STUDIES ON REFRACTION

With reference to the Study on Refraction published page 35 *of Volume XXII of the* International Hydrographic Review, *Monaco,* 1945, *the International Hydrographic Bureau has received from the « Deutsches Hydrographisches Institut » of Hamburg a letter sent by Dr. Freiesleben to Mr. J. E. R. Ross of the Geodetic Service of Department of Mines and Resources, Ottawa. We believe that the contents of this letter, which tend to confirm the results obtained by Mr. Ross, will prove of interest to readers of the* International Hydrographic Review; *the following copy is therefore appended :*

Hamburg, 28th September, 1948.

Dear Mr. Ross,

It was only a few days ago that I caught sight of your publication in Volume XXII of the *Hydrographic Review,* which article is highly interesting and worthy of acknowledgement. Based on thorough studies which I made together with F. Conrad (†) and G. Prüfer I think I shall be able to give an interpretation of your results. Our voluminous observations of the depth of the dip of horizon, carried through from 1933 to 1938, could be evaluated, owing to the war, unfortunately only belated, and cannot be published because of lack of funds, although the work is ready for print. In No. 1 of the *Deutsche Hydrographische Zeitschrift* I gave an extract of it on the Theory of the Depth of the Dip of Horizon of which I enclose a separate impression. Another extract dealing with some geophysical consequences will appear in one of the next issues of the aforementioned journal.

If you will compare the formula $Kt = 5{:}04 \sqrt{0.1123\ h + T_o - T_h}$ derived at by me and the graphic presentation 3 with your results you will find that your observations are falling under a section where one has to accept for $T_o - T_h$ negative values in general, above all, as long as the wind blows with little strength. For in May and June, and partly still in July, the water and with it the lowest air-layer above it is mostly colder than higher air-layers, anyhow such ones up to which you observed. You will notice that in this case for observations of the depths of the dip of horizon out of greater heights a greater value $\frac{Kt}{h}$ will be obtained than for such ones made in lesser heights. As a consequence the factor m (in my publication called "k") must give falling values at increasing heights, as you prove this. Above this, however, too small values $\frac{Kt}{h}$ will result and therewith too big m ones, as you likewise prove, if average conditions as they are observed all the year round are generally compared.

Just the same, the formula for the calculation of the distance of the dip of horizon containing $\sqrt{1 - m}$ in the denominator, the factor of the formula for the distance of the dip of horizon must, based on your observations, result too big. Now, differences are developing in temperature, above all if it is calm or if there is only little movement in the air; in case of stronger winds one will be able to count with temperatures and differences in temperature coming up to the "average conditions", from which follows for the time of year of your observations, and as you could observe it, a decrease of m with increasing strength of wind.

It gives me great pleasure and satisfaction that your studies confirm the results of ours although they have been made quite independently and from quite different points of view —, and I think, you too will be content with my information.