CORRESPONDENCE.

ASSURANCES WITH RETURN OF PREMIUMS.

To the Editor of the Journal of the Institute of Actuaries.

SIR,—On p. 163 of the October No. of the *Journal*, Mr. King gives a corrected solution of the problem discussed on p. 293 of the *Text-Book*, Part II, namely:—"To find the annual premium for a "whole-life assurance, under the condition that all the premiums "paid are to be returned, with compound interest at rate j, along "with the sum assured, the premiums to be calculated at rate i; "when of necessity i is $>j$." By slightly modifying the solution, the result may, I think, be made rather more suitable for numerical calculation. We have, denoting the annual premium by π,

$$\left.\begin{array}{l}\text{Value of return}\\ \text{in respect of}\\ \text{1st premium}\end{array}\right\} = \frac{\pi}{D_x}\{(1+j)C_x \quad +(1+j)^2C_{x+1}+(1+j)^3C_{x+2}+\&c.\}$$

$$\left.\begin{array}{l}\text{Value of return}\\ \text{in respect of}\\ \text{2nd premium}\end{array}\right\} = \frac{\pi}{D_x}\{(1+j)C_{x+1}+(1+j)^2C_{x+2}+(1+j)^3C_{x+3}+\&c.\}$$

&c. &c.

The total value of the return in respect of the premiums will therefore be (by summing perpendicularly)

$$\frac{\pi}{D_x}\{(1+j)M_x+(1+j)^2M_{x+1}+\&c.\}.$$

We see that the terms in this expansion respectively represent the value of the return in respect of the *last* premium paid, the last premium but one, and so on; and, in fact, the formula might have been at once deduced in this manner.

The formation of the selected terms necessary for summation by Lubbock's formula, if we use Mr. King's expression, involves the calculation of $\log M'_x$ at a special rate of interest, and even if we use the modified formula $\frac{C'_x+C'_{x+1}(1+a_{\overline{1}|})+\&c.}{D'_x}$, we have to form $\log C_x$ at a special rate of interest. By the formula given above, however, the calculation takes the form $\log M_{x+n}+\log(1+j)^{n+1}$, and as both these logs are usually tabulated the work will be small.

I am, Sir,
Your obedient servant,
G. J. LIDSTONE.

4 *&* 5 *King William Street, E.C.*,
17 *October* 1889.