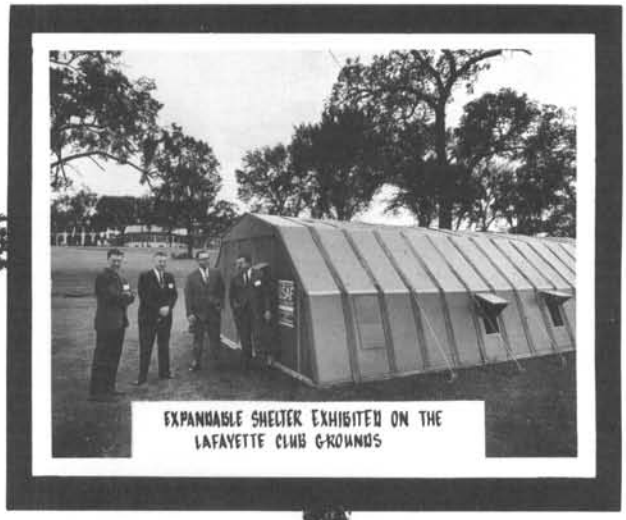
2nd AEROSPACE EXPANDABLE STRUCTURES CONFERENCE

GEN. BLEDMAIER, SPEAKING; LEFT TO RIGHT, F. FORCES, AFAPL, CONF. CHAIRMAN, DR. W.E. THOMPSON, VICE PRES-DIR. OF RSCH, ADM, GEN. KARL KOLVAAG; J.H. DANIELS, ADM. RRFS; & COL. R.T. HEMSLEY, DIR. AFAPL



EXPANDABLE SHELTER EXHIBITED ON THE LAFAYETTE CLUB GROUNDS

DISPLAY FROM FABRIC RESEARCH LABORATORIES, INC. DEDHAM, MASSACHUSETTS

CONFERENCE IN SESSION IN THE MAIN BALLROOM OF LAFAYETTE CLUB

NOON LUNCHEON DURING AEROSPACE CONFERENCE

SECOND
AEROSPACE EXPANDABLE STRUCTURES CONFERENCE

25, 26 and 27 May 1965

Sponsored By

AIR FORCE AERO PROPULSION LABORATORY

In Cooperation With

ARCHER DANIELS MIDLAND COMPANY

In
Minneapolis, Minnesota

FOREWORD

This conference presents technical contributions summarizing the status of current, significant research in the field of expandable structures. It is our hope that these contributions will encourage the undertaking of new research in expandable structures. This conference has been designed to provide a forum of authorities to critique current research and to propose new research and applications for expandable structures which are necessary to advance the art.

Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

RICHARD T. HEMSLEY
Colonel, USAF
Director, AF AeroPropulsion Laboratory

ABSTRACT

This report contains a presentation of technical contributions summarizing the status of current, significant research in the field of expandable structures. The report is based upon the discussions at the Second Aerospace Expandable Structures Conference held 25-27 May 1965 at the Lafayette Club, Minnetonka Beach, Minnesota. The subject matter has been arranged in six sessions in the order of presentation at the conference, followed by six papers which were not given at the conference.

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Director, Air Force Aero Propulsion Laboratory

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CONFERENCE SITE

The conference was held at the Lafayette Club located in a beautiful setting on Lafayette Bay of Lake Minnetonka, Minnetonka Beach, Minnesota.

EXHIBITS

Exhibits of interesting structures, equipment and materials pertinent to the conference are located on the porch behind the front of the conference hall and on the lawn between the club house and the lake. The exhibits are presented for your interest by:

Air Inflatable Products Corp,
Samford, Connecticut

Fabric Research Laboratories, Inc
Dedham, Massachusetts

GCA Viron Division, A Division of GCA Corp,
Minneapolis, Minnesota

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Culver City, California

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ACKNOWLEDGEMENT

Special acknowledgement is given to William E. Thompson, Vice President in charge of Research, Archer Daniels Midland; Gerald R. Ault, Conference Arrangement Chairman, ADM; and John Wickland, Conference Public Relations, ADM, for their efforts in the arrangement and running of this Second Aerospace Expandable Structure Conference. Mr. Warren R. Davidson, GCA Corporation, is also commended for his efforts in arranging the technical displays exhibited at the conference.

The front cover of this report was designed by Tom Rotroff, Department of Industrial Design, College of Design, Architecture, and Art, University of Cincinnati.

EXPANDABLE STRUCTURES FOR OUR GROWING SPACE PROFICIENCY

Brigadier General Joseph S. Bleymaier
Deputy Commander for Manned Systems
Hq, Space Systems Division (AFSC)

Good morning, ladies and gentlemen. I welcome the opportunity to participate in this second Expandable Structures Conference. Our sister organization, the Research and Technology Division, has direct responsibility for expandable structure research; but we in the Space Systems Division have uses for the results of this research. Our partnership, therefore, is a close and, I hope, a continuing one.

Some of you who are pilots, or ex-pilots, may have heard the story of the nearsighted flyer who, despite his affliction, had an excellent record. He could readily see the instruments but couldn't distinguish objects 15 to 20 feet ahead of him. He was asked how he could possibly land an airplane under those conditions.

"Oh," he explained, "I bring the plane in on instruments. Then when I know I'm getting close to the runway I just watch the co-pilot."

He was asked, of course, what possible good it did to watch the co-pilot.

"Simple," said the old expert. "When I see him flinch and cover his eyes with his arms, why I just flare out and there we are, safe and sound on the deck."

