CORRESPONDENCE.

SOLUTION OF PROBLEM PROPOSED BY JUVENIS.

To the Editor of the Assurance Magazine.

SIR,—Referring to the question proposed by Juvenis, in the April Number of the *Magazine*, I send the particulars of the method which I adopted to find an approximate solution.

The question is, if I understand it correctly, "What is the value of a perpetuity to be enjoyed by 48, in the event of 55, 53, 51, and 50, all dying before him; the first payment to be made at the end of the year in which the *last* of these four lives should fail?"

The value of this perpetuity, at 4 per cent, will be equal to an assurance of £26, payable if 55, 53, 51, and 50, should all die before 48. In order to simplify the solution, I substituted a single life, corresponding to the value of an annuity on the *longest* of the four lives, and found the value of an assurance payable if the single life, thus obtained, should die before 48. The value was, at 4 per cent. and using the Carlisle tables, 3·7752 years' purchase of the rental of the estate.

There are, however, many things which would have an important bearing on this value; for instance, the state of 48's health and of that of the other lives, whether they are related to each other by blood, &c.; in short, actuaries would, in stating a value, be guided more by their own judgment than by any tabular or mathematical value, which can only, without great trouble, be approximate. If 48 were selling his interest, it is quite probable that he would only realise two years' purchase for it.

I am, Sir,
Yours obediently,
T. M.

THE SAME SUBJECT.

To the Editor of the Assurance Magazine.

SIR,—The suggestion made by Juvenis in the last April Number of our *Journal* is one which I, and I believe many others engaged in our pursuits, would be glad to see extensively acted upon.

The estimates of actuaries are now constantly made the subjects of discussion in courts of law and equity and before other tribunals; and the great difference of opinion which they so frequently exhibit becomes conspicuous, and tends to bring such estimates into doubt and general discredit. Any process, therefore, which will serve to bring this want of agreement

within reasonable limits is most desirable; and since the one suggested by Juvenis is obviously calculated to effect this object, it appears to me well deserving of our support, and I for one shall hope to see a constant succession of questions or cases put forward, and some agreement arrived at as to the principles in accordance with which they should be solved; for it is in the difference of the principles adopted for the solution, and not in the mere calculation, that the discrepancies most commonly arise—that is to say, the discrepancies are of a logical rather than of a mathematical kind. This will, I dare say, appear in the solutions to the question proposed by Juvenis, supposing more than one solution to be given.

It is not unlikely that the proposer contemplates a strictly mathematical solution, involving a minute investigation of the probabilities of survivorship amongst the lives he has enumerated. That would not be the view taken by an actuary before whom the case came in the ordinary way for an opinion. He would seek to discover what sum could be safely invested in the purchase of such a reversion, and what it would cost to assure against the contingencies affecting it; and he would find in that point of view that such a reversion was worthless. Hence we see that in this case, as in almost all others, more than one solution can be given; and our attention is directed to the importance of ascertaining what interpretations can be put upon a question, and of guarding against a solution intended for one of them being mistaken for another.

I am, Sir,
Your obedient servant,
A FELLOW OF THE INSTITUTE.

ON THE VALUE OF OPTIONS.

To the Editor of the Assurance Magazine.

Dear Sir,—In the last Number of your *Journal* a letter by Mr. Makeham is inserted, in which the writer endeavours to prove that the method which I had previously given for finding the single premium for a deferred annuity, with the condition that the premium shall be returnable (without interest) at death or, at the option of the purchaser, at any time before the annuity becomes payable, is defective, inasmuch as in his opinion it provides only for the deferred annuity and the return of the premium in the event of death; which return he assumes that I have made payable, with one year's interest thereon, at the end of the year in which the life fails.

My present object is, in the first place, to show that Mr. Makeham has entirely overlooked the very point on which alone the interest in the problem may be supposed to rest, as he "naively," but erroneously, remarks, "*that in assurances of this description the value of the policy always exceeds the premium paid upon it—a circumstance which does not depend upon the mode of computing the premium, but arises from the nature of the contingency itself*"; and in the second place I wish to point out, that in the solution which I have given the sum returnable is P_x, and is made *at the time of*, or *prior to*, death, and is not $P_x(1+i)$; nor is it made at the end of the year in which the life fails, as Mr. Makeham has assumed.

It can hardly be necessary for me to refute the assertion that "*the*