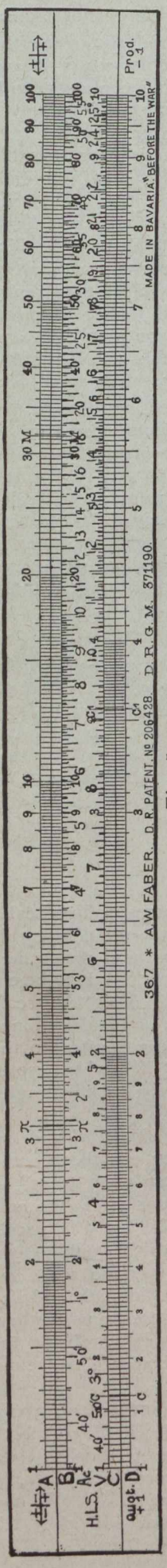

Fig. 5.

scale on the face of the rule, and the "T" scale in conjunction with the "D" scale.

Rules for Using "Curve" Slide Rule.

(1) $A_c = R \cdot \frac{\pi}{180} \cdot A$

Use scale "A_c" on slide (graduated from about 35′ to 57° 18′) in conjunction with scale "A" on face of rule.

(a) Radius and angle given—to find arc: Set slide index to the radius on scale "A" and the cursor to the angle subtended at the centre of circle by arc. The value of "arc × 100" will then be indicated by the cursor on scale "A".

(b) Radius and arc given—to find angle subtended at centre: Set slide index to the radius on scale "A" and below "arc × 100" will be found the required angle.

For angles below 35′ or above 57° 18′, use direct proportions, which in the case of small angles can be made in the convenient ratio of 10 to 1.

(2) $x = R \sin A$

Use scale "S" on slide (graduated from about 35′ to 90°) in conjunction with scale "A" on face of rule.

(a) Radius and angle given—to find x: Set slide index to the radius on scale "A" and the cursor to the given angle (which is the angle subtended at the centre of circle by a certain arc the length of which need not necessarily be known). The value "x × 100" will then be indicated by the cursor on scale "A".

For angles below 35′, since the sines of small angles are approximately proportional to the angles themselves, values can be determined by direct proportion using a ratio of 10 to 1 for convenience.

Up to 4° the difference between sine A and $\frac{\pi}{180} \cdot A$ is very small.

The difference between x and A_c for a radius of 1,000 feet and an angle of 4° is only 0.056 feet which can ordinarily be neglected. Therefore, the portion up to 4° of the sine scale could, on the ordinary slide rule, be used to determine A_c values. Values for angles greater than 4° could be determined by direct proportion with a fair amount of accuracy.

(3) $y = R \text{ vers } A$

Use scale "V" on slide (graduated from about 2° 34′ to 25° 50′) with scale "A" on face of rule.

(a) Radius and angle given—to find y: Set slide index to the radius on scale "A" and the cursor to the given angle. The value "y × 1,000" will then be indicated by the cursor on scale "A".

For angles below 2° 34′—Since the versines of small angles are approximately proportional to the squares of the angles, values under 2° 34′ can be determined by using larger angles in the proportion of 10 to 1 and dividing the result by 100.

For angles above 25° 50′—Now, vers $A = \sin A \times \tan A/2$ and therefore values can be found by using the back of the slide on which are both the sine and tan scales.

(4) $T = R \tan A/2$.

Use "T" scale on slide (graduated (i) from about 5° 43′ to 45° or preferably by changing the figures only, (ii) from about **11° 26′ to 90°**).

(a) Radius and angle given—to find T: Set slide index to the radius on scale "D" and the cursor to (i) one-half the angle "A" or (ii) the angle "A." The value "T × 10" will then be indicated by the cursor on scale "D".

For angles (i) below 5° 43′ or (ii) when A is less than 11° 26′. When A is between 0° and 4°, the corresponding sine of $A/2$ may be substituted. From 4° to 11° 26′, the corresponding sine of $A/2$ may be used, and the result increased by $\left(\frac{A/2 - 1}{10}\right)$ percent.

TABLE I

Calculation	SLIDE RULE				GRAPH				Drafting	
	Observer 1		Observer 2		Observer 1		Observer 2			
Offsets	Offset	Error	Offset	Error	Offset	Error	Offset	Error	Offset	Error
x										
Point ① 43·8	43·8	—	43·8	—	43·8	—	43·8	—	43·1	-0·7
② 87·2	87·3	+0·1	87·1	-0·1	87·25	+0·05	87·2	—	86·8	-0·4
③ 130·4	130·5	+0·1	130·5	+0·1	130·3	-0·1	130·3	+0·1	129·8	-0·6
y										
① 1·5	1·5	—	1·5	—	1·4	-0·1	1·5	—	1·6	+0·1
② 5·9	5·9	—	5·9	—	6·0	+0·1	5·9	—	5·7	-0·2
③ 13·2	13·2	—	13·3	+0·1	13·2	—	13·4	+0·2	13·2	—

(5) $x_1 = x \dfrac{\sin [90° - (A/2 - K)]}{\sin (90° - A/2)}$

(6) $y_1 = y \dfrac{\sin (A/2 - K)}{\sin A/2}$

(7) $C_d = \dfrac{x}{\sin (90° - A/2)}$

(8) $C_d = R \sin A/2$

Use scale "S" on slide in conjunction with scale "A" on face of rule.

For ordinary conditions equation (8) may be written $C_d = R \sin A$, where A is not over 4°.

Also, C_d can be ordinarily assumed equal to A_c for a value of A not over 6°.

The relations between A_c, x and C_d can therefore be thus expressed:—

$x = C_d = A_c$ for A not over 4°
and $C_d = A_c$ for A not over 6°

Ordinary 10-in. Slide Rule with "S" and "T" Scales.—From a study of the foregoing rules it will be apparent that the ordinary slide rule could be used though not so readily in computing properties of curves; x, T, x_1 and y_1 and C_d values could be directly obtained as on the "curve" slide rule.