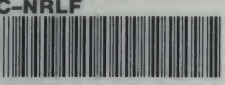

are now ready.

In the **PRIMER** the vowel sounds are presented in an easy and natural manner, being in every case exemplified by real words rather than by arbitrary syllables, and arranged in rhyming groups. The lessons are composed of sentences woven into narratives, and hieroglyphic lessons have been introduced for the purpose of making the work of revisal more varied and interesting.

In the **FIRST STANDARD** the narrative form has been preserved throughout, and the lessons, while incidentally supplying considerable information, are mainly intended to enable the child to overcome the mechanical difficulties of reading. They have therefore been made as light and attractive as possible; many elliptical, and, as a new feature, several alliterative and hieroglyphic, lessons have been constructed. Easy lessons are also given in Script for the reading and writing of Manuscript.

In the **SECOND STANDARD** a variety of interesting matter has been simplified by the syllabification of difficult words and the grouping together of common affixes. A novel feature is the introduction of lessons on the Tenses of Verbs. Useful information is imparted on common objects and animals, with lessons inculcating duty and honour. In Dictation a large proportion of the matter is shown in Script; while the Exercises

appended to these, direct increased attention to the subjects presented, and furnish plenty of school-work.

In the **THIRD STANDARD**, as the child will now have acquired considerable fluency in easy reading, a varied selection has been made from authors that have long been favourites with the young. In the Dictation all the difficulties in spelling monosyllables and easy dissyllables have been anticipated, and the Exercises, which are partly in Script, have been constructed so as to foster the habit of observing words and their distinctions.

II. GEOGRAPHY.

Three little works have been prepared by Mr W. Lawson, F.R.G.S., St Mark's College, Chelsea; Author of "Geography of the British Empire," etc.

1. The **GEOGRAPHICAL PRIMER** will be found adapted to the requirements of Standard IV. The meaning of a Map is clearly explained; an outline is given of the Chief Divisions of the World; while the numerous facts have been selected and arranged to suit the age of the pupils.

2. The **GEOGRAPHY OF ENGLAND** meets the requirements of Standard V., and is intended to succeed the "Geographical Primer." The style and subject are a little in advance, and there is some attempt to show the dependence of one part of the geography upon another. A Chapter on the principal Railways will be found to meet the increasing desire for information on this subject.

3. **ELEMENTS OF PHYSICAL GEOGRAPHY.** This work has been written as a "Specific Subject," with special reference to the New Code. The language and illustrations are simple, and suited to the capacity of pupils of from ten to fourteen years of age.

III. ARITHMETIC.

This subject has been undertaken by Mr Alex. Trotter, Teacher of Mathematics, etc., Edinburgh; Author of "Arithmetic for Advanced Classes," etc.

Part I. embraces Standards 1 and 2.
,, II. ,, ,, 3 and 4.
Part III. (*in preparation*) will embrace Standards 5 and 6.

[*Continued at end of Book.*

LESSONS

IN

ARITHMETIC

FOR

Junior Classes.

WITH

TABLES OF MONEY, WEIGHTS, AND MEASURES,

ACCORDING TO THE IMPERIAL STANDARDS.

By JAMES TROTTER,

LATE OF THE SCOTTISH NAVAL AND MILITARY ACADEMY,

Author of "A Complete System of Arithmetic," etc.

New Edition.

EDINBURGH:

OLIVER AND BOYD, TWEEDDALE COURT.

LONDON: SIMPKIN, MARSHALL, AND CO.

Price 6d., or 8d. cloth. Advanced Arithmetic, in Continuation of this Work, 6d., or 8d. cloth. Also, strongly bound together in leather, 1s. 3d. Answers to both Works, 6d. each.

1872.

SCHOOL-BOOKS BY JAMES TROTTER,

LATE OF THE SCOTTISH NAVAL AND MILITARY ACADEMY.

LESSONS in ARITHMETIC for Junior Classes. 6d.

A COMPLETE SYSTEM of ARITHMETIC, Theoretical and Practical. 3s.

TROTTER'S EDITION of HUTTON'S BOOK-KEEPING. 2s.

A COMPLETE SYSTEM of MENSURATION, by Ingram & Trotter. 2s.

INGRAM and TROTTER'S EUCLID; containing the Elements of Plane Geometry and Trigonometry 1s. 6d.

INGRAM'S CONCISE SYSTEM of MATHEMATICS. Revised by Mr Trotter. 4s. 6d.

TROTTER'S LOGARITHMS and PRACTICAL MATHEMATICS. 3s.

INGRAM and TROTTER'S ELEMENTS of ALGEBRA. 3s.

PRINTED BY OLIVER AND BOYD, EDINBURGH.

ADVERTISEMENT TO THE ENLARGED EDITION.

The following little Work was originally composed for the use of the Author's Junior Classes. It was afterwards submitted to the public, in the hope that it would be found worthy of an introduction to Public Schools and Academies, and that, from the number and variety of the Exercises, it might prove a useful auxiliary to Governesses and Families.

This hope having been fully realized, the present Edition has been subjected to a careful revision, and enlarged by the introduction of simple illustrations of the various rules and of a considerable number of Practical Exercises; at the end of the work also, are given Exercises on that system of Decimal Coinage which, in course of time, is most likely to be adopted in this country.

These additions have been made by the Author's son, Mr Trotter, Teacher of Mathematics, &c., who has recently prepared a Continuation of this Work for Advanced Classes.

MULTIPLICATION TABLE.

2 times	4 times	6 times	8 times	10 times	12 times
2 are 4	2 are 8	2 are 12	2 are 16	2 are 20	2 are 24
3 ... 6	3 ... 12	3 ... 18	3 ... 24	3 ... 30	3 ... 36
4 ... 8	4 ... 16	4 ... 24	4 ... 32	4 ... 40	4 ... 48
5 ... 10	5 ... 20	5 ... 30	5 ... 40	5 ... 50	5 ... 60
6 ... 12	6 ... 24	6 ... 36	6 ... 48	6 ... 60	6 ... 72
7 ... 14	7 ... 28	7 ... 42	7 ... 56	7 ... 70	7 ... 84
8 ... 16	8 ... 32	8 ... 48	8 ... 64	8 ... 80	8 ... 96
9 ... 18	9 ... 36	9 ... 54	9 ... 72	9 ... 90	9 ... 108
10 ... 20	10 ... 40	10 ... 60	10 ... 80	10 ... 100	10 ... 120
11 ... 22	11 ... 44	11 ... 66	11 ... 88	11 ... 110	11 ... 132
12 ... 24	12 ... 48	12 ... 72	12 ... 96	12 ... 120	12 ... 144

3 times	5 times	7 times	9 times	11 times	20 times
2 are 6	2 are 10	2 are 14	2 are 18	2 are 22	2 are 40
3 ... 9	3 ... 15	3 ... 21	3 ... 27	3 ... 33	3 ... 60
4 ... 12	4 ... 20	4 ... 28	4 ... 36	4 ... 44	4 ... 80
5 ... 15	5 ... 25	5 ... 35	5 ... 45	5 ... 55	5 ... 100
6 ... 18	6 ... 30	6 ... 42	6 ... 54	6 ... 66	6 ... 120
7 ... 21	7 ... 35	7 ... 49	7 ... 63	7 ... 77	7 ... 140
8 ... 24	8 ... 40	8 ... 56	8 ... 72	8 ... 88	8 ... 160
9 ... 27	9 ... 45	9 ... 63	9 ... 81	9 ... 99	9 ... 180
10 ... 30	10 ... 50	10 ... 70	10 ... 90	10 ... 110	10 ... 200
11 ... 33	11 ... 55	11 ... 77	11 ... 99	11 ... 121	11 ... 220
12 ... 36	12 ... 60	12 ... 84	12 ...108	12 ... 132	12 ... 240

EXPLANATION OF ARITHMETICAL TERMS AND SIGNS.

NUMBER is either a *unit*, or consists of a *collection* of units; being the name given to our conception of things considered as *one* or *many*.

ABSTRACT NUMBERS. When we consider numbers in their general nature, without referring them to any particular subject, they are then called *abstract;* as, 3, 7, 10, &c.

CONCRETE OR APPLICATE NUMBERS. When we consider number not in its general nature, but as applied to certain particular things, as, two pounds, three pence, &c., it is termed *concrete* or *applicate.*

A WHOLE NUMBER consists of one or more units.

A FRACTION consists of one or more parts of unity.

A MIXED NUMBER consists of a whole number and a fraction.

A COMPOUND NUMBER consists of several applicate numbers joined together in one expression; as, £4, 6s. 8d.

AN EVEN NUMBER is that which can be divided into two equal whole numbers.

AN ODD NUMBER is that which cannot be divided into two equal whole numbers.

A PRIME NUMBER is that which can only be divided by itself and unity, without a remainder; and numbers are said to be prime to each other when no number but unity will divide both without a remainder.

A SQUARE NUMBER is the product of any number by itself.

A CUBE NUMBER is the product of a number and its square.

A COMPOSITE NUMBER is that produced by multiplying two or more numbers together; thus $28 = 4 \times 7$ is a composite number, and 4 and 7 are called its *component* parts.

AN ALIQUOT PART is a number which is contained in a greater an exact number of times; thus 4 is an aliquot part of 16, but not of 17, as it is contained exactly 4 times in the former, and in the latter 4 times and 1 over.

AN INTEGER is any whole number; as, a pound, a mile, &c., or, 1, 2, 4, 6, 9, &c.

MINUEND is the greater number in Subtraction.

SUBTRAHEND is the less number.

MULTIPLICAND in Multiplication is the number to be multiplied or repeated.

MULTIPLIER is the number by which we multiply, or which expresses how often the multiplicand is to be repeated.

PRODUCT is the sum or result of the operation in Multiplication.

FACTORS. The multiplicand and multiplier are called *factors* of the product.

DIVISOR in Division is the number by which we divide.

DIVIDEND ..... is the number to be divided.

QUOTIENT ..... is the number which shows how often the divisor is contained in the dividend, or the result of the operation.

DENOMINATION in applicate numbers is the name of the subject to which the number is applied; as, pounds, shillings, yards, miles, &c.

NUMERATOR is the upper number of a fraction, and shows how many parts of unity are expressed by the fraction.

DENOMINATOR is the under number of a fraction, and shows into how many parts the unit is divided.

A COMMON MEASURE is any number that will divide two or more numbers without a remainder, and their *greatest common measure* is the greatest number that will do so thus 2 is a common measure of 12 and 18, and 6 is their greatest common measure.

A COMMON MULTIPLE of two or more numbers is any number that contains each of them an exact number of times, and the least number that will do so is called their LEAST COMMON MULTIPLE; thus 48 is a common multiple of 12, 6, and 4, and 12 is their least common multiple.

= (*equal to*)	denotes *equality;*	thus 21s. = 1 guinea.	
+ (*plus*)	..... *addition;*	thus 6 + 4 = 10.	
− (*minus*)	..... *subtraction;*	thus 7 − 3 = 4.	
× (*multiplied by*)	..... *multiplication;*	thus 4 × 3 = 12.	
÷ (*divided by*)	..... *division;*	thus 18 ÷ 6 = 3.	

: (*is to*) : : (*as*) are signs used in *proportion* to denote an *equality* of *ratios;* thus 4 : 6 : : 8 : 12 denote that the *ratio* of 8 to 12 is the same as that of 4 to 6, and is read, 4 is to 6 as 8 is to 12.

¼ represents a *farthing*, or the *quarter* of any thing.
½ ..... a *halfpenny*, or the *half* of any thing.
¾ ..... *three farthings*, or *three quarters* of any thing.

ARITHMETICAL TABLES.

