A NOTE ON THE ARITHMOMETER AS AN AID TO
ACTUARIAL WORK.

By F. J. Jacobs, A.I.A.

The arithmometer is peculiarly adapted for working out the
chief details of a classified valuation of a life assurance office.
The process is a simple one, being merely a series of multiplica-
tions, and the work can be carried out very rapidly by an
ordinary computer. The results worked out and set down by
one computer can be checked and verified by a second com-
puter using a different machine, while any errors in the
original work may be investigated by a third worker, using a
third machine. By this means complete accuracy is ensured,
and the use of the different machines avoids any possibility of
error should either of them happen to fall out of order and
become liable to repeat its own mistakes.

Several able expositions of the uses of the arithmometer
have been published, and amongst them may be cited papers
by Major-General Hannuyngton and Mr. Peter Gray in the
16th and 17th volumes respectively of the Journal of the In-
stitute of Actuaries. At the beginning of his paper Mr. Gray
remarks:—“It is usual to describe the arithmometer as a
machine which enables a person, however unskilled himself,
to perform the operations of multiplication and division with
facility, rapidity, and unfailing accuracy. This, as a descrip-
tion, is correct as far as it goes, but as an enumeration of the
properties of the machine it is inadequate and defective. It
entirely omits that property which forms its special adapta-
tion to our purpose, and in default of which its utility would
be comparatively limited. Besides the facilitation of the
operations named the machine will also in forming the product
of two given numbers either add that product to or subtract
it from another given number according to the pleasure of the
operator.” Mr. Gray then proceeds to give illustrations of
the adaptability of the machine for the construction of tables,
and amongst the acturial problems he investigates are:—

1. To form a table of assurances from a corresponding
table of annuities.

2. To construct a table of policy values from a given
table of annuities.

3. To construct commutation columns from any given
mortality table.

Amongst modern tables constructed by the calculating
machine must be mentioned those computed by Mr. David
Carment, F.I.A. A copy of the work is submitted for inspec-
tion. These tables show the value at the end of any number of years of an endowment assurance for £100, payable at different ages and under different rates of interest, according to the "Institute of Actuaries H.M. Tables of Mortality." In constructing these tables Mr. Carment utilised a modification of Gray's continuous method, and, speaking briefly, the work consisted in placing upon the machine a constant (the reciprocal of a certain function) and multiplying this by the successive differences of another function, the results being, of course, taken down after each operation. The process of the work is lucidly explained by Mr. Carment in the preface to his tables. It must be noted that the multiplication referred to is performed continuously, and that each step is performed without erasing the result attained by the preceding operation. The correctness of each column of results is proved by a very simple calculation. The whole of the tables were calculated by means of the arithmometer, with the exception of a small portion at the end, which, owing to the partial breakdown of the author's machine, were done by another process; the book is an interesting example of the work that can be performed by the calculating machine.

I have frequently had occasion to use the arithmometer in the computation of different results, and have found it a most correct and expeditious means of performing work that might, under ordinary circumstances require a tedious mental application. The arithmometer now exhibited by Mr. Johnston is, as he has stated, of the latest pattern, and combines the original model with a stability and perfection of construction that should reduce to a minimum the possibility of errors arising from imperfect or impaired machinery.