Although I don't recommend this as a flying safety technique, I would suggest to you this morning that while our outlook on space today is limited we are not turning back from our responsibilities or opportunities. If we watch each other -- if we apply the results of our research and technology in a timely, practical manner, we'll produce systems that will give us all the space proficiency we require or desire.

For example, a full-size expandable structure, for possible use in space as a solar collector, a shelter, or even a space station is being built and will be tested this fall at the Aero Propulsion Laboratory at Wright-Patterson Air Force Base.

This 25-foot long, 10-foot diameter honeycomb structure is being built here in Minneapolis by the Viron Division of the Geophysics Corporation, under an Aero Propulsion Laboratory contract. The entire structure is compressed into a small package held together at the front and rear bulkheads by explosive bolts.

A follow-on program involving an extension of this technology into a 75-foot diameter structure is already planned.

The advanced solar turbo electric concept program being conducted by the sponsor of this conference also has significance to military and NASA projects. This program is aimed at providing a 52-foot diameter expanded solar collector and associated energy conversion equipment which could provide 15 kilowatts of electrical power for future space systems.

Another potentially useful project being conducted by the Aero Propulsion Laboratory is the development of expandable crew transfer tunnels/airlocks and space "maintenance hangars."

Prototype transfer tunnels are to be developed and tested for possible application to manned systems, such as our Manned Orbiting Laboratory. The use of expandable components could, quite obviously, effect considerable savings in payload volume. As a matter of fact, there are expandable structure experiments planned for early MOL flights.

A keynote address is supposed to sound a note of challenge -- and, ladies and gentlemen, you have a challenge clearly before you. A few years ago we complained that our space ambitions were rapidly being overcome.

We have, for example, the Titan III space launch system -- capable of an assortment of orbits, a variety of trajectories, and payloads ranging from 5,000 to 25,000 pounds.

On the fourth test flight of the Titan III, May 6th, we put the upper stage -- which we call the transtage -- into three successive orbits, exactly as planned. We released the two satellites the bird was carrying, and then we carried out a fourth ignition which put the vehicle into a final 1,500 to 2,000 mile orbit.

This fourth "burn" was the first ever accomplished in space, and let me tell you how close we came to meeting the parameters. We planned a perigee of 1,502 nautical miles; we achieved 1,500 miles. We were shooting for an apogee of 2,007 miles; we got 2,015 miles. The orbital period we programmed was 156.5 minutes; the actual orbital pass time clocked out to be 156.7 minutes. The eccentricity, or deviation from the circular, was calculated to be .049. It proved to be exactly that.

In addition to hitting the mark on this bonus test, we came extremely close to putting the payloads into the intended orbits -- the experimental Lincoln Laboratory communications package into a 1,700 to 11,000 mile elliptical orbit, and the radar calibration satellite into a 1,700 mile circular orbit.

This fourth and final test of the Titan III "A" configuration (without the two large solid motors) climaxed a remarkable series -- the first flight being 95 per cent successful and second and third flights producing the most accurate orbits ever attained by U.S. space vehicles.

Next month we will launch the first Titan III-C. With 2.4 million pounds of thrust from the first-stage large solid propellant motors, we propose to put a 21,000 pound payload into space. Counting the weight of the transtage vehicle, this will amount to nearly 30,000 pounds on orbit!

We have, therefore, a pretty good launch system going for us. The real demanding challenge facing us today is for functional, meaningful, practical payloads. The use of expandable techniques and technologies affords us an opportunity to take added advantage of the greater weight-lifting capabilities now available to us by simultaneously minimizing the pre-orbit volume and weight of our payloads.

Certainly, there is an abundance of possible payloads in our space future -- payloads for both military and nonmilitary purposes. One very important one on the horizon is the one I have already mentioned -- the Manned Orbiting Laboratory.

The MOL, if approved, clearly has the potential of serving as a proving ground in space, both for men and for equipment; and as a point of sensible departure to systems supporting military missions. Once its initial "laboratory" functions are satisfied, the MOL system -- encompassing the Gemini B plus the Titan III transtage -- could translate into a true work-oriented manned orbiting vehicle. As such, this mission-designed system may well qualify as our first experimental space vehicle -- the "X-1" of space.

The outlook, therefore, is both promising and exciting.

The MOL, during its development and early uses, may serve not only as a carrier for experiments with expandable structures, but may well benefit from the expandable arts as applied to the construction and furnishings of the vehicle itself.

This is what I mean by the importance of close and continuing rapport on the part of the R&T Division and its laboratories, the Space Systems Division, and our industry associates.

Ten years ago only a few engineers were pursuing expandable structures research for aerospace applications. Today this research has "expanded" far beyond the imaginations of even its most ardent supporters. During the past two years, some $45 million has been spent in research programs.

The view ahead is for perhaps fewer programs, but programs that are more intensive and directed toward practical applications. A number of these programs promise to culminate in actual space experiments.

This, of course, is the objective of all our efforts -- to produce systems that will work, and that will work for us, in space. We have an excellent foundation for progress in the past 10 years of aerospace achievements. The Titan III provides us a new dimension of booster versatility and flexibility. The Manned Orbiting Laboratory affords us a new threshold to manned space capabilities.

There's no question about it, our space dexterity is expanding. You have helped; you can continue to help. No matter how distant or difficult our objectives, we have the skills and the resources to do the job.

And as you in this industry have so amply demonstrated, both of these attributes are expandable.

Thank you.

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