ADDITION AND SUBTRACTION TABLE.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

NOTE. Before commencing Arithmetic it is absolutely necessary that the pupil should commit to memory that part of the preceding table which is cut off by a double line. The remaining part should likewise be learned as soon as possible. The same remark applies to the Multiplication and Division Table on the next page, as well as to all the tables which follow. Indeed the earlier that a child begins to learn the Arithmetical Tables, the more lasting will the impression be upon the mind, and his progress in Arithmetic afterwards will be easy and unobstructed.

MULTIPLICATION AND DIVISION TABLE.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
3	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
4	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
5	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
6	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
7	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140
8	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160
9	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180
10	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
11	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	187	198	209	220
12	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
13	13	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260
14	14	28	42	56	70	84	98	112	126	140	154	168	182	196	210	224	238	252	266	280
15	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300
16	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288	304	320
17	17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340
18	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306	324	342	360
19	19	38	57	76	95	114	133	152	171	190	209	228	247	266	285	304	323	342	361	380
20	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

NOTE. In using the preceding table for a Division one, we take the numbers in the left-hand column out of the numbers in the same horizontal line, and the number of times each is contained will be found either in the top or bottom line.

STERLING MONEY.

4 farthings *qrs.*	= 1 penny	*d.*
12 pence	= 1 shilling	*s.*
5 shillings	= 1 crown	*cr.*
20 shillings	= 1 pound or sovereign	£
21 shillings	= 1 guinea	*G.*

TROY WEIGHT.

24 grains *gr.*	= 1 pennyweight	*dwt.*
20 dwt.	= 1 ounce	*oz.*
12 ounces	= 1 pound	*lb.*

Gold, Silver, and Jewels, are weighed by Troy Weight.

APOTHECARIES' WEIGHT.*

20 grains *gr.*	= 1 scruple	℈
3 scruples	= 1 dram	ʒ
8 drams	= 1 ounce	℥
12 ounces	= 1 pound	*lb.*

Used only for medical prescriptions.

AVOIRDUPOIS WEIGHT.

16 drams *dr.*	= 1 ounce	*oz.*
16 ounces	= 1 pound	*lb.*
28 pounds	= 1 quarter	*qr.*
4 quarters	= 1 hundred wt.	*cwt.*
20 hund wt.	= 1 ton	*T.*
112 lbs.	= 1 cwt.	

7000 grains	= 1 lb. avoird.
14 lb.	= 1 stone

This table is used for all articles, except Gold, Silver, and Jewels.

LINEAL MEASURE.

12	lines *li.*	= 1 inch	*in.*
12	inches	= 1 foot	*ft.*
3	feet	= 1 yard	*yd.*
5½	yards	= 1 pole	*po.*
40	poles	= 1 furlong	*fur.*
8	furlongs	= 1 mile	*mi.*
1760	yards	= 1 mile	

2 yds. or 6 feet	= 1 fathom
2½ feet	= a military pace
4 inches	= 1 hand
1½ foot	= 1 cubit
22 yds. or 66 ft.	= 1 chain; and as the chain contains 100 links, each link is = 7·92 inches, and 80 chains = 1 mile.

CLOTH MEASURE.

2¼ inches	= 1 nail	*nl.*
4 nails	= 1 quarter	*qr.*
4 quarters	= 1 yard	*yd.*

3 quarters	= 1 Flemish ell *Fl. e.*
5 quarters	= 1 English ell *En. e.*
6 quarters	= 1 French ell *Fr. e.*
37 inches	= 1 Scotch ell *Sc. e.*

GEOGRAPHICAL MEASURE.

6076 feet nearly	= 1 geo. mile
3 miles	= 1 league *le.*
20 leagues	= 1 degree *deg.* or °
360 degrees	= the earth's circumference

SQUARE, OR LAND MEASURE.

144 square inches	= 1 square foot	
9 sq. feet	= 1 square yard	
30¼ sq. yards	= 1 pole or perch	
40 perches	= 1 rood	*ro.*
4 roods	= 1 acre	*ac.*
640 acres	= 1 sq. mile	

36 sq. yards	= 1 rood of building
100 sq. feet	= 1 square of flooring
10 sq. chains, or 100,000 sq. links	= 1 acre

CUBIC, OR SOLID MEASURE.

1728 cubic inches	= 1 cubic foot	
27 cubic feet	= 1 cubic yard	
40 cubic feet of rough, or 50 of hewn timber	= 1 load	*lo.*
42 cubic feet	= 1 ton shipping	
5 cubic feet	= 1 barrel bulk	

MEASURE OF CAPACITY.

2 pints *pt.*	= 1 quart	*qt.*
4 quarts	= 1 gallon	*ga.*
2 gallons	= 1 peck	*pk.*
4 pecks	= 1 bushel	*bu.*
8 bushels	= 1 quarter	*qr.*

ANGULAR MEASURE.

60 seconds ″	= 1 minute	′
60 minutes	= 1 degree	°
30 degrees	= 1 sign	*s.*
12 signs	= 1 circle	*circ.*

* In the British Pharmacopœia (1864), the oz. Troy of 480 grains has been abolished, while the lb. avoir. of 7000 grains, and the oz. avoir. of 437½ grains, have been adopted.

APOTHECARIES' FLUID MEASURE.*

60 minims *min.*	= 1 drachm	*fl. drm.*
8 drachms	= 1 ounce	*fl. oz.*
20 ounces	= 1 pint	O.
8 pints	= 1 gallon	C.

QUARTERLY TERMS.

In England.

Lady-day,	March 25.
Midsummer,	June 24.
Michaelmas,	September 29.
Christmas,	December 25.

In Scotland.

Candlemas,	February 2.
Whitsunday,	May 15.
Lammas,	August 1.
Martinmas,	November 11.

FLOUR & BREAD WEIGHT.

A peck-loaf	= 17 lb. 6 oz. avoird.
A half-peck do.	= 8 11 —
A quarter-loaf	= 4 5½ —

A peck of flour is 14·44 lb., or 14½ lbs. nearly, and a bushel 57¾ lbs. very nearly. Five bushels make a sack, which ought to weigh 288·8 lbs. avoirdupois.

HAY AND STRAW WEIGHT.

36 lbs. avoir.	= 1 truss of straw
56 lbs.	= 1 truss of old hay
60 lbs.	= 1 truss of new hay
36 trusses	= 1 load

Hay sold between the beginning of June and the end of August, of that year's growth, is reckoned new.

TIME.

60 seconds *sec.*	= 1 minute	*mi.*
60 minutes	= 1 hour	*ho.*
24 hours	= 1 day	*da.*
7 days	= 1 week	*we.*
4 weeks	= 1 co. month	*mo.*
365 days, or 52 weeks and 1 day	= 1 co. year	*ye.*
365¼ days	= 1 Julian year	
366 days	= 1 leap year	

The year is divided into 12 calendar months, viz.:

January	31 days.	July	31 days.
February	28 —	August	31 —
March	31 —	Septem.	30 —
April	30 —	October	31 —
May	31 —	Novem.	30 —
June	30 —	Decem.	31 —

The number of days in each month may be easily remembered from the following lines:

Thirty days hath September,
April, June, and November;
All the rest have thirty-one,
Excepting February alone,
Which hath but 28 days clear,
And 29 in each leap year.

365 days 5 hours 48 min. 50 sec. = 1 solar or tropical year.

MISCELLANEOUS TABLE.

24 sheets	= 1 quire of paper
20 quires	= 1 ream
10 reams	= 1 bale
12 articles	= 1 dozen
20 articles	= 1 score
12 dozen	= 1 gross
12 gross	= 1 great gross
120 articles	= 1 great hundred
500 bricks	= 1 load
1000 tiles	= 1 load
500 herrings	= 1 barrel
500 red do.	= 1 cade
1000 sprats	= 1 cade
60 herrings	= 1 keg
100 lbs. avoir.	= 1 barl. gunpowder
56 lbs.	= 1 firkin of butter
64 lbs.	= 1 firkin of soap
256 lbs.	= 1 barrel of soap
112 lbs.	= 1 barrel of raisins
19½ cwt.	= 1 fodder of lead

* According to the British Pharmacopœia (1864).

MONEY TABLE.

Farthings.	*Pence.*	*Pence.*	*Shillings.*	*Shillings.*	*Shillings.*
qrs. d.	d. s. d.	d. s. d.	sh. £ s.	sh. £ s.	sh. £ s.
4= 1	12=1 0	57=4 9	20=1 0	65=3 5	110=5 10
5... 1¼	13...1 1	58...4 10	21...1 1	66...3 6	111...5 11
6... 1½	14...1 2	59...4 11	22...1 2	67...3 7	112...5 12
7... 1¾	15...1 3	60...5 0	23...1 3	68...3 8	113...5 13
8... 2	16...1 4	61...5 1	24...1 4	69...3 9	114...5 14
9... 2¼	17...1 5	62...5 2	25...1 5	70...3 10	115...5 15
10... 2½	18...1 6	63...5 3	26...1 6	71...3 11	116...5 16
11... 2¾	19...1 7	64...5 4	27...1 7	72...3 12	117...5 17
12... 3	20...1 8	65...5 5	28...1 8	73...3 13	118...5 18
13... 3¼	21...1 9	66...5 6	29...1 9	74...3 14	119...5 19
14... 3½	22...1 10	67...5 7	30...1 10	75...3 15	120...6 0
15... 3¾	23...1 11	68...5 8	31...1 11	76...3 16	121...6 1
16... 4	24...2 0	69...5 9	32...1 12	77...3 17	122...6 2
17... 4¼	25...2 1	70...5 10	33...1 13	78...3 18	123...6 3
18... 4½	26...2 2	71...5 11	34...1 14	79...3 19	124...6 4
19... 4¾	27...2 3	72...6 0	35...1 15	80...4 0	125...6 5
20... 5	28...2 4	73...6 1	36...1 16	81...4 1	126...6 6
21... 5¼	29...2 5	74...6 2	37...1 17	82...4 2	127...6 7
22... 5½	30...2 6	75...6 3	38...1 18	83...4 3	128...6 8
23... 5¾	31...2 7	76...6 4	39...1 19	84...4 4	129...6 9
24... 6	32...2 8	77...6 5	40...2 0	85...4 5	130...6 10
25... 6¼	33...2 9	78...6 6	41...2 1	86...4 6	131...6 11
26... 6½	34...2 10	79...6 7	42...2 2	87...4 7	132...6 12
27... 6¾	35...2 11	80...6 8	43...2 3	88...4 8	133...6 13
28... 7	36...3 0	81...6 9	44...2 4	89...4 9	134...6 14
29... 7¼	37...3 1	82...6 10	45...2 5	90...4 10	135...6 15
30... 7½	38...3 2	83...6 11	46...2 6	91...4 11	136...6 16
31... 7¾	39...3 3	84...7 0	47...2 7	92...4 12	137...6 17
32... 8	40...3 4	85...7 1	48...2 8	93...4 13	138...6 18
33... 8¼	41...3 5	86...7 2	49...2 9	94...4 14	139...6 19
34... 8½	42...3 6	87...7 3	50...2 10	95...4 15	140...7 0
35... 8¾	43...3 7	88...7 4	51...2 11	96...4 16	141...7 1
36... 9	44...3 8	89...7 5	52...2 12	97...4 17	142...7 2
37... 9¼	45...3 9	90...7 6	53...2 13	98...4 18	143...7 3
38... 9½	46...3 10	91...7 7	54...2 14	99...4 19	144...7 4
39... 9¾	47...3 11	92...7 8	55...2 15	100...5 0	145...7 5
40...10	48...4 0	93...7 9	56...2 16	101...5 1	146...7 6
41...10¼	49...4 1	94...7 10	57...2 17	102...5 2	147...7 7
42...10½	50...4 2	95...7 11	58...2 18	103...5 3	148...7 8
43...10¾	51...4 3	96...8 0	59...2 19	104...5 4	149...7 9
44...11	52...4 4	97...8 1	60...3 0	105...5 5	150...7 10
45...11¼	53...4 5	98...8 2	61...3 1	106...5 6	151...7 11
46...11½	54...4 6	99...8 3	62...3 2	107...5 7	152...7 12
47...11¾	55...4 7	100...8 4	63...3 3	108...5 8	153...7 13
48...12	56...4 8	101...8 5	64...3 4	109...5 9	154...7 14

NUMERATION TABLE.

