But C_D is composed of two parts,

$$C_D = C_{D0} + C_{Di}$$

The parasite drag C_{D0} may be considered constant except at low speeds and the induced drag C_{Di} is related to the lift.

$$C_{D_i} = \frac{C_L^2}{\pi A.R.}$$

At top speed $C_L = 0.25$, hence $C_{Di} = 0.005$ and $C_{D0} = 0.045$. Therefore in general:

$$C_D = 0.045 + \frac{C_L^2}{13.8} \qquad (9)$$

For any selected forward speed V and gross weight the lift coef. C_L is readily obtained and hence C_D from Equation 9. Since $C_L/C_D = L/D$, the sinking speed Vs is calculated from $V \div L/D$. The steps are given below in Table 1 and the results presented in Fig. 1.

The rate of climb in the absence of the glider is, from Equation 8:

$$V_C = V_{cf} - V_s$$

This is simply the vertical intercept between the speed polar curve and the fictitious rate of climb curve. The intercept is zero at top speed and, as a check, we note that the curve representing the fictitious rate of climb at 90 b.h.p. intersects the speed polar at cruising speed.

In Fig. 1, uncorrected Vcf maximum exceeds the quoted maximum rate of climb. The error results from applying Equation 9 at low speeds where the assumption is in error that C_{D0} = const. A correction satisfactory for our purposes can be obtained by "fairing" the low speed portion of the polar to have as a tangent the line defining Vc = 750 f.p.m. with the point of contact at best climbing speed V = 65 m.p.h.

The speed polar of the glider will often be available, otherwise it can be calculated by methods analagous to the above. Typical curves for the "Tiger Moth" and De Havilland "Sparrow" Glider are given in Fig. 2. The ordinates of these curves are now factored and summed according to Eqs. 5 and 6 to obtain the fictitious sinking speed of the train as indicated in Fig. 3. The true rate of climb of the train follows immediately from Eq. 8 since Vcf is known for the tug, and the maximum value is 720 f.p.m. For practical purposes it may be desirable to use a somewhat lower value, as these results are based on full rated power, sea level operation, and a low speed flying technique.

From the standpoint of safety, more important than the rate of climb is the ability to clear the obstacles which always abound in the vicinity of otherwise attractive fields. The angle of climb is easily found from the foregoing since both flight path speed, V, and vertical component, Vc are derived, i.e.:

$$\sin \frac{V_c}{V} = \alpha$$

The graphical procedure is demonstrated in Fig. 4 from the results of Fig. 3 and in the absence of wind in the example.

$\sin \alpha \text{ max} = 1/6$ or $\alpha \text{ max} = 10^\circ$ approximately.

Wind corrections are simply added to or subtracted from the horizontal scale to give the correct ground speed.

Almost invariably the maximum angle of climb occurs at minimum flying speed and allowances should be made for an understandable reluctance on the part of the tug pilot to operations right at the stall.

The Author wishes to acknowledge the helpful suggestions of Mr. W. Z. Stepniewski.

TABLE 1

C_L	V f.p.s.	C_D (Eq. 9)	L/D	Vs f.p.s.	Vs (Corrected)	n	Vcf (Eq. 1)
0.2	175	0.048	4.16	42	42	0.75	31.6
0.3	143	0.052	5.77	25	25		
0.4	124	0.057	7.02	18	18		
0.6	101	0.071	8.45	12	12.8	0.60	25.3
0.8	87.5	0.091	8.80	9.9	11.6		
1.0	78.5	0.118	8.50	9.2	11.1		
1.2	71.5	0.149	8.05	8.9	11.0		

TROPHY HONORS TAYLOR BOYER

The Herbert J. Sargent Jr., Memorial Trophy was awarded in 1947 to Taylor M. Boyer in recognition of his "sincere efforts devoted to the advancement of motorless flight."

"Bipps" Boyer donated practically all his spare time for over two and one half years to carry the burden of editing SOARING to keep those interested in motorless flight informed and united. He did this entirely without monetary remuneration and the calibre of his work set a standard which will be difficult to duplicate. "Bipps" has now become a father and this fact, along with his long neglected personal affairs, forced him to retire.

The entire gliding and soaring fraternity owes T. M. B. a sincere vote of thanks.

Sponsored by the Hudson Valley Glider Club, this trophy honors the memory of the late Herbert J. Sargent, Jr., of Jersey City, New Jersey.