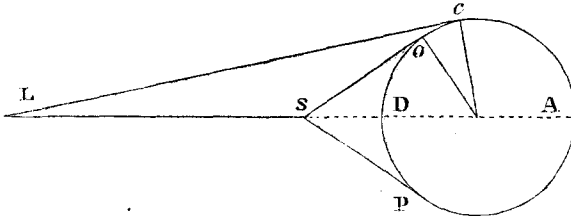


following postulate is given: *the required intensity of resistance, to balance a given force, is proportional to the obliquity of that resistance to the given force.* This is true, and may be usefully impressed. It reverses the assumption of Mr. Clifford, and makes the transmitted forces through the connecting-rods, in their own directions, *inversely* as the cosines.

Let S P, be the short connecting-rod in its return, corresponding with its position at S O, and the piston-rod moving from S, towards D; then, by Mr. Clifford's theory, the force transmitted by the push, (thrust) through the connecting-rod, in its own direction, is decreased by the obliquity in the ratio of the cosines *directly*. But the arrangement of power and resistance is identical with what is called the "toggle joint press," acting downwards; and Mr. C. himself would admit, under this latter name, that the power moving in the direction of S to D, transmits, through the connecting-rod S P, in its own direction, a force increasing with the obliquity—in the ratio of the cosines *inversely*.



It ~~must not~~ be inferred that the above exhibit leads to a superiority in the short rod; the equality is shown in the completion of the act, and the greater efficiency near D, is but the compensation of what is withheld near A.

Cincinnati, 5th February, 1844.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

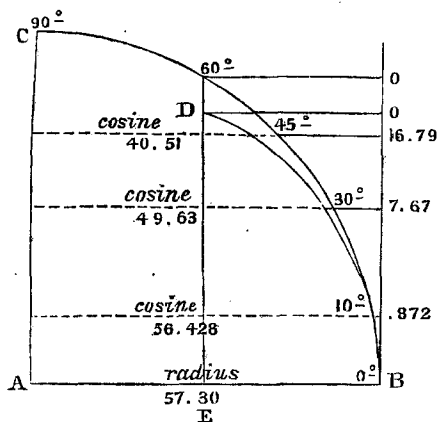
On finding Sine, Cosine, &c. By THOMAS W. BAKEWELL.

Tables for finding the sine, cosine, &c., when accessible, supersede other means for that end; but where they are not, the following rule is offered, as obviating, without the aid of logarithms, an elaborate process.

The following reasoning leads to the rule: Let B C, be a quarter circle of 90 units long, which gives a radius of 57.30; let B D, be the half of a corresponding cycloid, of which E D, is the base, produced to the circle at 60°. D B, of the cycloid is equal to A B. 57.30 radius of the circle. The ordinates O O to the circle and cycloid, are equal 38.65.

Now it is the property of the cycloid, that its ordinates are as the squares of the included portions of the curve from B, and if we nominally reduce the portion of the circle at 60°, to that of the cycloid, and call it 57.30, and make equivalent nominal reductions at other points

of the circle below 60° , it, the circular arc, will also have its ordinates at those points, as the squares of the included portions from B.



But the circle and the cycloid may be considered coincident from 0° to 17° , and as the octant of 0° to 45° , is sufficient to establish the sines, &c., of the quadrant, the remaining space of required reduction is from 17° to 45° , and through these 28 degrees the ratio of reduction is nearly direct and uniform. The immediate results of the rule, are the ordinates to the circle, as .872 - 7.67 - 16.79, which may be termed *supplements to the cosines*; and which, being known, we find, by familiar process, the cosine, sine, versed sine, and chord, and, more remotely, other geometric properties, growing out of the relation of the circle to a straight line.

The rule is not perfect, and in giving the multipliers, small errors and fractions have been compromised in such manner as to combine, as far as possible, brevity with accuracy; but at no one point does the error exceed $\frac{1}{3800}$ th part of the radius.

RULE to find the supplement to cosine from 0° to 45° , where radius is 57.3. From 0° to 17° , multiply the square of the degree in question, by the decimal .00872.

Example for 10° .

$$10^2 = 100 \times .00872 = .872 \text{ sup. to cosine.}$$

From 17° to 45° deduct from said .00872 as often .0000152, as the degree in question is above 17° , and with the remainder multiply the square of said degree.

Example for 30° .

$$13 \times .0000152 = .0001976 \text{ for deduction,}$$

$$.00872 - .0001976 = .0085224 \text{ for multiplier,}$$

$$30^2 = 900 \times .0085224 = 7.67 \text{ supplement to cosine.}$$

Cincinnati, 20th Feb., 1844.