Units	9
Tens	98
Hundreds	987
Thousands	9; 876
Tens of Thousands	98; 765
Hundreds of Thousands	987; 654
Millions	9; 876; 543
Tens of Millions	98; 765; 432
Hundreds of Millions	987; 654; 321
Billions	9; 876; 543; 210
Tens of Billions	98; 765; 432; 109
Hundreds of Billions	987; 654; 321; 098
Trillions	9; 876; 543; 210; 987

ROMAN NOTATION.

THE Romans used the following letters only for numbers, viz. I one, V five, X ten, L fifty, C a hundred, D or Iↀ five hundred, and M or CIↀ a thousand.

Any letter followed by another of equal or less value denoted the sum of their separate values; thus III three, LXXVI seventy-six.

Any letter followed by another of greater value denoted the difference of their separate values; thus XL forty, XC ninety.

Every ↀ annexed to Iↀ, and every C and ↀ joined to CIↀ increased the value ten times; thus Iↀↀ five thousand, CCIↀↀ ten thousand.

A line drawn over a letter denoted that its simple value was increased a thousand times; thus $\overline{X}$ ten thousand, $\overline{XL}$ forty thousand.

I	or	1	XVII	or	17	LX	or 60
II	..	2	XVIII	..	18	LXX	.. 70
III	..	3	XIX	..	19	LXXX	.. 80
IV	..	4	XX	..	20	XC	.. 90
V	..	5	XXI	..	21	C	.. 100
VI	..	6	XXII	..	22	CI, &c.	.. 101
VII	..	7	XXIII	..	23	CC, &c.	.. 200
VIII	..	8	XXIV	..	24	CCCC or CD	.. 400
IX	..	9	XXV	..	25	Iↀ or D	.. 500
X	..	10	XXVI	..	26	IↀC or DC, &c.	.. 600
XI	..	11	XXVII	..	27	IↀCCCC, DCCCC, or CM	900
XII	..	12	XXVIII	..	28	CIↀ or M	.. 1000
XIII	..	13	XXIX	..	29	CIↀC or MC, &c.	.. 1100
XIV	..	14	XXX	..	30	MM or $\overline{II}$, &c.	.. 2000
XV	..	15	XL	..	40	Iↀↀ or $\overline{V}$, &c.	.. 5000
XVI	..	16	L	..	50	Iↀↀↀ or $\overline{L}$, &c.	.. 50,000

ARITHMETIC.

Arithmetic, as a science, explains the properties of numbers, and as an art, the methods of computing by them.

The fundamental rules are, Numeration, Notation, Addition, Subtraction, Multiplication, and Division.

The characters by which all numbers are expressed are, 1, *one* or *unit;* 2, *two;* 3, *three;* 4, *four;* 5, *five;* 6, *six,* 7, *seven;* 8, *eight;* 9, *nine;* 0, *cipher* or *nought.*

NUMERATION

Is the art of reading a number expressed in figures.

Trillions.	Billions.	Millions.	Thousands.	Units.
604;	450;	360;	412;	474.

Read or write in words the following:

24079—Twenty-four thousand and seventy-nine.

79—97—18—24—81—67—76—35—67—26—53—91—19—48—101—208—84—110—802—111—109—119—125—152—319—913—301—310—4617—4107—4170—28410—20814—5106—74125—47010—2097431—501746—730087—1730086—9704010—21070—20202020—5170409—2017101—74107—1074010—29654301—102030401—157301074—748017018—547207542—63710073001—54872195543270.

NOTATION

Is the art of expressing any given number in figures.

Express in figures the following:

Five thousand and sixty-four—5064.

Seventy-four—ninety-six—one hundred and one—one hundred and ten—one hundred and eleven—two hundred and eight—one hundred and eighteen—one hundred and thirty-one—one hundred and thirteen—seven hundred and eight—nine hundred and eighty—two thousand, three hundred and twenty-one—nine thousand and seven—twenty-one thousand and ten—one hundred and fifty thousand and five—six millions, forty thousand and thirty—eighty-nine millions, one hundred and forty thousand and twenty-six—seven hundred billions, ten millions, eleven thousand, one hundred and one—four hundred and one millions, seventy thousand and seventeen—eight trillions, twenty billions, sixty-nine millions, four thousand and sixty-three.

SIMPLE ADDITION

Is the method of finding a number equal to several numbers taken together. The number found is called the *sum* or *amount*.

EXERCISES ON THE ADDITION TABLE.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1	2	3	4	5	6	7	8	9	4	5	6	7
1	2	3	4	5	6	7	8	9	3	4	5	6
1	2	3	4	5	6	7	8	9	2	3	4	5
1	2	3	4	5	6	7	8	9	1	2	3	4
1	2	3	4	5	6	7	8	9	4	1	2	3
1	2	3	4	5	6	7	8	9	2	5	1	2
1	2	3	4	5	6	7	8	9	3	2	5	7
7	14	21	28	35	42	49	56	63	19	22	26	34

14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.
7	6	9	5	4	9	7	7	6	3	6	2	6	2	4
3	3	5	2	2	1	3	4	4	4	2	1	7	3	5
9	8	4	1	7	2	8	8	8	5	7	2	8	4	6
6	4	3	4	1	4	1	2	7	9	3	3	9	5	7
5	2	6	8	6	6	5	1	3	6	1	4	1	6	8
4	1	2	3	8	7	4	1	5	8	2	6	2	7	9
2	6	1	7	5	5	2	3	4	7	2	1	3	8	2
8	8	8	9	9	8	6	3	2	3	3	2	4	9	4
4	4	7	6	3	3	9	4	1	4	4	3	5	1	5
7	5	3	8	2	6	7	2	1	5	4	4	6	2	6
1	2	6	2	7	4	3	1	2	6	2	5	7	3	7

29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.
7	4	7	8	1	7	4	7	9	9	6	3	5	7	9
2	2	9	7	9	2	2	9	7	2	7	8	2	2	5
6	3	6	6	6	1	9	6	5	8	4	1	1	9	4
1	1	5	2	3	8	9	3	6	6	8	7	4	8	6
8	8	4	1	4	4	8	8	3	8	2	4	7	5	7
3	7	2	3	8	2	7	7	8	4	4	2	9	3	2
9	5	1	8	7	1	5	2	7	2	8	6	8	1	1
5	4	3	4	2	3	6	9	4	2	2	9	3	4	3
6	2	9	6	1	8	7	8	5	8	6	8	6	7	5
4	1	5	2	6	2	8	4	8	7	5	3	9	2	7
5	3	2	1	1	1	5	6	3	4	1	7	4	3	9
3	8	1	8	8	6	4	3	7	6	2	9	8	9	6

Example. Add together 847, 478, 19, and 951. Ans. 2295.

Solution. Arrange the numbers as in the margin; adding the units' or right-hand column, 1 and 9 are 10 and 8 are 18 and 7 are 25; write down 5 and *carry* 2 to the second column: 2 and 5 are 7 and 1 are 8 and 7 are 15 and 4 are 19; write down 9 and *carry* 1 to the third column: 1 and 9 are 10 and 4 are 14 and 8 are 22; write down 22, and the answer is 2295.

847
478
19
951
2295

The work may be checked by adding the columns downwards.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
234	754	869	549	214	314	987	374	215	118
982	475	698	495	421	431	879	743	152	181
342	638	986	218	638	209	798	437	521	811
758	863	213	821	863	920	654	865	634	214
875	921	542	637	759	516	465	685	463	579
426	192	121	736	975	651	546	856	346	798

11.	12.	13.	14.	15.	16.	17.	18.
7486	2146	4816	5411	2222	8888	5555	4848
4867	6412	6184	2196	3333	9999	6666	5959
2194	1093	7298	3482	4444	1111	7777	6767
1942	3901	8735	9876	5555	2222	8888	7676
7368	2473	4567	3846	6666	3333	9999	9595
3687	3742	8912	2198	7777	4444	1111	8484

19.	20.	21.	22.	23.	24.	25.	26.
1234	7921	4869	1276	1874	2764	4872	5729
5678	1297	5728	2761	7481	6427	3481	5278
9012	3808	6372	3849	2310	3818	5834	6483
3456	8076	7184	4598	1046	2984	6287	7321
7890	5487	8296	5623	9875	4629	7821	1234
1234	7923	9543	6312	5793	9273	1234	5678

27.	28.	29.	30.	31.	32.	33.	34.
9847	2146	4121	1214	2009	9817	9002	7189
6438	6148	1246	6421	9002	1789	2009	9871
5279	5437	3459	9543	4716	2138	6174	8312
7346	2977	9528	8259	6174	4817	4716	7184
8978	3888	6473	3746	8136	7864	6318	4687
6438	8436	8987	7898	2198	3189	8912	9813

35.	36.	37.	38.	39.	40.	41.	42.
8729	4816	7286	9112	9876	5469	5726	8768
7298	3729	3465	2968	2187	3874	6275	7543
4165	5412	2187	4627	4632	5286	3874	2189
2189	8046	7129	3729	2893	9684	9873	9138
3145	4208	1408	8463	3984	5836	3521	4672
8729	9807	1076	2198	5726	2194	1234	8279

43.	44.	45.	46.	47.	48.	49.	50.
7284	4869	2790	4286	5216	2149	1876	2168
4563	4964	4623	6384	2615	9186	3848	8614
3629	5208	2347	2198	3842	3456	2193	2196
9245	2080	5867	5486	2876	7289	1984	5483
5483	1897	3867	2173	3184	9738	4876	3146
2196	7986	9218	4817	7296	4865	3842	8965

51.	52.	53.	54.	55.	56.	57.	58.
9726	6295	4872	2138	4965	9876	3097	2974
8643	4368	2198	5483	3846	6298	9808	9084
5273	7348	8169	9654	3876	6786	4097	9840
2736	2763	2357	3672	6723	7236	1876	9489
1894	9653	6539	4875	9864	2198	8965	1284
9867	2198	4963	2186	4372	7234	8629	5814
3095	1986	9631	8472	3729	2139	6243	8145

59.	60.	61.	62.	63.	64.	65.	66.
7486	2981	7298	2184	4763	4863	3456	9871
2193	1892	8917	4218	8769	6348	7890	2179
4728	3720	2347	5763	2986	2176	1234	5046
2089	4175	5486	3698	4863	8472	5678	6804
9082	5176	3847	7296	3648	2784	9012	8470
4754	2347	9176	4738	2198	5168	3456	1986
7538	6129	7153	7219	1927	3615	7891	3459

67.	68.	69.	70.	71.	72.	73.	74.
1874	2112	7411	2119	86	834	2174	2487
7486	331	1721	9112	186	4747	4187	87
8291	2897	862	7486	5681	6363	83	7428
9182	987	48	3849	2196	5995	3189	83
3748	729	5496	486	987	559	5	4876
1876	8297	7486	42	91	87	1765	42
741	54	59	3798	8746	63	6789	9899
3496	7289	876	7983	3904	7298	49	114

75.	76.	77.	78.	79.	80.
87469	18734	89846	19876	98846	11421
84697	81423	72844	28674	21174	21896
33442	47884	51168	54869	38965	69847
21756	58337	27489	96843	56897	38176
67498	21486	98472	21876	21984	47897
39846	68742	21224	48638	51478	38189
27485	89638	18769	88768	31894	49898
58744	48621	97652	21777	98499	98974

81.	82.	83.	84.	85.	86.
74985	71279	84120	98797	98724	34563
12345	48694	21796	38468	84786	78908
67890	38848	69845	21896	86749	42809
90876	97120	38471	54868	87498	90786
65217	17208	18769	98976	98863	36094
71489	80967	48684	48698	97377	27158
38594	74689	18769	38489	98776	38646
48684	98467	38478	89765	19864	64583

87.	88.	89.	90.	91.	92.
47216	90804	49899	48899	87748	47189
86143	79048	98765	37744	51123	98765
31487	21886	34775	44768	17648	38486
21879	66477	21984	89443	48679	34896
39842	38896	56348	34886	15015	69847
23876	59769	84237	29876	27987	97849
54875	27998	73486	54869	92764	38488
16846	54889	54997	12345	89898	21776

93.	94.	95.	96.	97.	98.
94863	42174	8989	49864	97867	8765
8639	7148	98798	644	1008	219
86394	837	654	6449	976	38480
7563	1896	94568	21786	54890	10846
75638	61784	28	38486	12789	8973
6387	4721	2875	9876	76	87997
29846	12	38486	54868	38147	738
4875	38469	94783	987	21898	84778

99. 7368+ 8451+5184+6372+ 3147+1763+2189.
100. 5436+ 2195+7964+6830+ 8347+5146+ 798.
101. 73847+85487+3486+5763+84695+3146+ 495.

