

TECHNICAL NOTES.  
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

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No. 25.

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CENTER OF PRESSURE COEFFICIENTS FOR AEROFOILS  
AT HIGH SPEEDS.

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It has been customary to calculate the strength of the rear wing beam for the "high speed" condition on the assumption that the center of pressure was at 0.50 of the wing chord. It can be shown that this assumption is not justified, regardless of the utility of a "high speed" condition in strength calculations.

In the course of an investigation of the C.P. movement for a series of aerofoils, it was found the C.P. moves rearward more or less uniformly with increase in speed. This is shown in Fig. 1, in which the C.P. data for a number of notable aerofoils are plotted against the speed factor  $C_{L_{max}}/C_L$ . It will also be noted that there is a wide variation in the C.P. location at a given speed factor for the aerofoils given. The C.P. location at high speeds is invariably well forward for thin "high speed" aerofoils and well aft for thick "high lift" aerofoils.

It has been shown in a series of recent papers by some of the leading continental mathematicians that the center of pressure for certain aerofoils may be calculated from the curvature of the mean camber. The methods are quite involved and therefore

\* Reproduction of Navy Aircraft Technical Note No. 209.

useless from the viewpoint of the average engineer. It appears, however, that a practical substitute for the curvature of the mean camber is the "Angle of Trail," or angle between the chord of the aerofoil and the tangent to the curve of mean camber at the trailing edge, as shown in Fig. 2. The center of pressure data for 117 aerofoils of the Göttingen series have been analyzed in order to connect the C.P. movement with the angle of trail. The results are given in Fig. 3, in which the C.P. for three speeds, expressed in terms of the landing speed, are plotted against the angle of trail,  $B$ .

It is obvious from an inspection of Fig. 3, that the greater the angle of trail the further aft will be the C.P. at a given speed factor. It should be noted that the C.P. movement increases with an increase in  $B$  to such an extent that the usefulness of aerofoils of this class may be limited to airplanes having a low speed range, i. e., ratio of maximum to minimum speeds. The assumption of 0.50 as the position of the center of pressure at high speed is obviously without justification.

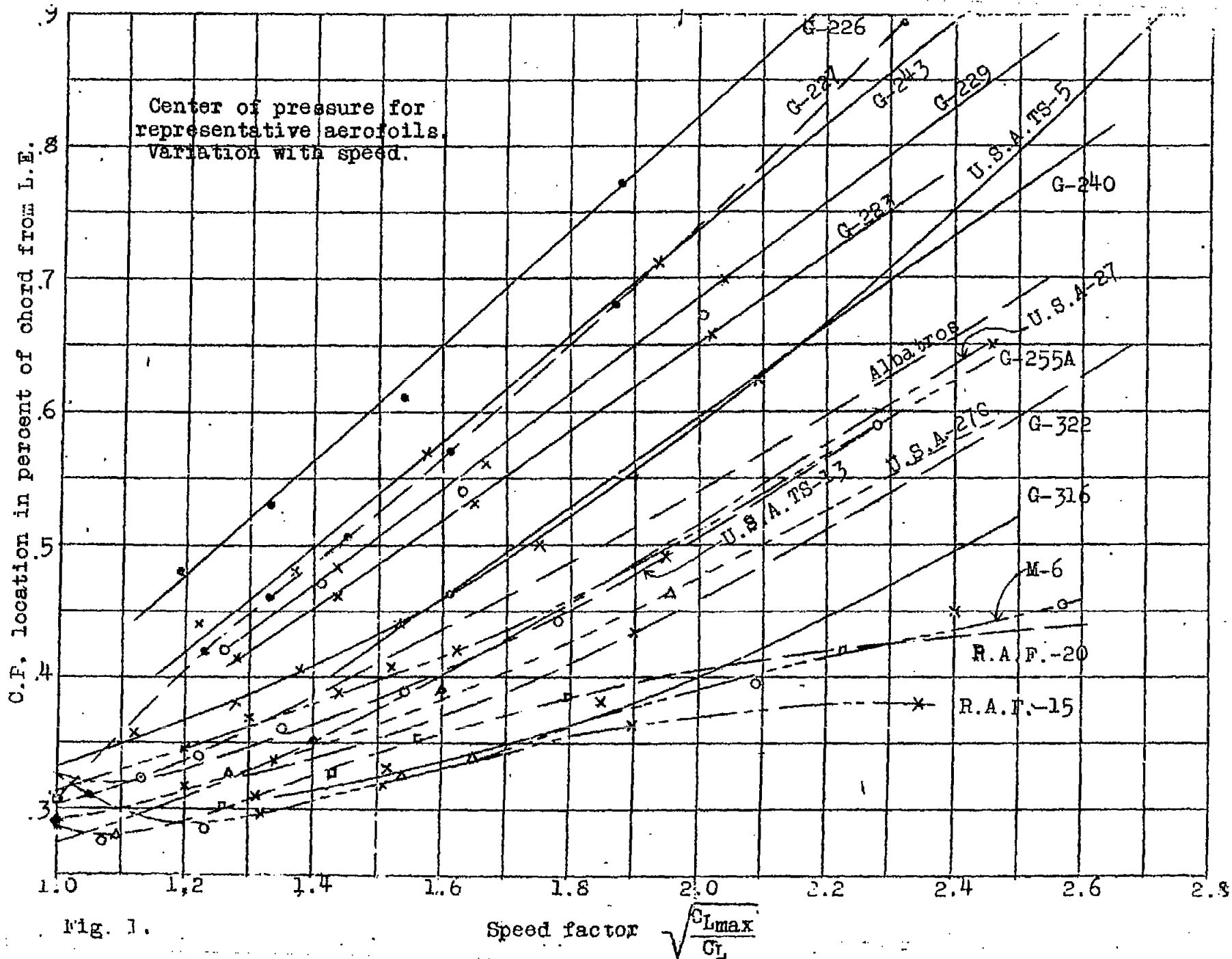
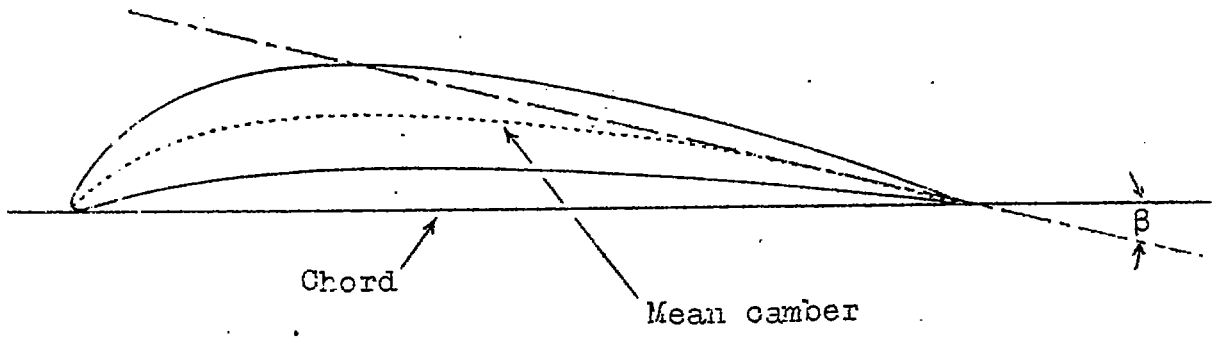


