of aerodynamics history that you covered particularly stimulating.

You skillfully took seemingly unrelated topics in the history of aerodynamics and blended them into a unified theme that not only showed the progress that has been made to date through such principles as the area rule and supercritical wing, but pointed to the future directions we can expect research to take. We are very grateful for this exciting glimpse into advanced technology that you furnished us. Thank you very much.

Sincerely,

M. B. Zisfein
Acting Director
Dear Dick:

I was very pleased when Mel Zisfein told me that you had agreed to give the first John Grierson Memorial Lecture. The subject "Towards More Efficient Aircraft" is most fitting since you have contributed so much to that goal. We expect the audience to range in sophistication from practicing professionals to interested laymen.

As you know, the lecture is scheduled for 8:00 p.m. on May 18 in the National Air and Space Museum Theater. Prior to the lecture, I will be pleased to host a small informal dinner with members of the staff at 6:30 p.m. We will, of course, reimburse you for all expenses, and there is an honorarium of $500.

If we can help you in any way with travel or hotel arrangements, please let me know. I look forward to seeing you again.

With best wishes,

Sincerely,

Michael Collins
Director

Dr. Richard T. Whitcomb
Head, Transonic Aerodynamics Branch
Langley Research Center
Langley Station
Hampton, Virginia 23665

NASA-LANGLEY MAR 27 1978
**NAME AND TITLE OF TRAVELER:** Dr. Richard T. Whitcomb  
**INSTALLATION OR OFFICE:** NASA–Langley Research Center

**PROPOSED TRAVEL:**

- **August 24–30:** Ninth Congress of the International Council of the Aeronautical Sciences (ICAS) Technion, Israel Institute of Technology, Haifa, Israel. Present paper entitled "Review of NASA Supercritical Airfoils".
- **Aug. 31 – Sept. 2:** Annual leave to visit Athens, Greece.

**RECOMMENDATION**

- **APPROVAL**
- **DISAPPROVED**
- **SEE ATTACHED REMARKS**
- **YES**
- **NOT REQUIRED**

**SIGNATURE AND TITLE**

**OFFICE OF INTERNATIONAL AFFAIRS**

- **APPROVAL**
- **DISAPPROVAL**
- **SEE ATTACHED REMARKS**
- **ATTACHED**
- **NOT ATTACHED**
- **NOT REQUIRED**

**ASSOCIATE DEPUTY ADMINISTRATOR**

- **APPROVED**
- **DISAPPROVED**

**DATE**
10 April 1958

Dr. Richard T. Whitcomb,
NACA Langley Aeronautical Laboratory,
Langley AFB
Hampton, Virginia,
U.S.A.

Dear Dick,

First I would like to thank you for the day you devoted to our Aachen trip during your recent stay in Brussels. Visits of this nature are of great assistance to us in our endeavors to establish good European scientific relations and in our efforts to obtain good research through these relationships.

As a result of our talks with Professor Klaus Oswatitsch of DVL, we have received his proposal to investigate shock diffusers for improving the efficiency of high supersonic and hypersonic wind tunnels. This proposal has been forwarded to Headquarters, Office of Scientific Research (ARDC), copy of letter enclosed, and is presently under evaluation by that office.

The proposal by Professor Oswatitsch covers investigations in the area of Mach 2.5 to Mach 3.0, but as we discussed, it appears the results of these investigations will be applicable to higher Mach Numbers of primary interest to the Air Force.

In the event you may be in the Washington Area and have any comments concerning Professor Oswatitsch's proposed work and its application to higher Mach Numbers, I am sure they would be highly appreciated by ARDC. If such an occasion arises, it is recommended that you contact Mr. Milton Rogers, Mechanics Division, Directorate of Aeronautical Sciences, Hq's., ARDC.

I have enclosed a number of reports by Professor Oswatitsch and Dr. Keune, which were donated for your interest.

Thank you again, Dick, for your most helpful assistance in this matter.

Sincerely,

Robert E. Lucas

Robert E. Lucas
Major, USAF
Chief, Aeronautics and Propulsion Division
SUN 23 FEB 58

Dear Dick

All tours differ and each one has its high spot (its low too! 😞) and for me, the high of the Brussels trip was our times together. I do hope we may meet again and discuss some more the big middle. Should one say "rædelse"?
I think you might enjoy my home, wife and kids. They would enjoy you Bay side if a pleasant place - we always have a guest room. Come and visit.

Enclosed copies of my memoranda may interest you. I've heard not any one peep from any one.

How are you, scholar? Did you ever get back to the woods? Those beautiful woods! Strange too.

You n' Paul
Dear Dick,

I suppose you have returned to the States by the time and I hope that you had a pleasant journey after leaving here. I just missed you in Paris the week after you left.

Needless to say that your lectures both to the students and at the conference were greatly appreciated by the staff and me. I wish to thank you for the time and effort you spent for the preparation of the lectures which I know must have been considerable. We are still getting comments about the conference and everyone has mentioned how very much they liked your lectures. You may be interested to know that last week "Aeroplane" had a two-page article on the lectures.

The family enjoyed very much having you with us and I hope that in the near future you will be able to visit us again.

With kindest personal regards,

Sincerely yours,

Paul

R.P. Harrington
Technical Director.