102.	103.	104.	105.	106.
714816	187621	876548	971028	918765
148617	317849	721473	876980	187659
548389	948647	374869	487694	876591
821864	218698	968768	527389	243876
217784	384869	486842	938765	438762
548987	198768	172986	387659	387624
987786	214729	348697	647548	876554
489754	987486	374898	475486	554433
457986	579864	548694	754864	765432

107.	108.	109.	110.	111.
314579	869457	304756	274816	908076
145793	694578	475630	748163	807069
457931	945786	756309	481634	760908
579314	457869	563098	816345	219374
894632	578694	630987	123456	475432
946328	786945	789063	234567	173849
463284	123456	890637	345678	948386
632846	789012	637890	876543	872198
328466	345678	378906	765432	749865
778998	901234	906378	654321	384976

112.	113.	114.	115.	116.
548637	493128	795846	497864	998776
486378	931284	598467	864794	887769
863789	312849	218694	468479	776698
637890	128493	580308	684947	433821
749087	740086	984678	218624	388466
490876	409648	394867	374186	218968
471874	218408	973842	987384	478149
548643	184820	298765	219864	941798
896847	123456	458738	718698	217486
376849	654321	219986	398748	989999
729287	987489	487219	216847	874865

117. 47563+74298+98254+214865+652193+381964+300892+476983+396847+734682.

118. 214736+637240+509984+998447+219863+863214+792186+197235+748692+897628.

119. 742869+38475+8476+317286+863217+9846+72354+748693+7486+95476+4721864.

120.	121.	122.	123.	124.
786904	5744	217846	849784	216
72189	186473	3868	84	47386
2891	862	9	7698	472
749863	7648	778466	377669	8
2847	97448	47	4886	67489
47283	189654	3848	847334	738789
898647	347219	543896	27	48
98	386	8965	7846	2748
749	4	47	987654	64
7864	786473	889764	87654	736
987654	876	74869	78	876489

125. 7486+7489+9846+3748+5634+7486+9847+5329+4675+3869+9873+8469+4683.

126. 5276+8943+9486+3114+98760+3456+72894+729+89657+3846+47836+7584+48765.

127. 74486+311472+68476+38169+744869+1870+542138+216746+9876+521869+31468.

128. 7486957+75312984+9104763+7238641+521437+43879654+9876+34819+9896543+47869847.

129. The population of London, in 1851, was 2,362,236; of Dublin, 258,369; of Edinburgh and Leith, 191,221; of Glasgow, 329,097; of Liverpool, 375,955; of Birmingham, 232,841; of Manchester, 316,213; of Bristol, 137,328; and of Leeds, 172,270: required the amount of the whole.

130. Bought a house for £3150; what should it be sold for to gain £275?

131. The number of wrecks and collisions on or near the coasts of the United Kingdom in 1852 was 1015; in 1853, 832; in 1854, 987; in 1855, 1141; and in 1856, 1153: find the whole number during these five years.

132. The total number of British Cavalry who joined the Allied Army in the Crimean Campaign, was 4819; Artillery, 7032; Sappers and Miners, 403; and Infantry, 43,726: how many men joined in all?

133. In 1856, the passengers conveyed by Rail in Scotland were, First Class, 1,664,005; Second Class, 1,952,240; Third Class, 9,476,226; Mixed, 4767: find the total number.

134. In the same year the receipts were, First Class, £232,130; Second Class, £171,588; Third Class, £436,564; Mixed, £14,892: required the whole sum.

135. Find the sum of twenty-seven thousand, eight hundred and forty-nine,—thirty-eight thousand, five hundred and forty-six—eight thousand and nine—twelve thousand, nine hundred and sixty-three—five thousand and forty—five hundred and seventy-eight thousand and forty-six—nineteen thousand and sixty—twenty-seven thousand, eight hundred and forty-seven.

136. A merchant has £1275 in the bank; his goods are worth £2750; his household furniture, £565; and debts owing to him, £674: how much is he worth?

137. What quantity of tea was consumed in the United Kingdom in 1856, England having consumed 47,986,635 lbs.; Scotland, 6,583,233 lbs.; and Ireland, 8,708,344 lbs.?

138. In 1856, the Emigrants to Canada consisted of 5555 English; 3872 Scotch; 4357 Irish; 3136 Prussians; 2806 Norwegians; 1249 Germans; 823 Belgians; 260 Swiss, and 381 Italians, French, &c.; find the whole number.

139. Two travellers start from the same place and travel in opposite directions, the one travels 75 miles the first day, 63 the second, and 45 the third; while the other travels 65 miles the first day, 180 the second, and 378 the third: how far distant will they then be from each other?

140. In 1856, the quantity of coffee consumed in England was 33,019,884 lb.; in Scotland, 1,197,685 lb.; and in Ireland, 778,385 lb.: what quantity was consumed in the United Kingdom?

141. In 1856, the tonnage of registered ships in the British Empire was in England, 3,461,031 tons; in Scotland, 592,974; in Ireland, 250,455; in Jersey, Man, &c., 62,496; and in the Colonies, 949,780 tons: find the amount of tonnage.

142. A merchant owes to A £597, to B £694, to C £748, to D £899, to E £1045, and to F £1303; how much does he owe in all?

SIMPLE SUBTRACTION

Is the method of taking a less number from a greater.

The greater number is called the *minuend*, the less, the *subtrahend*, and the number found, the *remainder* or *difference*.

Ex.			Ex.	
From	7986734		607482678	minuend.
Take	2463212		5140346	subtrahend.
Diff.	5523522		602342332	remainder.

1.	2.	3.
217486973489	46798765483	85179684729
105342341056	23214342352	23123461304

4.	5.	6.
600796857439	10008694758	85069857497
342526125	3242745	3042354443

Ex. From 10574363 take 683592. Ans. 9890771.

Sol. 2 from 3 leaves 1, write down 1; 9 from 6 we cannot, but 9 from *ten* leaves 1 and 6 are 7; write down 7; having borrowed *ten*, *carry one* to 5 is 6 from 3 we cannot, but 6 from *ten* leaves 4 and 3 are 7; write down 7 and *carry one* to 3 is 4 from 4, &c.

From	10574363
Take	683592
Difference	9890771
Proof	10574363
Proof	683592

The work may be checked by *adding* the *lower number* and *remainder* together, or by *subtracting* the *remainder* from the *upper number*.

7.	8.	9.
217634821643	90000000000	47386743841
124368412781	47654321809	31728698748

10.	11.	12.
987214638475	47869386481	63112141763
298765428969	18976248656	32197648763

13.	14.	15.
804765786935	30241704862	47214127004
276548674876	18702930409	21807163047

16.	17.	18.
172876548734	20468754874	53748688714
89658714968	9876547185	31765948976

19.	20.	21.
374869040735	10074021004	21047386943
9876524698	734861047	987654897

22.	23.	24.
734869548647	20417386984	15473846731
27486009829	1763047098	7348209872

25.	26.	27.
111473869875	21765483642	60000472986
9174869989	9176254961	73864786

28.	29.	30.
300712684734	10203040506	60708090104
987000487	1020304050	6070809017

31.	32.	33.
10000473698	34072986410	20172345604
784629	29738047306	1073647298

34.	35.	36.
70047216384	17047386473	40100721647
1976006548	8721738462	1700876109

37.	38.	39.
21734007201	21738400078	40072173867
9172073167	4764873091	74169081

40.	41.	42.
100002402503	600043216753	100000643289
76543209	67429768	854989

43. From 748163486 take 79106474 and 549876.
44. From 2104738400 take 219846736 and 2173844.
45. From 2174863 take 478654+312842+176348.
46. From 548629+748634 take 318467+21986+73894.
47. From 2198641+200473 take 54876+78698+9846.
48. From 8047+7048+5734 take 2174+3846+8497.
49. From 5278+9176+8796 take 8976+7421+1121.
50. From 9873+7894+2198 take 4987+8746+1471.
51. Take 2173+4173+9876 from 78469+2174+8459.
52. Take 74867382176983 from 4879684721674974.
53. Take 58217384698746 from 5763847218698481.
54. Take 91047384687690 from 9476347869485203.
55. Take 20734076948763 from 9846738479894210.

56. The battle of Waterloo was fought in 1815, and the battle of the Alma in 1854; how many years elapsed between them?

57. A merchant owed £2476, but has paid £1587; how much does he still owe?

58. A man born in 1775, died in 1858; what was his age?

59. Napoleon I. born in 1769, died in 1821; what was his age?

60. A man was 98 years old in 1858; when was he born?

61. America was discovered in 1492; how long is it since?

62. A piece of cloth contained 1074 yards; 274 yards were sold to one person and 123 yards to another; how many yards remained?

63. From Edinburgh to York by rail is 209 miles, and to London 413 miles; how far distant is York from London?

64. A ship sails from London to Sydney, a distance of 13,640 miles; after sailing 7684 miles, how far has she still to sail?

65. What number added to 354896 will make 432678?

66. The sum of two numbers is 4789246, and the less is 849758; what is the greater?

67. How long is it since the invention of printing in 1430?

68. In 1856, the number of Post-office Orders issued in the United Kingdom was 6,178,982; the number issued in England and Ireland was 5,693,459: how many were issued in Scotland?

69. The receipts from passengers and goods by rail in Scotland amounted to £2,319,217 in 1856, and from goods alone £1,464,041; find the receipts from passengers alone.

70. How long is it since the invention of gunpowder in 1400?

71. B was born when A was 27 years old; what age is A when B is 51, and how old is B when A is 76?

72. A merchant owed to A £7486, but has paid him £4736; to B, £5746, but has paid him £3721; to C, £10,844, but has paid him £7483; to D, £5748, but has paid him £4106; to E, £5120, but has paid him £3980; and to F, £11,111, but has paid him £9879; how much does he owe to each, and how much in all?

SIMPLE MULTIPLICATION

Is a short method of finding the sum of any given number when repeated as many times as there are units in another given number.

The number to be repeated is called the *multiplicand*, the other number, the *multiplier*, and the result is called the *product*.

The two given numbers are also called *factors* of the product.

CASE I. When multiplier does not exceed 12.

Ex. Multiply 5974587 by 8. Ans. 47796696.

SOL. 8 times 7 are 56, write down 6 and *carry* 5; 8 times 8 are 64 and 5 are 69, write down 9 and *carry* 6; 8 times 5 are 40 and 6 are 46, &c.

