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[redacted] PHASE II - TENTATIVE CONCLUSIONS

1. In the light of the discussion in the Cambridge meeting of 4 December, it appears to be in order to restate in slightly different terms as follows, the four techniques under consideration as means of reducing radar reflectivity.

a. Reliance on external surfaces or partially buried shielding surfaces to reflect radiation at innocent angles. The use of this technique will inevitably involve unconventional aircraft configurations.

b. For the higher frequencies the absorption of radiation appears to require moderately thick (1" to 3") but lightweight absorptive material.

c. With special reference to low frequencies, treatment of the edge, or possibly of an outer layer of a structure in such a way that its conductivity is graduated, rising with greater distance from the edge or surface so as to render the edge or surface "soft" electrically and thereby to avoid a discontinuity.

d. For both high and low frequencies, the use of materials and structures which are highly transparent. At low frequencies, structural members made of most non-conductors are wholly transparent. At higher frequencies it may be necessary to bury a non-conducting structural member in a layer of foam of graduated density to eliminate a sharp discontinuity and maximize the transparency of the member.

2. By implication the above list excludes the feasibility of the absorption of low frequencies radiation. This reflects disappointing experience with external dipoles as presently installed on the U-2 and with

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modifications of this arrangement designed to achieve greater broad bandedness. The present arrangement of dipoles gives a considerable reduction in return (probably over 12 db) but there is some evidence to indicate that this reduction is insufficient. The principal limitation on this technique, however, is its narrow bandedness.

3. The most important new discovery in this entire program is the apparent ability of a disc made of conducting material to reflect even low frequency radiation off at innocent angles with extremely low return to the radiating site. The preliminary evidence indicates that this property of a disc enables it to act as a shield throughout virtually the whole frequency spectrum so that a disc with a conventional cylinder mounted above it (but not extending beyond it) gives very low return reflection. The disc may, of course, be any conducting surface and may therefore be an almost weightless layer buried in a non-conducting structure and could even be painted on to a frame under the surface. The possibilities of ellipsoid shapes, of bowl shapes and of multiple discs are being energetically examined. The apparent broad bandedness of this system renders it enormously promising. If further experiment supports and confirms the preliminary evidence, this reflective technique will be the most powerful yet devised in the attack on the problem and will create a strong presumption in favor of aircraft configurations which permit the technique to be used.

4. Another conclusion which seems reasonably well established on the basis of both theory and limited measurement is that plastic structures are much less reflective than metal but too reflective to render their use a full solution to the problem. At S-band the return from a wholly plastic structure, leaving aside all problems of shielding of metal components, would probably be down by no more than 15 db from a similar metal structure. At X-band the reduction and reflectivity would be considerably less. Plastic structures derive their greatest advantage from their transparency at low frequencies.

5. The foregoing conclusions may be summarized as follows with special reference to their bearing on the problem of aircraft design.

a. Any aircraft will have to contain large, reflective metal components, notably the engine. The only promising technique so far in sight for achieving a major reduction in the reflectivity of such components at low frequencies is that of reflection by discs and related shapes as described in paragraph 3 above.

b. Since it is not feasible to build a whole aircraft as a flying saucer, there will be structural members that cannot be shielded by this technique from low frequency radiation. The use of plastics for these structures and the elimination (as completely as possible) from them of metal components would leave them transparent to low frequency radiation.

c. Although the disc shielding technique is also effective at higher frequencies, a complication is encountered if the disc, ellipse, or bowl is buried in the structure in that the shielding or covering structure, even if made of plastic, would give forth significant reflection at S-band and even more at X-band. Accordingly, even those parts of the aircraft in which reliance is placed on shielding must have outer surfaces so configured as to reflect at innocent angles.

d. For the same reason, those structural members (wings and empennage) which cannot be shielded need to be so configured as to minimize back reflection if really low return is desired at the high frequencies.

e. Although the foregoing indicates that main reliance may well have to be placed on innocent reflection throughout the frequency spectrum, the technique of rendering an edge or surface electrically "soft" may be useable to achieve protection at both high and low frequencies for certain structural members that cannot be shielded.

6. Taken together the above conclusions point away from heavy reliance on the absorption of higher frequency radiation. The basic reason

is that, although it might not be too difficult to incorporate provision in a design of aircraft for absorptive materials of high effectiveness and proven performance, the use of these materials is inconsistent with effective low frequency camouflage. The presence of absorptive materials within a plastic structure would render the latter non-transparent at low frequencies. Their use extensively on the fuselage of an aircraft is either incompatible with shielding by discs or else unnecessary in conjunction with such shielding. Although absorbent materials are compatible under circumstances with graduated conductivity, it appears unlikely that this combination of techniques would be effective for as large a structure as the fuselage at low frequencies. In any event this technique is bulky and hardly seems feasible except in special applications, such as wings and possibly horizonal stabilizers.

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