CORRECTIONS TO DEEP SEA SOUNDINGS

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Historical Account

In 1962 I had only just embarked in the survey ship *Sirius* when I was assigned to service in the hydrographic department on board. My colleagues informed me that there was at that time an important problem claiming their attention. Its solution. outlined below, appears to me of great interest to all hydrographers.

After two years of hydrographic surveying for drawing up Chart No. 1000 the plotting of soundings according to their Raydist fix had showed that at the intersections of the checking lines with the sounding lines excessive errors (hundreds of metres) existed and varied with depth.

At first it was thought that these errors could be attributed to the Raydist fixes. After verification of the Raydist recordings and the calibration of equipment these fixes were found to be correct.

After this check there was no doubt whatever but that the errors must arise from the variations in the speed of rotation of the echo sounder's motor, a speed regulated to agree with the speed of sound in sea water.

These variations in the intensity of the motor's inductors could have been due to bad handling of the speed regulating control on the part of one or several operators.

When this problem was made known to the head of the hydrographic department of the DHN he at once thought that the work on soundings would be entirely useless, and that there was no means of saving the plotting sheets.

At the same time, on board we were searching to try to obtain a correct solution to the problem. Our efforts were finally successful since the survey work was not lost.

Deriving correction formulae

The deep-sea Escla Low echo-sounder has the characteristic of registering every rotation of the stylus on the Teledeltos recording paper. It

is thus possible to determine fairly easily the soundings and the number of revolutions per minute which are marked on the recorder.

We shall call :

R, the number or r.p.m. effected by the stylus;
n, the actual number of r.p.m. of the motor;
p, the recorded depth;
n_0, the number of the motor's revolutions, corresponding to a calibration of 2800 r.p.m.,
p_0, the actual depth;
v_0, the speed of sound nominally corresponding to the calibration;
v, the speed of sound corrected for sounding.

We may write :

280 R = n (Ratio between the number of rotations of the motor and that of the stylus = $\frac{1}{10}$) (1)

$$\frac{n}{n_0} = \frac{v}{v_0} \quad (2)$$

$$\frac{v}{v_0} = \frac{p}{p_0} \quad (3)$$

whence :

$$\frac{n}{n_0} = \frac{p}{p_0} \qquad \text{or } n = n_0 \frac{p}{p_0} \quad (4)$$

Substituting in formula (4) the expression of n given by formula (1) we obtain :

$$280\ \mathrm{R} = n_0 \frac{p}{p_0}, \quad \text{whence } p_0 = \frac{n_0 p}{280\ \mathrm{R}} = \frac{2800\ p}{280\ \mathrm{R}}$$

$$p_0 = p \times \frac{10}{\mathrm{R}}$$

Once the ratio $\frac{10}{\mathrm{R}}$ was obtained it was only necessary to multiply it by the recorded depth to have the actual depth p_0, which corresponds to n_0 revolutions and to the value v_0 of the nominal speed of sound in water.

Determination of " R "

In order to determine R it suffices to count the number of stylus traces between the marks inscribed at the time of the Raydist fix and to divide this number by the interval of time in minutes elapsed between two consecutive marks. In our case we pressed the marking pedal every 5 minutes and thus we should have obtained 50 stylus traces between two consecutive marks when the motor was regulated to 2800 r.p.m. The following table gives the results obtained for the various determinations of 10/R.

Day	Fixes	10/R
F	From Fix 51 to Fix 57	0.962
G	" 87 " 92	0.962
S	" 56 " 58	0.962
P	" 28 " 35	0.962
P	" 41 " 43	0.962
	" 13 " 46 and	0.962
U	" 125 " 146	
V	" 1 " 4	0.980
V	" 52 " 56	0.980
V	" 140 " 182	0.980
Z	" 69 " 73	1.000
Z	" 136 " 138	0.980
Z	" 142 " 147	0.962
Z	" 147 " 152	0.962
Z	" 152 " 158	variable
Z	" 158 " 185	0.680
Z	" 191 " 192	variable
Z	" 192 " 221	0.680
Z	" 225 " 278	0.697
AA	All Fixes	0.697
RA	"	1.000
XF	"	0.943
ZF	"	0.943

NOTES

1.— The other fixes not listed correspond to soundings obtained with a hydrographic sounder when the ship was nearing land.

2. — Certain 10/R factors (0.697, 0.680 for example) were obtained by taking average values of R.

EXAMPLE

AA day — On this day the number of stylus traces for the 5 minute intervals varied between 71 and 72. The arithmetical mean of 71.75 traces was adopted. Thus

$$R = \frac{71.75}{5} = 14.35 \text{ and } \frac{10}{R} = 0.697.$$

Depth p determined at Fix 66 = 3700 metres.
Corrected depth p_0 : $3700 \times 0.697 = 2579$ metres
Δ_p (sounding error) = 1121 metres.