Multiplicand	5974587
Multiplier	8
Product	47796696

1. 384607592176 × 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
2. 597260875486 × 2, 4, 6, 8, 10, 12, 11, 9, 7, 5, 3.

These Exercises may all be checked by Addition.

CASE II. When the multiplier is found in the table.

Ex. Multiply 74867384 by 14. Ans. 1048143376.

74867384 × 14 = 2 × 7

2

149734768 prod. by 2

7

1048143376 prod. by 14

Ex. Mult. 748673 by 20

20

14973460

1. 748674869 × 16, 18, 24.
2. 530472937 × 15, 21, 32.
3. 374216487 × 22, 30, 28.
4. 796548737 × 33, 42, 45.
5. 975318642 × 25, 36, 49.
6. 759386154 × 35, 27, 44.
7. 649587596 × 36, 40, 42.
8. 927635849 × 48, 54, 56.
9. 123456789 × 55, 60, 63.
10. 987654321 × 64, 66, 70.
11. 219703842 × 72, 77, 81.
12. 504382796 × 84, 88, 90.
13. 846593742 × 96, 99, 110.
14. 142857142 × 96, 81, 63.
15. 846153846 × 80, 96, 77.
16. 952380952 × 81, 121, 144.
17. 543207159 × 99, 132, 121.
18. 791364857 × 84, 110, 100.
19. 517369428 × 56, 54, 132.
20. 629752837 × 45, 121, 81.

CASE III. When the multiplier is not found in the table, and does not exceed 156, or $12 \times 12 + 12$.

Ex. $74238476 \times 26 = 5 \times 5 + 1$

5	
371192380 =	5 times
5	
1855961900 =	25 "
74238476 =	1 "
1930200376 =	26 times

Ex. $67584937 \times 38 = 6 \times 6 + 2$

6	
405509622 =	6 times
6	
2433057732 =	36 "
135169874 =	2 "
2568227606 =	38 times

1. $674295386 \times 17, 23, 26, 29, 31, 34, 37, 43, 46.$
2. $965830295 \times 38, 47, 52, 58, 62, 68, 74, 79, 83.$
3. $534869738 \times 39, 59, 69, 75, 87, 93, 103, 105, 115.$
4. $275963849 \times 19, 38, 47, 59, 74, 87, 95, 137, 149.$

CASE IV. When the multiplier exceeds 156.

Ex. 3210421765×235

235	
16052108825 =	5 times
9631265295 =	30 "
6420843530 =	200 "
754449114775 =	235 times

Ex. 48769486×407500

407500
24384743000
341386402
195077944
19873565545000

1. $74863847 \times 364, 729.$
2. $43958172 \times 513, 624.$
3. $79586216 \times 734, 856.$
4. $31596857 \times 807, 965.$
5. $74951084 \times 750, 398.$
6. $16847593 \times 976, 304.$
7. $39416809 \times 854, 930.$
8. $20537958 \times 216, 648.$
9. $53104009 \times 729, 356.$
10. $69073854 \times 457, 390.$
11. $90768300 \times 278, 936.$
12. $71765184 \times 548, 690.$
13. $5976843 \times 2798, 6005.$
14. $3179648 \times 4035, 3907.$
15. $5271809 \times 4576, 7689.$
16. $6485937 \times 3090, 7406.$
17. $7258369 \times 5480, 4729.$
18. $5184736 \times 2751, 6043.$
19. $4958674 \times 1234, 5678.$
20. $6395274 \times 9560, 8009.$
21. $7261587 \times 8154, 6700.$
22. $8430957 \times 8900, 3007.$
23. $9375864 \times 7461, 5893.$
24. $1059769 \times 9876, 4500.$
25. $51948673 \times 7040908.$
26. $94076803 \times 4567890.$
27. $72584692 \times 1234567.$
28. $40759864 \times 70049000.$
29. $36947582 \times 84000960.$
30. $52749683 \times 90004396.$

1. My income is £29 per week; what is it per annum?
2. 87 parishes are each assessed £37; what is the whole assessment?

3. How many sheaves are in a field containing 3276 shocks, each 12 sheaves?

4. How many miles does a ship sail in 17 days at the rate of 169 miles a-day?

5. How many hours are there in a year?

6. How often does the seconds hand of a watch revolve in a day and in a year?

7. A railway train travels at the rate of 35 miles an hour; how many miles does it travel in 56 hours?

8. A ship's cargo consists of 435 boxes, each containing 598 apples; find the number of apples.

9. How many letters are there in a volume of 436 pages, each page 39 lines, and each line 52 letters?

10. Sound moves at the rate of 1142 feet in a second; how many feet will it move in 75 seconds?

11. A peal of thunder is heard 35 seconds after seeing the flash of lightning; how far distant is the cloud?

12. A train consists of 13 carriages having each 3 compartments, each containing 12 seats; how many passengers would find seats?

13. What is the value of an estate, containing 7564 acres at £56 per acre?

14. A ship's crew of 375 men is provisioned for 115 days, now each man is to receive 16 ounces a-day; how many ounces have they in all?

15. A ship after sailing 37 hours at the rate of 7 miles an hour, encounters a storm, which drives her back during 7 hours at the rate of 12 miles an hour; she then sails at her original rate during 5 hours; how many miles will she now be upon her voyage?

16. How many shots does a fleet of 3 ships of 72 guns each, 5 of 91 and 7 of 42, fire in 93 rounds?

17. How many soldiers are there in 12 regiments of 9 companies each, and each company consisting of 95 men?

18. How much powder does a sixteen gun-battery of 18 pounders expend in 18 hours, if each gun is discharged 22 times in an hour, the charge for an 18 pounder being 6 lbs.?

SIMPLE DIVISION

Is the method of finding how often one number is contained in another.

The number we divide by is called the *divisor*, the number to be divided, the *dividend*, and the result, the *quotient*.

CASE I. When the divisor does not exceed 12.

Ex. Divide 47286492 by 7. Ans. 6755213$\frac{1}{7}$.

SOL. 7 is not contained in 4, but 7 in 47 is 6 and 5 over; place 5 before 2, then 7 in 52 is 7 and 3 over; 7 in 38 is 5 and 3 over, &c.

The work is proved by multiplying the *quotient* by the *divisor* and adding in the *remainder*.

Divisor. Dividend.
7)47286492
6755213$\frac{1}{7}$ Quot.
7
47286492 Proof.

1. 7298763408 ÷ 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
2. 5487219876 ÷ 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
3. 9846798764 ÷ 12, 6, 2, 3, 11, 9, 10, 8, 5, 4, 7.

CASE II. When the divisor is found in the table.

Ex. Divide 74263849 by 14. Ans. 5304560$\frac{9}{14}$.

2)74263849÷14=2×7
7)37131924— 1 quot. by 2
5304560— 4 ... 14
4×2+1=8+1=9 rem.

Ex. 275473 ÷ 20
2,0)27547,3
13773$\frac{13}{20}$ Quot.

1. 34867896÷15, 16, 18.
2. 48678963÷20, 21, 24.
3. 86789634÷25, 27, 28.
4. 21750486÷30, 32, 33.
5. 30975219÷35, 36, 40.
6. 93048765÷42, 44, 45.
7. 12345678÷48, 50, 54.
8. 23456789÷56, 60, 63.
9. 34567890÷64, 66, 70.
10. 51146784÷72, 77, 80.
11. 38712967÷81, 84, 88.
12. 76921783÷90, 96, 99.
13. 47654876÷100, 108, 110.
14. 76548764÷120, 121, 132.
15. 98765432÷144, 121, 108.
16. 23457219÷ 72, 81, 50.
17. 34807280÷ 54, 96, 44.
18. 48702083÷108, 88, 77.
19. 54621487÷132, 81, 56.
20. 18765486÷144, 54, 48.
21. 33144777÷121, 36, 32.
22. 11847654÷120, 64, 66.
23. 28048694÷110, 72, 42.
24. 78648769÷108, 99, 35.

CASE III. When the divisor is not contained in the table.

Ex. Divide 48769847 by 7486. Ans. $6514\frac{6043}{7486}$.

Divisor.	Dividend.	Quotient.
	7486)48769847(	$6514\frac{6043}{7486}$
7486 × 6 =	44916	7486 Divisor.
	38538	39084
... × 5 =	37430	52112
	11084	26056
... × 1 =	7486	45598
	35987	6043 Rem.
... × 4 =	29944	48769847 Dividend.
Remainder.	6043	

1. 77486694 ÷ 23, 31, 43.
2. 54809678 ÷ 26, 37, 47.
3. 48096785 ÷ 29, 39, 51.
4. 57486786 ÷ 17, 19, 13.
5. 38492136 ÷ 52, 53, 57.
6. 48675846 ÷ 61, 75, 69.
7. 21486483 ÷ 73, 74, 78.
8. 54862187 ÷ 79, 82, 83.
9. 48765486 ÷ 85, 86, 87.
10. 30846298 ÷ 89, 91, 95.
11. 74869548 ÷ 97, 92, 98.
12. 34112118 ÷ 93, 74, 94.
13. 21476548 ÷ 784, 842.
14. 58643876 ÷ 542, 876.
15. 79864879 ÷ 325, 498.
16. 54867384 ÷ 173, 156.
17. 79847684 ÷ 139, 147.
18. 54867486 ÷ 163, 184.
19. 73846548 ÷ 217, 298.
20. 65482173 ÷ 248, 263.
21. 87460094 ÷ 376, 483.
22. 86754800 ÷ 800, 900.
23. 38476700 ÷ 600, 390.
24. 48216784 ÷ 740, 500.
25. 7384698700 ÷ 17640.
26. 4869873846 ÷ 47687.
27. 7298740000 ÷ 87000.
28. 3216504000 ÷ 36500.
29. 2190874860 ÷ 17000.
30. 5486384766 ÷ 37480.
31. 4768754867 ÷ 176487.
32. 7321987645 ÷ 279864.
33. 5419738473 ÷ 548637.
34. 2176548698 ÷ 248765.
35. 1876487693 ÷ 764869.
36. 3175486987 ÷ 987654.

1. A product is 4822150080, and one of the factors 704; what is the other?
2. My yearly income is £364; what is that per week?
3. Great Britain and Ireland contain a population of 27,675,780, and their surface is 121,385 square miles; how many inhabitants is that on an average to the square mile?
4. France contains a population of 35,700,000, at the rate of 175 to the square mile; how many square miles is the surface of France?

5. If a floor 40 feet long require 1280 stones, each a foot square, to pave it; what is its length?

6. The number of letters in a volume containing 746 pages is 1,846,350; how many letters are in a page?

7. An assessment for the poor of £5616 is raised from 48 parishes; how much is levied from each parish?

8. If a pigeon fly at the rate of 56 miles an hour, what time would it take between Edinburgh and the Cape of Good Hope, a distance of 5544 miles?

9. Divide £6725 equally among 25 men.

10. In how many days will a ship accomplish a voyage of 4473 miles, sailing 213 miles in a day?

11. How many loaves, each weighing 69 ounces, can be made from 16,491 ounces of flour?

12. The circumference of a wheel is 13 feet; how often does it revolve on a road 68,640 feet long?

13. A tax of £7791 is to be levied from 53 parishes; how much must each pay?

14. Divide 343 oranges equally among 7 boys.

15. How many carriages, each containing 36 passengers, would be required to convey 648 persons?

16. A gentleman's income is £6205 per annum; how much is it per day?

17. One man alone can build a wall in 378 hours; in how many hours would 7 men do the same?

18. 7 regiments, consisting of 716 men each, are to be reduced into 4 others of equal strength; how many men will be in each new regiment?

19. How often can 375 be subtracted from 744375?

20. 15,855 ounces of beef are divided among 755 soldiers; what is the weight of each man's ration?

