FUTURE TACTICAL BOMBER PROGRAM

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Your invitation to speak on our Tactical Bomber Program could not have been more fortunately timed. It arrived one day last spring when a group of us in the laboratories were discussing ways and means of solving some of the present and future problems facing us in radome design.

Today's answer to many of tomorrow's problems, whose sheer size and qualitative demands appear to elude human capacity seems destined to out-distance even the most starry-eyed prognostications.

So on this occasion it seems befitting that we extend our appreciation to the forward looking group of men who so wisely chose to establish so necessary a function as this annual radome symposium, allowing us to take a minute off from the hurly-burly of production and look to see what lies ahead. For like explorers, we must, at intervals climb the highest peaks to view the terrain ahead in order to spare ourselves the pain of coming up hard against unforseen problems and pitfalls.

As you may or may not know, we at the Long Beach Division of the Douglas Aircraft Company have thus far limited ourselves to the production of transport and troop carrying aircraft plus tactical bombers.

A tactical bomber may be defined as small or medium sized high speed aircraft with the capability of delivering a large pay load of destruction up to one thousand miles, at altitudes of 25 feet to 60,000 feet and return. It must carry communication, bombing, navigation, ILS, IFF, ECM (both passive and active), DF, IR, evasive maneuver, confusion repeating, rendezvous and computing equipments, plus many others almost too numerous to mention. It must have the speed of an interceptor and carry the bomb load of a B-36 in all weather; and it must be capable of being maintained and serviced in the front lines with a minimum of ground support equipment. To say the least, the tactical bomber is designed as an extremely versatile weapons system.

There are many problems ahead of us, but one of the foremost confronting Radome Designers and Engineers today is that of the extreme temperature increases on the radome, due to aerodynamic heating.

In our present program we are concerned with temperatures of 340°F at speeds of MACH 1.5 at sea level, to temperatures of 2,000°F at speeds of MACH 5.0 at 100,000 feet.

At speeds only slightly higher than MACH 3.5 (2700 MPH) it is no longer purely a problem of lacking knowledge for solutions, but we face a serious gap in our knowledge of the problems.

At higher temperatures and pressure, the air can be disassociated into separate gaseous components. At still higher figures electrons can be displaced and the air can become ionized. Some exploratory tests into this region have indicated <u>chemical</u> reactions as well as mechanical reactions.

On the urgent list to extend the bounds of our scientific knowledge are:

1. Fundamental studies of heat transfer both from gases to solids and within solids.

2. Studies of nuclear bond within solids

3. Studies of why the effects of temperature bring about the loss of structural strength.

A drastic change in the presently used radome materials and techniques is <u>eminent</u> in the immediate future to eliminate the existing design deficiencies of our future aircraft.

We have made some progress in the structural qualities of plastics, ceramics and silicons, some in fabrication techniques and others in basic radome design. However, a completely integrated solution to these many complex problems still eludes us.

It is no longer feasible to design a hemispherical radome, drill a few holes around the edges, fabricate an attach ring and mount it on the front of an aircraft. In many cases the radome is an integral part of the primary structure of the aircraft. As the speed requirements increase the radome becomes longer and smaller in diameter and angles of incidence jump from 0° to 50°, to 40° to 85°. Our structure people tell us it must be extremely thick to carry the loads. <u>Our systems people say it must have 90° transmission and 3 MILS boresight error in order not to degrade system operation.</u> %?? Our aerodynamic people tell us the only place to obtain accurate air flow data is to put a pitot tube square in the center. Our operations analysis people tell us the pitot tube must have in-flight refueling capabilities, and the project people tell us it must be anti-iced to obtain all weather operation.

Our radomes must not only meet all these requirements, but because of thier missions they must be capable of withstanding nuclear radiation blasts up to 2000°F for 30 seconds and still not absorb enough heat to cause damage to the housed equipment rated at 180°F. This means a reflective coating. This coating must withstand rain and hail erosion at high speeds and temperatures and yet not affect transmission.

The radomes must be impervious to chemical reaction due to Jet fuel spillage. They must be capable of possibly flying through clouds of nitrous oxide and monatomic atmospheric oxygen that may be used for photography or ECM, without physical damage and they must withstand pressures subjected at altitudes of 100,000 feet and maintain a pressure seal.

The here-to relatively unimportant problem of radomes for flush mounted antennas looms up now as a new area for work. The problems of ionized air, heat and voltage breakdown at high altitudes can no longer be set aside.

These are but a few, but may suffice to indicate the trend that is so eminent in the growing magnitude of unsolved problems lying ahead.

So, today I would like to suggest some areas of serious deficiency that cry for action. There are several for us to choose from, but three command our instant attention. I speak of a looming shortage of usable radome material, a deficiency of technical manpower that is already with us and a growing dearth of new, basic knowledge.

Everyone of these in an essential ingredient of our success and each is sufficiently critical now to pose a threat for the future.

These problems are now sufficiently commanding to demand an ever increasing expenditure of time, manpower and dollars in research and development programs.

We must look ahead, recognize areas of both deficiency and plenty, then plan and act accordingly.

It is evident to all of us that there is a desperate need for trained Engineers and Physicists and especially those interested in this highly specialized field of radome design.

The dependence upon you and the others in kindred engineering and scientific fields is a very real and conscientious thing. In more ways than we readily realize, it is upon you, whom we rely, not only for our progress but for our protection.

There is more truth than fiction in the story of the devoted old lady who began her morning prayers with these words, "Give us this day our daily bread and enough Engineers and Scientists to keep us alive until tomorrow".

Whether we like it or not, we are in a race for technical supremacy with those who order the affairs of the Communistic states. The stake is frightening; it is the continued existence of the free world and perhaps man himself.

We are at the threshold; possibly across the threshold of another of the creative surges that have marked the great epochs in the history of man's progress. The circumstance is by no means of our contrivance alone. But while a little fatalism is not out of place, indeed it is essential. Our wine is from our own vines and to think otherwise would be folly. The challenge is clear, exhilarating and direct. We have little choice but to meet it head on and we must not fail in the opportunity it provides.

All in all, the picture is one of immense responsibility and great promises. Certainly a field which has come so far in so few years can be expected to meet the challenge with every success.