joined in the Funk & Wagnalls' movement to reform their participles in signed articles, and I, therefore, submit a request for permission.

G. K. Gilbert.

Washington, D. C.,
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An Explanation of the So-Called Pseudo-Aurora.

Occasionally, during the winter season, dwellers of our Northern cities have noticed by night a strange optical phenomenon, which some one has called the 'pseudo-aurora,' and which, so far as I know, has not been heretofore explained.* My attention was first called to it some years ago, in Moorhead, Minn. Over each arc lamp, used in street lighting, appears a strange column of pure white light, seeming to extend vertically to a great height; a peculiar transparent shaft, like the brightest bars of the aurora borealis, yet standing very still, and always vertical over the lamp from whatever point viewed. When each arc lamp in the whole town is thus attended by its vivid shaft the display is magnificent and, seen against the northern sky, might easily suggest the 'pseudo' name. On an evening of special beauty these columns seem to reach almost to the zeinth, and other sources of light add their shafts to the display. The evening star gives a shaft below as well as above, and the late rising moon stands right *in* a broad column of light.

Looking about for causes, and noticing from time to time the conditions under which this meteor appeared, the following facts were observed: The temperature is always below the freezing point, oftenest about zero. The sky is cloudless, air still or barely moving, and more or less full of frost crystals. The display is finer, completer, when most crystals are present, though by no means does the mere presence of crystals in the air furnish the spectacle. The shafts of light are most sharply defined and apparently higher when the air is stillest. With more wind the shafts spread out, diffuse, becoming indistinct, and with a gentle breeze the light seems to be more or less evenly distributed through the entire upper air, like a fine luminous dust suspended there.

*See Loomis's *Meteorology*, p. 224.

Having noticed these conditions, it is apparent that the crystals are the important factor, and reflection of light from their facets is suggested at once. Of course to get a vertical shaft of light by reflection necessitates a constant horizontal position of the crystal faces, and I searched long and arduously for a ballasted crystal, floating like a parachute, but found none. What I did find in each case was a minute hexagonal plate of solid ice, in no case more than one millimeter in diameter, extremely thin, and of glassy smoothness.

I experimented with this idea: Making some hexagonal plates an inch across, of the lightest glazed bond paper, and letting them fall in still air from a height, the whole story is told. Each plate floats gently down, at times making a rapid chute edgewise, but quickly recovering a horizontal position, so that of all the time involved in falling, the larger part is taken up while the plate is in a position approximately horizontal. We have seen the same thing in autumn when the great basswood leaves let go and float slowly down.

Now, filling the air with such plates, each of which is a perfect mirror, we have in the vertical plane, between our eye and the light, innumerable crystals, from the lower surface of which rays of light from the lamp are reflected to our eye, and seen by the eye as though located in the straight line in which they enter the eye, and at a distance equal to the distance traveled from the lamp. This gives the vertical column, the location of any single point in it being shown by construction, the same as an image in a plane mirror.

The little crystal plate adjusts itself, like a flat stone at the bottom of the torrent, or a cake of ice at the top of the sea, with its broad surface normal to the force acting upon it. So long as this force is gravity only, the position of the crystal is horizontal. But if the wind be blowing this adds a horizontal component, giving with gravity a resultant no longer vertical, to which the plate becomes normal. With the departure of the crystal from the horizontal position the vertical shafts of light disperse.

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