21. How many dozens of wine are in 64 pipes, each containing 756 bottles?

22. A product is 2632938, and one of the factors 246; what is the other factor?

23. A ship sails 5712 miles in 28 days; how many miles is this on an average per day?

24. The circumference of the Earth is 25,000 miles nearly; how long would a person take to travel this distance at the rate of 40 miles per hour?

SUPPLEMENT TO MULTIPLICATION AND DIVISION.

I. When the multiplier contains a fraction.

Ex. $6487536 \times 8\frac{3}{5}$

$8\frac{3}{5}$

$5\overline{)19462608} = 3$ times.

$3892521\frac{3}{5} = \frac{3}{5}$ times.

$51900288 = 8$ times.

$55792809\frac{3}{5}$ Product.

II. When the divisor contains a fraction.

Ex. $487654 \div 3\frac{1}{5}$

$3\frac{1}{5}$) 487654

5 5

$16\left\{\begin{array}{l} 2)\overline{2438270} = \text{prod. by } 5 \\ 8)\overline{1219135} \end{array}\right.$

$152391\frac{7}{8}$ Quotient.

1. $7486948 \times 4\frac{1}{2}, 6\frac{2}{3}, 8\frac{1}{5}$.
2. $5721987 \times 5\frac{1}{4}, 7\frac{5}{8}, 10\frac{1}{2}$.
3. $7121846 \times 8\frac{2}{7}, 9\frac{3}{4}, 11\frac{1}{2}$.
4. $5987648 \times 4\frac{7}{8}, 7\frac{3}{5}, 6\frac{2}{3}$.
5. $3842198 \times 10\frac{5}{8}, 11\frac{7}{9}, 3\frac{4}{7}$.
6. $4876529 \times 8\frac{4}{7}, 12\frac{1}{2}, 2\frac{1}{13}$.
7. $7214867 \times 37\frac{2}{11}, 46\frac{5}{17}$.
8. $4962184 \times 65\frac{12}{17}, 304\frac{11}{15}$.
9. $4763148 \times 113\frac{6}{11}, 312\frac{17}{18}$.
10. $2147634 \times 416\frac{2}{11}, 549\frac{14}{15}$.
11. $9847693 \times 179\frac{1}{5}, 484\frac{7}{31}$.
12. $6478796 \times 44\frac{11}{12}, 57\frac{13}{18}$.
13. $5463784 \times 41\frac{2}{3}, 59\frac{6}{23}$.
14. $8754964 \times 84\frac{8}{9}, 93\frac{7}{18}$.
15. $8075084 \times 108\frac{11}{15}, 275\frac{3}{19}$.

1. $4765847 \div 4\frac{3}{4}, 6\frac{2}{3}, 7\frac{2}{3}$.
2. $5862190 \div 3\frac{3}{7}, 5\frac{6}{11}, 13\frac{3}{5}$.
3. $4948645 \div 2\frac{3}{13}, 8\frac{1}{2}, 9\frac{2}{3}$.
4. $5482169 \div 6\frac{5}{12}, 9\frac{5}{8}, 7\frac{4}{13}$.
5. $7928465 \div 10\frac{1}{2}, 11\frac{1}{3}, 12\frac{1}{4}$.
6. $5786478 \div 13\frac{1}{2}, 14\frac{2}{3}, 15\frac{3}{4}$.
7. $87486736 \div 27\frac{1}{16}, 24\frac{3}{17}$.
8. $57638469 \div 17\frac{1}{9}, 18\frac{1}{4}$.
9. $78621475 \div 47\frac{3}{4}, 56\frac{1}{12}$.
10. $86275846 \div 63\frac{14}{17}, 94\frac{9}{16}$.
11. $51840963 \div 71\frac{5}{13}, 84\frac{11}{31}$.
12. $78219865 \div 58\frac{14}{17}, 64\frac{11}{17}$.
13. $21973465 \div 251\frac{4}{17}, 512\frac{11}{15}$.
14. $34758694 \div 589\frac{6}{11}, 845\frac{10}{19}$.
15. $97986089 \div 736\frac{4}{7}, 367\frac{12}{17}$.

EXERCISES ON THE PRECEDING RULES.

1. In 1856, the number of seamen registered in England was 156,913; in Scotland, 29,987; in Ireland, 13,403; in Jersey, Man, &c. 5424; and in the Colonies, 62,032: find the whole number.

2. In 1851, the population of the South-eastern Counties of Scotland was: Linlithgow, 30,590; Edinburgh, 259,493; Haddington, 36,363; Berwick 36,165; Peebles, 10,804; and Selkirk, 9802: find the sum.

3. In 1856, the number of births registered in Scotland was 52,301 males and 49,447 females; and the number of deaths was 29,417 males and 29,039 females: find the excess of births over deaths in that year.

4. How many passengers are in a train consisting of 4 first class carriages, each containing 18 persons; 3 second class containing 30 each, and 2 third class containing 40 each?

5. In 1856, the number of marriages in the 33 counties of Scotland was 20,487; what was the average number in each?

6. The British Army at the battle of the Alma was composed as follows:—Light Division, 5454 men; 1st Division, 4711; 2d, 4222; 3d, 3794; 4th, 4419; Cavalry, 1100; Artillery, 2700; Sappers and Miners, 400: how many men were engaged in all?

7. At the same battle, the loss of the British amounted to 2196 killed and wounded; how many effective men remained?

8. How many yards are in 15 pieces of cloth, each containing 56 yards?

9. Mercury's distance from the Sun is 36,793,000 miles, Mars' distance is 108,031,000 miles greater than Mercury's, and Neptune's is 2,710,114,000 miles greater than Mars'; find the distances of Mars and Neptune from the Sun.

10. In 1856, the number of Post-office Orders issued in Ireland was 461,723; the number in Scotland was 23,800 more than in Ireland, and the number in England exceeded that in Scotland and Ireland together by 4,284,490: how many were issued in Scotland, in England, and in the United Kingdom?

11. How many times is Mount Blanc, 15,732 feet in height, higher than Arthur Seat, which is 820 feet high?

12. At the battle of the Alma, the Fusilier Guards lost 11 officers and 170 non-commissioned officers and men killed and wounded; the Grenadiers, 3 officers and 126 men; and the Coldstreams, 3 officers and 27 men: at Inkerman, the Fusiliers lost 9 officers and 169 men; the Grenadiers, 9 officers and 223 men; and the Coldstreams, 13 officers and 178 men. How many of the Guards fell at Inkerman more than at Alma?

13. A pear-tree one year produced 14,861 pears, averaging 11 to the pound; how many lbs. were produced?

14. In how many days will a boy read through the

Bible, which contains 31,173 verses, if he reads 39 verses daily?

15. How often does the hammer of a clock strike in a day and in a year?

16. One female can cut out 300 gross of blanks for steel pens in a day; how many will she cut out in a year of 313 days?

17. A steel pen manufactory sends out 180,000,000 pens yearly; how many boxes, each containing a gross or 12 dozen, would they fill?

18. A gentleman has 3 farms containing 675 acres; the first and second together contain 490 acres; and the second and third 425 acres. how many acres are in each farm?

19. The gallant Sir John Moore fell at the battle of Corunna in 1809, at the age of 48; in what year was he born?

20. The Sun's diameter is 882,000 miles; how many times is it greater than the Earth's diameter, which is 7920 miles?

21. Divide 1584d. among 3 girls and 5 boys, giving each girl twice the number which a boy gets.

SOL. Since each girl gets 2 boys' shares, 3 girls have $2 \times 3 = 6$ boys' shares; the number of boys' shares is therefore $6 + 5 = 11$. Hence each boy gets $1584 \div 11 = 144$d., and each girl $144 \times 2 = 288$d.

22. How much grain will a farm of 16 fields, each 29 acres, produce, if one acre produces 9 quarters of grain?

23. A gentleman gave £484 to two charities, and to one he left 3 times as much as to the other; what did he leave to each?

24. Several volumes contain 10,192 pages; in how many days would a person read the whole, reading 4 hours a day and 7 pages an hour?

25. In a church there are 12 windows; in the lower sash there are 12 panes and in the upper 18; how many panes of glass are there in all?

26. A gentleman has 4 farms, containing 240, 375, 408, and 425 acres respectively, and he wishes to divide them into as many others of equal size; how many acres will there be in each farm?

27. In one class there are 150 boys, in another 145, in a third 140, in a fourth 135, and in a fifth 130; how many are there on an average in each?

28. The sum of two numbers is 2779, and their difference is 293; what are the numbers?

Sol.	2779		2779
Add	293	Subtract	293
2)	3072	2)	2486
	1536 is the greater.		1243 is the less.

29. At an election, the successful candidate had a majority of 84 votes out of 572 votes; how many had each of the two candidates?

30. The loss of the French and Sardinians at the battle of the Tchernaya or of Traktir Bridge, amounted to 1792 men killed and wounded; the French loss was 1292 more than the Sardinian: what was the loss of each?

31. Divide 204 apples among 4 girls and 5 boys, giving each girl 3 times as many as a boy.

32. Galileo died in 1642, and Newton in 1725; how long is it since each of these events, and how many years elapsed between them?

33. A gentleman dying, left £45,000; to his widow he bequeathed $\frac{1}{5}$ of his estate, and the remainder was to be equally divided among his 4 children; how much did he leave to each?

34. A ship at sea fires a gun, the report of which is heard $12\frac{3}{4}$ seconds after seeing the flash; how far distant is the ship, sound moving at the rate of 1142 feet per second?

35. Two casks of wine contain together 151 gallons, and one contains 31 gallons more than the other; how many gallons does each contain?

36. What number being divided by 337 gives 9472 for the quotient, and 108 for the remainder?

37. Divide £416 among 6 men and 8 women, giving each man 4 times as much as a woman.

38. Two brothers being asked their ages, said that the sum of their ages was 63, and that the difference of their ages was 9; find their ages.

COMPOUND NUMBERS

I. STERLING MONEY.

REDUCTION

Is the method of bringing numbers from one denomination to another without altering their value.

To bring higher to lower denominations *multiply*.

To bring lower to higher denominations *divide*.

Ex. Red. £20, 10s. 9½d. to farth.	Ex. Red. 19718 farth. to £.
Mult. by 20 and add 10s.	4)19718 Farth.
410 Shillings.	12) 4929½ Pence.
Mult. by 12 and add 9d.	2,0) 41,0s. 9½d.
4929 Pence.	£20, 10s. 9½d.
Mult. by 4 and add 2f.	
19718 Farthings.	

1. Reduce £35, 17s. 4¼d.; £28, 11s. 11¾d.; £40, 10s. 10¾d.; £200, 10s. 8¾d.; £574, 19s. 11½d.; £409, 17s. 4¼d.; £147, 10s. 10¼d.; and £105, 2s. 4¾d. to farthings.

2. Reduce £470, 10s. 0½d.; £270, 11s. 6d.; £672, 18s. 9½d.; £486, 12s. 1½d.; 12s. 4½d.; 17s. 3½d.; 11s. 11d.; £700, 10s. 2d.; £21, 15s. 3½d. to halfpence.

3. Reduce £87, 19s. 10½d.; £11, 11s. 11d.; £50, 19s. 6d.; £47, 15s. 9½d.; £400, 10s. 0½d.; £290, 16s. 4d.; £403, 11s. 11½d.; 16s. 8½d.; 11s. 5½d.; 13s. 4½d.; £43, 12s. 4d.; and 15s. 8½d. to halfpence and farthings.

4. Reduce 4786; 3040; 7098; 48769; 73846; 4098; 7214; and 38463 farthings to pence, shillings, and pounds.

5. Reduce 4876; 7487; 3562; 1749; 3689; 2177; 5848; 7216; 111111; 33333 halfpence to d. s. and £.

6. Reduce 78469; 738467; 87698; 714086 farthings: 48763; 21764; 50487; 140715 halfpence: 729374; 89214; 47865; and 571640 pence to sovereigns.

