November 15, 1952

Tabulation of Refractive Bending

100 representative days

by Grote Reber

Month	January		July	
	Bending Milli-radians	Scatter Half of Values	Bending Milli-radians	Scatter Half of Values
	Sea Incidence Angle 0.00 Degrees			
Total to top Atmos.	16.21	+1.49,-1.30	16.91	+0.71,-0.99
Up to 3.066 km.	11.40	+1.55,-1.30	11.97	+0.94,-1.19
Above 3.066 km.	4.66	+0.34,-0.15	4.93	+0.26,-0.21
	Sea Incidence Angle 1.42 Degrees			
Total to top Atmos.	8.88	+0.32,-0.36	9.18	+0.21,-0.18
Up to 3.066 km.	4.84	+0.28,-0.30	5.00	+0.19,-0.20
Above 3.066 km.	3.98	+0.26,-0.10	4.15	+0.22,-0.14

In my opinion the calculation of probable error has no meaning in this type of study. Undoubtedly there are errors in measurement. However these are so small compared to the variation of the phenomenon in question that they have no effect.

Beyond the above information the next question is: Is the distribution of values statistical or not? This can only be determined by plotting on probability paper. To a first approximation the answer is yes. The next question is where is most of the scatter in the bending? From the above table it is below 3.066 km. Finally, How does the scatter vary with altitude? From the above table it can be seen that the scatter decreases rapidly with altitude; infact much more rapidly than the magnitude of the bending.

P.S. Your value of 5.2' or 9.2% is not probable error. To get probable error one must know the average deviation and divide it by the square root of the number of observations. I don't know what the A.D. is but it most certainly is different than the range within which half the values fall as tabulated above. I believe the A.D. will be substantially larger.

Probable error would have meaning, if on one day we measured the bending "n" times before the bending had a chance to change. We then average the "n" values. This mean is subtracted from all "n" value to get individual deviations. all deviations are then summed using a positive sign and divided by "n" to get average deviation. A.D./$\sqrt{n}$ = P.E. for that particular day. (See over)

Probable error is that region of values within which it is equally likely that the true value will be, as it is likely the true value will be without. ~~Error~~ The scatter range of half the observations denotes merely that the other half the observations will be outside this range. There is a fundamental difference. P.E. implies the phenomenon remained constant (like the length of a bench) during successive observations and that the tools of measurement were too crude to get the correct length of bench; also the various answers followed a statistical relationship.

In the case of bending, the phenomenon did not stay constant and the various observations depart from statistical, particularly at the extremes. I think a much better term for the range of half the values would be Scatter Range or if one wishes to use the results for further computations it might be called Scatter Error. Since the values depart from statistical at the extremes the probability of getting a very large or small value is much greater than would be deduced from theory of statistics.