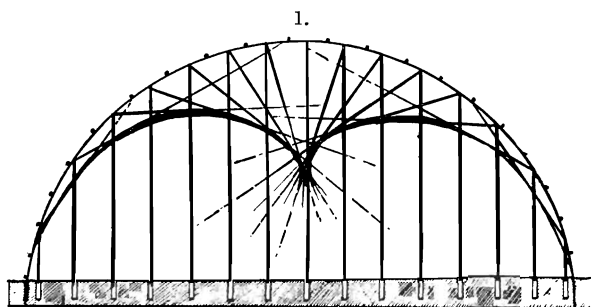


ART. XXXII.—*Demonstration of Caustics*; by ROBERT WILLIAMS WOOD.

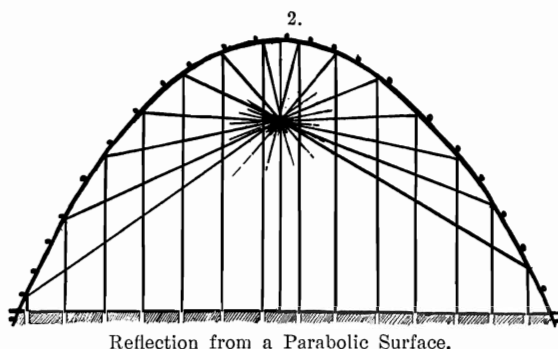
THE caustic surfaces by reflection from concave mirrors can be shown geometrically to be the paths to which all the reflected rays are tangent. A simple way of demonstrating this experimentally is the following: A strip of thin steel about 16 inches long, by 1 in width, is polished on one side until it has a good mirror surface. An accurate optical surface is of course unnecessary. The curve, for example a semi-circle, whose caustic is to be shown is drawn on a piece of photographic printing paper, and pinned down onto a board with a dozen or more pins, stuck vertically through the line. The steel strip is bent into this arc, and pressed firmly against the row of pins, the ends being held in place by a couple of small nails. In front of the steel arc across the diameter is set up a strip of Bristol board with a number of vertical slits, about  $\frac{1}{8}$  of an inch wide, and half an inch apart. On setting up the board in strong sun-light, in a plane pointing a little below the sun, the parallel rays passing through the slits trace their course on the paper, are reflected and trace their reflected paths also, which in the case of a semi-circular mirror will all be found to be tangent to an epicycloid. The complete curve can be traced by raising the grating for a moment or two. During the exposure it is best to bridge over the steel arc with a piece of card-board to exclude diffused daylight.



Epicycloidal Caustic showing tangential rays.

The accompanying drawings (figs. 1 and 2) are copied directly from the photographic tracings, and are of course negatives, the black lines representing the paths traced by the luminous rays. It is not easy to get a parabolic surface that shall bring all the rays to a focus, each side of the curve being apt to have a focus of its own; but a little careful manipulation and changing the position of the pins a trifle, will usually

bring them together. The card-board screen is shown (tipped over) in the drawing of the epicycloidal caustic.



The axis of the reflecting surface must of course point directly at the sun, or rather a little below it. If the paper is fairly sensitive the exposure need not be over a minute or two, and the motion of the sun will give no trouble. If a longer exposure is necessary the mirror may be turned a trifle from time to time.

These phenomena are adapted to projection, by employing a nearly parallel beam thrown along the screen, either directly or by means of a mirror. The reflecting surface and the slits should be much larger than the ones used for photographic representation.

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