7. Reduce £2716, 2s. 2½d.; £4176, 12s. 8½d.; £3108, 14s. 7½d.; £176, 0s. 2½d.; £417, 0s. 0½d.; £49, 17s. 6d.; and £2010, 10s. 6½d. to halfpence and farthings.

8. Reduce 41763; 58462; 71209; 17268; 38467; 84762; 47219; and 876213 farthings to sovereigns.

Ex. Red. £2475 to crowns and guineas.

1. £2475
20
5)49500 s.
Ans. 9900 cr.

2. £2475 × 20
21 { 3)49500 s.
7)16500
Ans. 2357 gu. 3 s.

9. Reduce £7485; £3876; £4921; £3817; and £3760 to crowns and guineas.

10. Reduce 17486; 887; 2130; 2491; 2168; and 7430 guineas to pounds.

Ex. Red. £21, 17s. 6d. to sixpences. Ans. 875 sixd.

£21, 17s. 6d.
20
437 s.
2 (sixd. in 1s.)
Ans. 875 sixd.

Proof.
2)875 sixd.
2,0)43,7s. 6d.
£21, 17s. 6d.

11. Reduce £121; £45, 7s. 6d.; £56, 18s. 6d.; £79, 18s.; £84, 5s. 6d.; and £99, 19s. 6d. to sixpences.

12. Reduce 448; 977; 2163; 3729; 4125; and 5763 sixpences to shil. and pounds.

13. How many half-crowns in £42, 7s. 6d.; £54, 12s. 6d.; £67, 15s.; and in £99, 17s. 6d.?

14. Reduce 528; 1254; 3453; 4869; 5871; and 7459 half-crowns to pounds, &c.

15. How many threepences are in £49, 7s.; £54, 6s. 3d.; £72, 19s. 6d.; and in £84, 14s. 9d.?

16. Reduce 1748; 2153; 3785; 5142; 6897; and 7455 threepences to shillings and pounds.

17. How many florins are in £170; £144; 6743 farthings; 1786 pence; and in 436 shillings?

18. Reduce 43 guineas; 77 gu. 8s. 7½d.; £37, 2s. 6d.; 93 gu. 2s. 4¼d.; 78 gu. 18s. 9¾d.; and 18s. 9¾d. to farth.

19. Find the sum of £18, 19s. 4¼d. + 5 crowns + 17 half-crowns + 234 florins + 17 guineas, in farthings and pounds.

20. How many pounds will a man save yearly, by laying aside 5s. 9½d. weekly?

21. How many penny stamps may be obtained for £49, 17s. 7d.?

COMPOUND ADDITION.

Sol. The sum of the farthings is 10 = 2½d., write down ½d. and carry 2 to the pence. The sum of the pence is 44 = 3s. 8d., write down 8d. and carry 3 to the shil. The sum of the units column of the shil. is 28, write down 8s. and carry 2 to the tens of the shil.: the sum is 7 ten shil. pieces = £3 and 1 ten shil. piece, write down 1 and carry 3 to the pounds. The sum of the pounds is £1733, and the whole answer is £1733, 18s. 8½d.—The results in Compound numbers may be checked as in Simple numbers.

Example.

£	s.	d.
381	17	6½
148	12	9½
412	16	7½
319	11	11¾
470	19	9¾
£1733	18	8½

1. £	s.	d.	2. £	s.	d.	3. £	s.	d.	4. £	s.	d.
24	11	4¾	31	17	11½	27	15	7¼	14	19	11¾
16	18	9½	13	14	10¼	72	18	10	12	16	8½
61	10	2¾	42	16	9¾	36	11	5½	29	11	5½
32	17	11½	24	12	4¼	63	10	4¾	18	18	8¾
45	16	3¼	56	18	11½	41	17	10½	15	14	10
5.			6.			7.			8.		
96	11	4½	49	19	11¾	68	16	8¼	15	14	9
69	13	7¾	94	13	7	86	15	5¾	19	17	10½
12	16	10	17	11	11½	74	11	9½	91	19	6¼
14	18	9½	16	15	5¼	47	16	10	51	14	11¼
29	15	6¼	18	18	11½	51	10	4¼	18	13	2½
31	17	11¾	81	17	10¼	15	8	11¾	81	10	9¾
9.			10.			11.			12.		
17	18	11¾	42	18	9¼	29	10	8¼	14	12	8¼
16	13	7½	36	17	2¾	34	8	11½	17	13	6½
19	12	4½	34	16	3¾	76	7	7¼	98	19	2
20	11	3¾	43	12	11½	82	11	10¾	84	10	6¾
31	17	8¼	45	19	10½	49	17	7¼	18	11	11¾
17	16	11½	53	11	4¾	63	13	9¾	19	10	8½
13.			14.			15.			16.		
45	17	8½	40	0	2½	51	8	3¾	82	12	11¾
49	16	4¾	38	19	11	64	19	11¾	41	18	7½
38	18	7½	51	15	5¾	73	17	10½	72	16	9
64	4	11¾	86	16	7	84	16	9½	88	11	4¾
39	17	6¼	13	14	10½	18	18	11¾	22	15	10½
83	11	4¾	89	19	6	17	14	10¾	16	18	7¼

17.			18.			19.			20.		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
274	13	$10\frac{3}{4}$	426	16	$4\frac{1}{2}$	410	10	$10\frac{3}{4}$	329	19	$11\frac{3}{4}$
476	12	$8\frac{1}{2}$	246	13	$3\frac{1}{2}$	104	17	$4\frac{3}{4}$	293	18	11
567	11	$4\frac{3}{4}$	642	17	$8\frac{3}{4}$	816	11	$11\frac{1}{2}$	932	17	$6\frac{1}{2}$
658	13	$7\frac{1}{4}$	351	9	$11\frac{1}{2}$	681	13	4	456	16	$10\frac{3}{4}$
549	18	$7\frac{1}{2}$	513	12	$4\frac{1}{4}$	168	12	$10\frac{1}{2}$	564	13	$3\frac{1}{2}$
721	16	$11\frac{3}{4}$	135	11	$11\frac{1}{4}$	473	2	$1\frac{1}{4}$	645	17	6
213	19	$10\frac{3}{4}$	497	18	$10\frac{3}{4}$	734	3	$0\frac{1}{2}$	897	13	$4\frac{1}{4}$
132	15	$7\frac{1}{4}$	974	19	$9\frac{1}{2}$	347	11	$11\frac{3}{4}$	978	19	$9\frac{1}{2}$

21.			22.			23.			24.		
476	11	$11\frac{3}{4}$	847	13	$6\frac{3}{4}$	984	17	$11\frac{1}{4}$	484	15	$4\frac{3}{4}$
725	13	$4\frac{1}{2}$	472	19	$2\frac{1}{4}$	845	15	$0\frac{3}{4}$	846	13	$8\frac{3}{4}$
870	11	$9\frac{3}{4}$	756	14	$11\frac{3}{4}$	756	13	$2\frac{1}{2}$	725	16	$10\frac{1}{2}$
708	17	$10\frac{1}{2}$	793	18	$5\frac{1}{2}$	384	11	$5\frac{1}{4}$	857	11	$4\frac{1}{4}$
534	16	$3\frac{1}{4}$	904	15	$8\frac{3}{4}$	479	18	$10\frac{1}{2}$	583	3	$9\frac{1}{2}$
729	19	$11\frac{3}{4}$	405	12	$10\frac{1}{4}$	721	19	$11\frac{1}{2}$	879	16	$8\frac{3}{4}$
297	18	$4\frac{1}{2}$	762	16	$8\frac{3}{4}$	562	13	$8\frac{1}{2}$	405	17	$7\frac{1}{4}$
972	15	$3\frac{3}{4}$	636	17	$9\frac{1}{2}$	629	16	$9\frac{1}{2}$	896	19	$11\frac{3}{4}$

25.			26.			27.			28.		
325	14	$7\frac{1}{2}$	420	12	$7\frac{1}{4}$	508	19	$7\frac{3}{4}$	874	13	6
256	15	$8\frac{3}{4}$	500	13	$8\frac{1}{2}$	850	11	2	847	16	$8\frac{1}{4}$
719	11	$6\frac{1}{2}$	721	16	$6\frac{3}{4}$	793	16	$7\frac{3}{4}$	856	17	$10\frac{3}{4}$
971	13	$10\frac{1}{2}$	217	18	$11\frac{1}{2}$	918	13	$4\frac{1}{2}$	865	11	$2\frac{1}{2}$
472	16	$8\frac{1}{4}$	172	16	$4\frac{3}{4}$	981	17	10	832	18	6
749	18	$11\frac{3}{4}$	901	17	$2\frac{1}{2}$	974	18	$6\frac{3}{4}$	823	7	$4\frac{3}{4}$
426	19	$9\frac{1}{2}$	847	19	$11\frac{3}{4}$	953	12	$11\frac{3}{4}$	748	16	3
273	17	$10\frac{1}{2}$	487	15	$10\frac{1}{4}$	947	13	$3\frac{1}{2}$	784	17	$4\frac{3}{4}$

29.			30.			31.			32.		
219	13	$11\frac{3}{4}$	549	16	$2\frac{1}{4}$	111	11	$11\frac{3}{4}$	204	8	$0\frac{3}{4}$
192	16	$5\frac{1}{2}$	495	17	10	222	17	$10\frac{1}{2}$	420	3	$11\frac{1}{2}$
921	17	4	954	11	$2\frac{3}{4}$	363	18	$2\frac{3}{4}$	569	18	$2\frac{1}{2}$
476	13	$6\frac{3}{4}$	867	18	$3\frac{3}{4}$	746	12	$9\frac{1}{2}$	931	13	11
764	18	$10\frac{1}{2}$	678	19	$3\frac{1}{4}$	805	13	$7\frac{3}{4}$	139	15	$4\frac{3}{4}$
647	11	11	786	12	9	508	19	$6\frac{1}{2}$	721	4	$8\frac{1}{4}$
513	17	$10\frac{3}{4}$	954	13	$8\frac{3}{4}$	741	10	$4\frac{1}{2}$	801	12	7
315	19	$8\frac{1}{2}$	987	16	10	417	11	$1\frac{1}{4}$	971	19	$10\frac{1}{2}$

33. £473, 18s. $10\frac{3}{4}$d. + £972, 11s. $4\frac{1}{4}$d. + £987, 19s. $11\frac{1}{2}$d. + £852, 17s. $9\frac{1}{2}$d. + £112, 15s. $6\frac{1}{4}$d. + £521, 14s. $8\frac{3}{4}$d. + £846, 13s. $7\frac{3}{4}$d. + £613, 12s. $9\frac{1}{2}$d. + £716, 17s. $11\frac{3}{4}$d.

