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DISTANCE OF THE VISIBLE HORIZON.

By the Rev. Robert Semple.

Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.
1	1·2 +	100	12·2	1900	53·3
2	1·7	200	17·3	2000	54·7
3	2·1	300	21·2	2200	57·4
4	2·4	400	24·5	2400	60·1
5	2·7	500	27·3	2600	62·4
6	2·9	600	30·0	2800	64 8
7	3·2	700	32·4	3000	67·1
8	3·4	800	34·6	3200	69·2
9	3·6	900	36·7	3400	71·4
10	3·8	1000	38·7	3600	73·4
20	5·4	1100	40 6	3800	75 5
30	6·7	1200	42·4	4000	77·4
40	7·7	1300	44·1	4200	79·3
50	8·6	1400	45·8	4400	81·2
60	9·4	1500	47·4	4600	83·0
70	10·2	1600	49·0	4800	84·8
80	10·9	1700	50·5	5000	86·6
90	11·6	1800	51·9	6000	94·9

THE exact relation between the height from which an observation is made, and the distance of the visible horizon not being generally understood, a few words regarding this point may prove interesting, besides tending to prevent waste of time, and not a little disappointment arising from vain seekings to perceive the invisible.

The distances given in the foregoing table are tangential, and make no allowance for refraction, the amount of which varies with the state of the atmosphere,* and its effect is to increase the range of vision. Refraction makes the sun and moon visible before they have actually risen above the line of the horizon and after they have sunk below it. In the same way, by the bending of the light rays, terrestrial objects are elevated into visibility. In many cases objects far below the horizon have been clearly seen. Thus, the French coast, with its cliffs and villages, has been seen from Hastings, although the distance is such as to place it beyond the range of ordinary vision.

The distance visible from any height may be readily calculated if it be borne in mind that heights are proportional to the squares of the distance of the visible horizon. Thus, if at a height of one foot above a perfectly level plain, that is, a plain every point of which is equidistant from the earth's centre, one can see a distance of 1·2 + miles; at a height of 2 feet one would see $\sqrt{2 \times (1{\cdot}2)^2}$ miles $= \sqrt{2{\cdot}88} = 1{\cdot}7$ miles; at a height of 3 feet, one would see $\sqrt{3 \times (1{\cdot}2)^2}$ miles $= \sqrt{4{\cdot}32} = 2{\cdot}1$ miles. To find the distance of the visible horizon, therefore, multiply the square of 1·2 + by the height, and extract the square root.

To find how far two heights are visible from each other, the distances visible from each must be added together. Two hills of the same height may be seen from each other twice as far as the horizon is seen from either. From this it follows that while the horizon is seen only 30 miles away from a height of 600 feet, yet two heights of 300 feet above sea level may be seen from each other though more than 40 miles apart. A lighthouse 200 feet above sea level is visible 17 miles to an eye at the sea level, but if the eye be raised 6 feet the light will be seen at 20 miles;

* Refraction has been observed to vary from $\frac{1}{15{\cdot}4}$ to $\frac{1}{9{\cdot}4}$; mean $\frac{1}{12{\cdot}6}$. There is least refraction during the middle of the day.

though the addition of 6 feet to the lighthouse itself would add only about a quarter of a mile to the range of visibility.

When the horizon consists of land, then, in judging as to the possibility of seeing two places each from the other, the height of the intervening land above sea level must be deducted from the height of both places, if the elevation occurs at the common horizon. From a hill (A) 1747 feet high, the visible horizon is 51 miles, and from another (B) 313 feet high, it is 21 miles. These heights would, therefore, be reciprocally visible at 72 miles; but if a height of 200 feet occurred at the common horizon, then the one would be invisible from the other. For as (A) would now be 1547 feet and (B) 113 feet, the distances visible respectively from each would be 48 miles and 13 miles—a total distance of 61 miles. Not more than a few feet of either height would be visible from the other even if the mountains were 10 miles nearer. Refraction would aid the observer to some extent. But when the possibility of seeing the cairn on a hill top is based on mathematical calculations, the observer may discover a further illustration of the subtlety of that science. The point he hoped to see may thoroughly satisfy Euclid's definition by having position but not magnitude.

The greatest distance yet seen is 183 miles, but this was by heliograph, from Mount Uncompahgre (14,418) in Colorado, to Mount Ellen (11,410) in Utah. Under the favourable atmospheric conditions which exist there, a party waited a week in September, 1894, and then the welcome "flash" came. It had the appearance of a bright red star, and by the aid of telescopes the signals from the distant station were read by the experts in charge with the utmost ease. In this case the "flash" was almost a communication between invisible points, the two mountain tops not being properly in the same horizon, and it was only for a brief hour that refraction in the morning and evening so bent the ray from the distant mirror as to lift it over the curving globe between.