Fig. 1.



Showing "angle of trail"

Fig. 2.

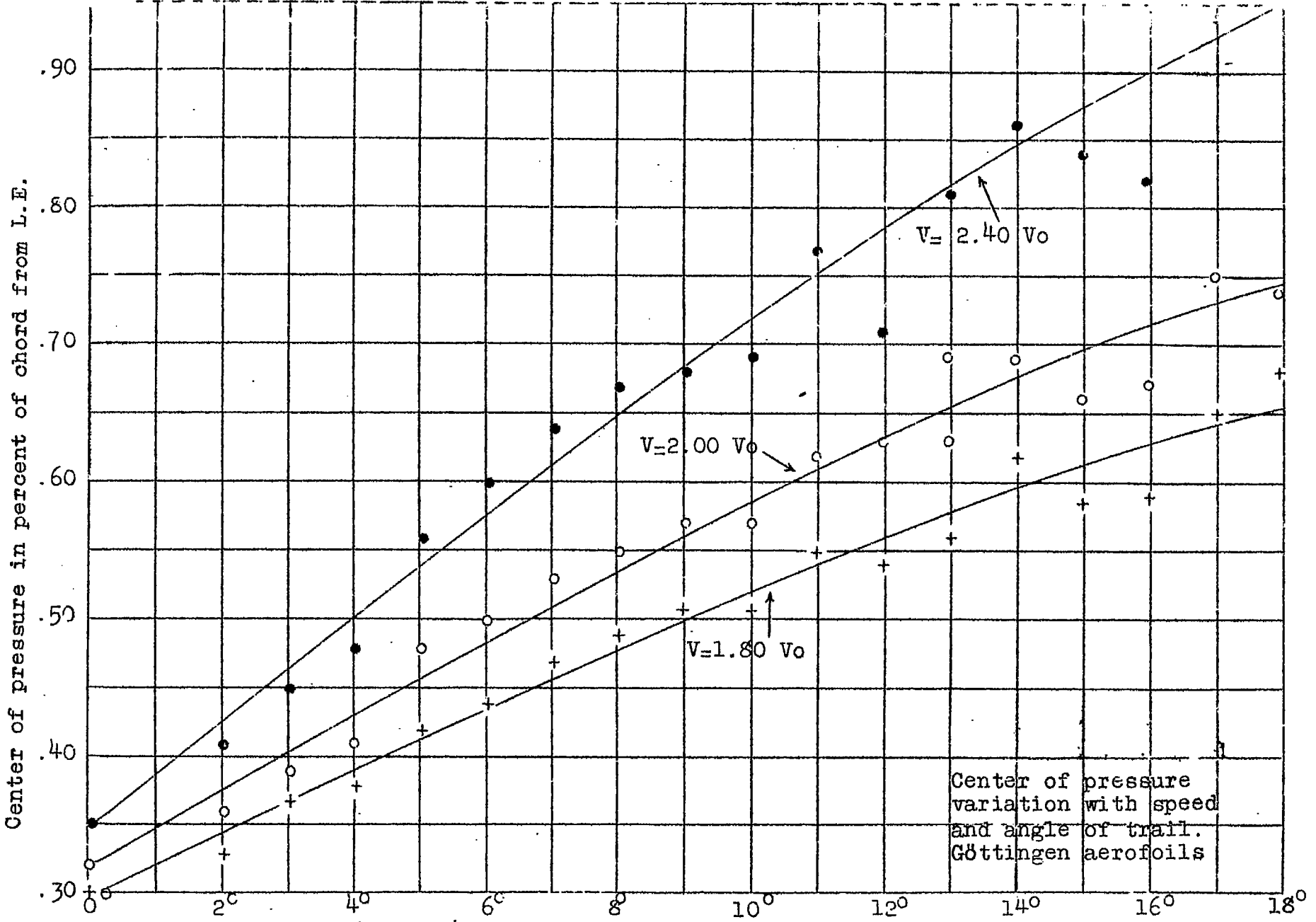


Fig. 3.

"Angle of trail" -  $\beta$  (See Fig. 2)