Mathematical Association

502. Note on the Teaching of the Mean Value Theorem and Its Extensions
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the order to be given at a given point on Pp to reach Q, and at a given point on Qq to reach R?

(2) What would be the course were the order received at a given point on EW to reach R? J. D. J. BISHOP, Major, Glos. Regt.

501. [V. 1. a. δ.] *"Russian Peasant" Multiplication in Roman Numerals.*

A method of multiplication stated to be in common use among the peasantry of the villages in Russia has been brought into notice in a note recently published in America. The method involves only the operations of doubling, halving and adding, and the object of this note is to show that it can be applied equally well to numbers expressed in Roman numerals.

The method is illustrated by the following example; say 37×39.

37	39	
18	[78]	omit
9	156	
4	[312]	omit
2	[624]	omit
1	1248	
Product	1443	

The numbers in the first column are got by repeatedly halving one factor, omitting remainders; those in the second column by repeatedly doubling the other factor. The numbers in the second column which stand opposite even numbers in the first are struck out, and the sum of those standing opposite odd numbers gives the required product.

It will be seen that the process of halving the numbers in the first column is exactly the same as would be required to express this factor in the binary scale of notation, only, instead of the remainders being written down, their positions are indicated by the odd numbers in the column. Thus $37 = 100101$ or $2^5 + 2^2 + 1$; and the numbers added in the second column represent 39 multiplied by 1, 2^2, 2^5 respectively.

When applied to Roman numerals, the process stands thus, for example: Multiply XLVI by LXIII.

XLVI	[LXIII]	omit
XXIII	CXXVI	
XI	CCLII	
V	DIV	
II	[MVIII]	omit
I	MMXVI	
	MMDCCCXCVIII	

G. H. BRYAN.

502. [C. 1. e. g.] *Note on the Teaching of the Mean Value Theorem and its Extensions.*

Two of the greatest stumbling blocks to the ordinary student of the Differential Calculus are the Mean Value Theorem and Taylor's Theorem. The argument given in Lamb's *Calculus*, § 56, is easy to follow, but there is always difficulty in writing down the function in (2). I suggest that the idea of comparison of $y=f(x)$ with another curve, as in § 66, be used for the Mean Value Theorem. Not only does that course simplify the proof of the Theorem itself, but it forms an easy introduction to the work of §§ 66 and 67, often found difficult. Starting by comparing $y=f(x)$ with $y=Ax+B$, we have the proof of the Mean Value Theorem. Proceeding then to a comparison with $y=Ax^2+Bx+C$, we obtain the results of §§ 66 and 67. The student then finds it fairly easy to extend the method to the proof of Taylor's Theorem as follows:

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Writing $$F(x)=f(x)-[A_n x^n+\dots+A_r x^r+\dots+A_0],$$
we determine $A_0, A_1, \dots A_n$ by the $(n+1)$ conditions,
$$F(a)=0,\ F_1(a)=0, \dots F_{n-1}(a)=0,\ F(a+h)=0.$$
The usual argument gives
$$n!A_n=f_n(a+\theta h).$$
The $(n+1)$ conditions defining $A_0, A_1, \dots A_n$ give
$$f(a)=A_n a^n+\dots+A_r a^r+\dots+A_0,$$
$$f_1(a)=nA_n a^{n-1}+\dots+rA_r a^{r-1}+\dots+A_1,$$
$$\dots\dots\dots\dots\dots\dots,$$
$$f_r(a)=\frac{n!}{(n-r)!}A_n a^{n-r}+\dots+r!Ar,$$
$$f_{n-1}(a)=\frac{n!}{1!}A_n(a)+(n-1)!A_{n-1}.$$
Hence $$f(a)+hf'(a)+\dots+\frac{h^{n-1}}{(n-1)!}f_{n-1}(a)$$
$$=A_0+\dots+A_r(a+h)^r+\dots+A_n[(a+h)^n-h^n]$$
$$=f(a+h)-A_n h^n.$$
Substituting the value of A_n, the result follows.

University of Queensland. H. J. PRIESTLEY.

503. [V. i. a. δ.] *Arithmetical Accuracy Test.*

Last summer an accuracy test was carried out in sixteen Public Schools of various types.

The papers and a summary of the results are printed below. The time allowed was 40 minutes. Each question was marked right or wrong, and the number who failed to get the right answer was recorded.

THE PAPERS.

A. 1. Add the ten sums of money given below. [£152,328 16s. 9d.
2. Express 200,000 inches as a compound quantity, in mi., yd., ft., in. [3, 275, 1, 8.
3. Find the value of $(23{\cdot}7 \times 0{\cdot}315)^2$, to three significant figures. [55·7.
4. Express $\frac{£2.\ 17s.\ 7d.}{£11.\ 13s.\ 6d.}$ as a decimal, to three significant figures. [0·616.
5. Find, to the nearest sq. ft., the total area of 20 boards, each 8 ft. 6 in. by 11 in. [156 sq. ft.

B. 1. Add the first *nine* sums of money given below. [£146,608. 17s. 1d.
2. Express 200,000 sec. as a compound quantity, in days, hours, etc. [2, 7, 33, 20.
3. Multiply 347 by 0·0365. [12·6655.
4. Divide 2·7 by 514·3, to five decimal places. [0·00525.
5. Multiply $3\frac{1}{5}$ by $2\frac{1}{3}$ and subtract the result from $10\frac{1}{12}$. [$2\frac{37}{60}$.

C. 1. Add the first *six* sums of money given below. [£101,056. 7s. 6d.
2. Reduce 6 t. 12 cwt. to pounds. [14784 lb.
3. Multiply 0·216 by 0·358. [0·077328.
4. Divide 1·63 by 8·54, to three decimal places. [0·191.
5. Multiply $12\frac{2}{7}$ by $5\frac{2}{3}$. [$70\frac{3}{7}$.

D. 1. Add the *last six* sums of money given below. [£98,379. 10s. 8d.
2. Reduce £253. 17s. 3d. to pence. [60927d.

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