to construct rounded fillets from the fuselage to the bubble. Similar to those developed for fuselage-wing intersections.

4. The design of a canopy according to Fig. 7b presents the best solution because it overcomes most of the difficulties mentioned above.
5. Bubbles can also be used for two-seater tandem or side-by-side. Surprising as it may seem, when two bubbles are mounted in tandem, less drag is obtained than if a continuous canopy is used. The visibility is also much better.

Dimensioning

The correct dimensions for a blown bubble can be given to close limits. First, the bubble should have sufficient headroom to make it possible for the pilot to turn his head with helmet and earphones. Second,

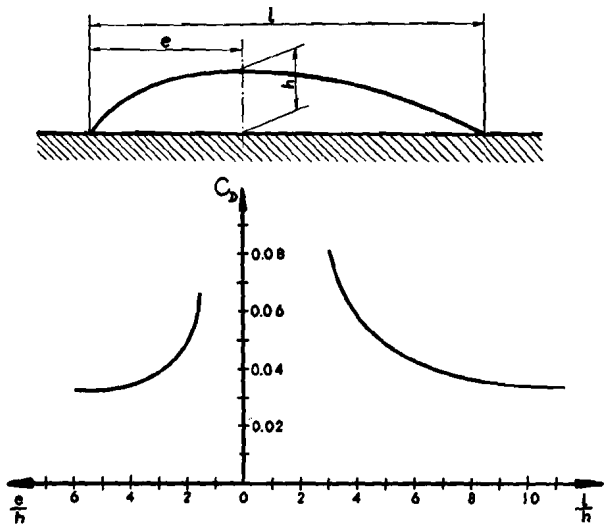

Fig. 10

The drag coefficients of the streamlined protuberance as a function of its relative length and height. Width of the protuberance, B = 2 to 4 times height. C_d refers to the cross-section of the bubble (Ref. 1).

the bubbles should be as small as possible in order to insure the best possible conditions for seeing as well as for low drag. Fig. 2, for example, shows a bubble which has been used on many sailplanes, TG-4A, TG-3A, TG-32, TG-2, proving that it is of a size suitable for practical use.

Many times pilots are prone to put ventilating hatches in the canopy. Why these ventilating hatches are placed in one of the regions most sensitive to flow disruption is a mystery. A far more sensible position for these vents would be on the nose of the fuselage. It is also unreasonable of the designer to locate the entrance hatch in such a way that the gaps interefere with the aerodynamic qualities of the bubble. Gaps perpendicular to the direction of the flight are especially bad and should be absolutely avoided.

Poorly formed canopies may be responsible for as much as 20% of the total drag of a sailplane. Figure 11 shows clearly that even the smallest irregularities in construction will increase drag. A well formed bubble should not contribute more than 2% of the total drag of a sailplane.

MORNING FLIGHT

By EMMA KROHNE

For beauty, thrills and sheer delight
Choose a morning clear and bright,
When Day has turned skies vivid blue,
Trimmed with a Cumulus Cloud or two;
While gentle breezes softly stir
And your engine voices a steady purr
As you climb above the fields and see
Lake and river, farm and tree,
Part of a pattern, as the World
Below you lies like a Print unfurled.
About you the puffs of Cumulii
Seem like sails across the sky.
The river, a silver ribbon now,
Flows through the fields where the farmers plow;
Past forest and village on to the Sea,
Singing its song, unfettered and free.
Just as you feel as you fly along—
Like a bird in the sky, in your heart a song.

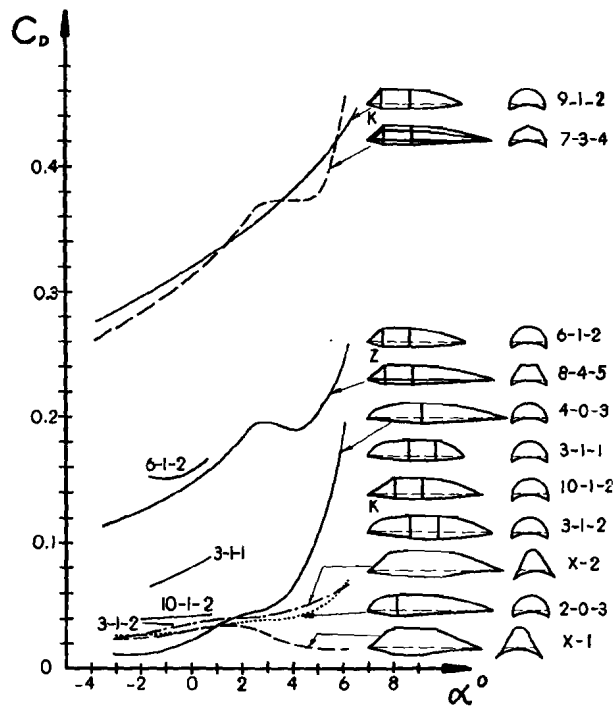

Fig. 11

The drag of different bubble types and its change as a function of angle of attack (Ref. 2), RN = 1.98 x 10^7. This table can be used only as comparison of different types of bubbles—not as a table for computing bubble characteristics. All bubbles are measured on the same streamlined body and at corresponding distances from the nose of the fuselage.

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