34.			35.			36.			37.		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
540	13	11¾	321	17	8½	463	18	9	897	11	8½
419	19	9	123	16	3¼	364	19	10¼	879	12	7½
914	13	4½	231	15	4½	643	11	2¼	798	13	4¾
411	12	2	213	18	11	634	17	10	789	16	11¾
114	8	6¾	312	16	8¾	346	18	9¼	978	4	2
701	13	4	132	11	2½	436	12	7½	987	11	4¾
158	17	11¾	474	13	6	183	16	8	363	15	7½
815	16	8	744	11	3¾	831	15	4½	633	18	9¾

38.			39.			40.			41.		
948	12	7½	574	11	10¾	530	11	4¾	876	11	11¾
489	13	6½	457	16	4½	504	17	11¼	768	19	10¼
894	19	9¼	739	19	9	876	19	9½	687	14	4½
276	15	4½	395	11	10¾	743	12	10¾	527	13	8
568	17	11¾	953	14	4½	549	13	6½	498	19	11¾
729	19	9	476	15	11¾	985	19	11¾	409	17	10¼
276	11	11½	729	13	8¼	859	18	10¾	490	17	10½
467	13	4½	297	16	4½	764	13	8½	385	13	4¾

42.			43.			44.			45.		
210	11	5¼	741	18	11	116	17	4½	901	18	7½
101	13	6½	387	16	5¾	161	13	5¾	910	13	4½
354	16	2¼	862	10	10½	600	17	2½	864	12	11½
726	15	11½	629	17	6¼	560	13	8½	648	17	6¾
367	18	10¾	748	15	5¾	74	11	3¾	899	11	11
481	19	11½	796	17	11¾	9	8	6	988	15	7½
816	15	8¼	869	19	10	408	12	11¾	749	18	11¾
964	17	10¾	176	17	8¾	780	16	9½	548	17	6½
489	19	11½	298	11	4½	473	18	11¼	721	16	2¼
984	12	6¼	476	10	6¾	729	16	7¼	387	19	9¾

46.			47.			48.			49.		
571	18	11¾	48	19	4½	500	11	11¾	344	18	10½
80	16	10½	480	13	6½	499	9	5¾	436	19	11¼
780	13	3½	408	15	9¼	72	18	6¼	87	13	8½
807	12	11½	72	11	4½	308	15	7½	728	12	1¾
709	11	4½	568	17	11¼	38	12	8½	864	11	11½
89	13	6½	367	13	2¾	380	11	3¾	86	13	4¼
10	16	7¼	673	18	8½	596	12	7	987	12	6½
840	15	11¾	469	12	10¾	65	13	8¾	49	14	9¼
742	18	9½	576	19	8½	962	18	7½	986	17	6½
476	13	4½	864	13	4¼	298	14	11½	806	4	2¼

50. A owes to B £743, 11s. 6½d., to C £325, 4s. 8¾d., to D £750, 19s. 10¾d., to E £113, 11s. 11¼d., to F £1041, 13s. 8¾d., to G £89, 16s. 8d., to H £1430, 15s. 11¾d., and to I £740, 16s. 10d.; how much does he owe in all?

51. A paid to B £675, 13s. 7¼d., to C £298, 16s. 10½d., to D £749, 13s. 7½d., to E £97, 18s. 6¾d., to F £987, 13s. 11½d., to G £75, 13s. 8¾d., to H £1279, 17s. 4¾d., and to I £684, 13s. 11½d.; how much did he pay in all?

52. A person collected in January £744, 11s. 8¾d., in February £896, 17s. 10¼d., in March £472, 17s. 4¼d., in April £583, 16s. 11¾d., in May £739, 17s. 6¾d., in June £1096, 13s. 8½d., in July £578, 12s. 8½d., in August £1374, 18s. 5¾d., in September £458, 11s. 11½d., in October £735, 13s. 4¼d., in November £2179, 16s. 4½d., and in December £532, 11s. 1¾d.; how much did he collect?

53. I received from A £736, 15s. 1¾d., from B £874, 13s. 8¾d., from C £879, 17s. 10¼d., from D £84, 11s. 2¾d., from E £98, 17s. 10¾d., from F £921, 16s. 11½d., from G £1093, 10s. 4¼d., and from H £729, 8s. 1¾d.; how much did I receive in all?

54. A owes me £274, 11s. 10½d., B £89, 13s. 7d., C £74, 11s. 1½d., D £96, 18s. 9¾d., E £65, 11s. 2½d., F £418, 4s. 6¾d., G £173, 13s. 4½d., H £748, 17s. 6¾d., K £847, 13s. 4½d., and I have in the bank £7486, 17s. 11¾d.; how much am I worth?

55. A housekeeper's account was, for beef, &c., £4, 2s. 7½d.; tea and coffee, 21s. 3d.; sugar, 17s. 7½d.; potatoes, 5s. 6½d.; butter, 11s. 7¼d.; fruit, 21s. 3½d.; and bread, 43s. 7d.: find the amount.

56. A corn merchant laid out on wheat, £597, 11s. 6½d.; on barley, £409, 17s. 4½d.; and on oats, £347, 9s. 11¾d.: what should he sell the whole for to gain £79, 18s. 11¼d.?

57. A gentleman left to his widow, £7692, 17s. 4½d.; to each of his two sons, £3000, 17s. 6d.; to each of his four daughters, £2559, 18s. 7½d.; and to his other relatives, £4975, 8s. 4½d.: how much was this in all?

58. A gentleman owes his tailor, £23, 14s. 8½d.; his bootmaker, £14, 7s. 3¾d.; his grocer, £48, 17s. 7¾d.; his baker, £35, 16s. 8½d.; his house-rent is £115, 17s. 6d.: how much must he draw from the bank to pay these sums?

COMPOUND SUBTRACTION

Ex.	£	s.	d.
From	429	17	8¾
Take	145	12	3¼
Diff.	£284	5	5½

Ex.	£	s.	d.
From	501	15	6½
Take	250	4	6¼
Diff.	£251	11	0¼

1. £	s.	d.	2. £	s.	d.	3. £	s.	d.	4. £	s.	d.
146	12	7½	247	16	10¾	375	15	6½	508	6	7¾
73	5	2¼	184	5	3½	183	10	4¼	348	3	7¼

Ex. From £742,15s.8¼d. take £653,17s.9½d. Ans.£88,17s.10¾d.

Sol. 2f. from 1f. we cannot, but 2f. from 4f. (or 1d.) is 2f. and 1f. is ¾d.; write down ¾d., and carry 1 to 9d. is 10d. from 8d. we cannot, but 10d. from 12d. (or 1s.) is 2d. and 8d. are 10d.; write down 10d., and carry 1 to 17s. is 18s. from 15s. we cannot, but 18s. from 20s. (or £1) is 2s. and 15s. are 17s.; write down 17s., and carry 1 to £653 is £654 from £742 are £88; write down £88.

From	£	s.	d.
	742	15	8¼
Take	653	17	9½
Diff.	£88	17	10¾

5.			6.			7.			8.		
427	13	4¼	450	10	4½	296	16	3½	609	13	6½
298	16	10½	276	13	8¾	109	11	11½	379	14	7¾
9.			**10.**			**11.**			**12.**		
825	11	6	742	17	8½	408	18	10	504	16	7¼
296	13	6¼	486	13	9½	298	19	9¾	329	16	8¾
13.			**14.**			**15.**			**16.**		
742	13	8½	200	0	0	804	10	1½	476	17	7¾
427	12	9¾	99	12	0½	721	13	6	298	17	11
17.			**18.**			**19.**			**20.**		
547	10	0	976	15	4	705	0	4½	325	6	0¼
238	11	0¾	762	18	3½	396	17	2¾	298	13	0½
21.			**22.**			**23.**			**24.**		
510	17	3¼	542	16	0¼	726	17	10½	789	11	5¾
496	16	11¼	486	16	0½	498	17	11	499	11	7½
25.			**26.**			**27.**			**28.**		
271	13	0½	542	16	0¼	980	15	6	832	17	6½
148	17	0¾	347	19	11¾	890	15	6¾	328	18	7¾
29.			**30.**			**31.**			**32.**		
532	16	7	424	19	10	173	16	1½	410	12	4¼
325	11	9½	248	19	10¼	99	17	0¾	147	13	7½

33.			34.			35.			36.		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
901	18	$0\frac{3}{4}$	386	16	4	409	11	$1\frac{1}{2}$	251	13	$4\frac{1}{2}$
496	18	$1\frac{1}{2}$	293	17	$2\frac{3}{4}$	359	11	6	151	17	$9\frac{3}{4}$
37.			**38.**			**39.**			**40.**		
109	13	10	499	17	$3\frac{1}{2}$	256	11	$2\frac{1}{4}$	704	14	4
96	13	$10\frac{1}{4}$	399	17	$6\frac{1}{4}$	193	4	$7\frac{1}{3}$	407	14	$9\frac{1}{3}$
41.			**42.**			**43.**			**44.**		
275	12	$3\frac{3}{4}$	326	9	3	533	4	$0\frac{1}{3}$	214	17	11
186	11	$7\frac{1}{2}$	263	18	$4\frac{1}{2}$	353	7	$6\frac{3}{4}$	142	17	$11\frac{1}{4}$
45.			**46.**			**47.**			**48.**		
973	0	$2\frac{1}{3}$	841	1	$0\frac{3}{4}$	711	5	2	817	0	0
739	3	$1\frac{3}{4}$	418	1	$2\frac{1}{2}$	117	5	$11\frac{1}{2}$	718	0	$0\frac{3}{4}$

49. £748, 13s. $6\frac{1}{3}$d.—£589, 15s. $8\frac{3}{4}$d.

50. £721, 15s. 8d. —£629, 13s. $11\frac{1}{4}$d.

51. £721, 17s. $6\frac{3}{4}$d.+£853, 13s. $1\frac{1}{3}$d.—£684, 13s. $6\frac{1}{2}$d. +£789, 17s. 11d.

52. £987, 2s. $1\frac{1}{3}$d.+£305, 2s. $11\frac{1}{2}$d.—£896, 12s. $8\frac{1}{4}$d +£296, 17s. $9\frac{1}{3}$d.

53. A merchant bought goods for £578, 15s. $6\frac{1}{3}$d., and sold them for £642, 8s. $7\frac{1}{4}$d.; what did he gain?

54. Borrowed 500 guineas and paid £125, 17s. $4\frac{1}{2}$d. at one time and £298, 14s. $5\frac{1}{4}$d. at another; what is still due?

55. The receipts of a railway one year amounted to £48,984, 17s. $8\frac{1}{4}$d.; and the year following to £50,492, 2s. 3d.; find the increase.

56. A housekeeper went to market with £5; she paid for beef 17s. $6\frac{1}{4}$d.; mutton, 12s. $7\frac{1}{2}$d.; fish, 7s. $8\frac{1}{2}$d.; tea, 6s. 5d.; coffee, 2s. $3\frac{1}{2}$d.; sugar, 7s. $1\frac{1}{2}$d.; vegetables, 7s. $3\frac{1}{4}$d. and sundries, 4s. $1\frac{3}{4}$d.; with what sum did she return?

57. A owed to B £748, 16s. $7\frac{1}{4}$d., but has paid £398, 17s. $6\frac{1}{3}$d.; to C £1000, but has paid £899, 17s. $4\frac{1}{2}$d.; to D £470, 11s. $4\frac{1}{3}$d., but has paid £381, 13s. $4\frac{3}{4}$d.; to E £721, 18s. $7\frac{3}{4}$d., but has paid £643, 11s. $9\frac{1}{4}$d.; to F £896, 13s. $2\frac{1}{4}$d., but has paid £799, 17s. $1\frac{3}{4}$d.; how much does he still owe to each and in all?

58. A merchant has in cash £7328, 17s. $11\frac{1}{3}$d., goods worth £12,748, 16s. 10d., furniture £574, 18s. $11\frac{1}{3}$d.;

A owes him £112, 17s. 6½d., B £327, 18s. 7½d., C £486 13s. 8¾d., D £89, 16s. 10½d. and E £136, 18s. 8½d.; at the same time he owes to F £574, 18s. 11½d., to G £324, 11s. 7¾d., to H £723, 18s. 6d., to I £327, 17s. 4¾d., and to K £587, 10s. 3¾d.: how much is he worth?

59. A gentleman's yearly income is £500, his household expenses £294, 13s. 7½d., rent £54, 13s. 6d., taxes £20, 11s. 8½d., servants' wages £25, 17s. 11d., tradesmen's accounts £52, 11s. 7¾d., and incidental expenses £24, 17s. 11½d.; how much does he save yearly?

60. Three ponies cost £35, 15s. 6d; the first and second cost £26, 10s. 4d. and the second and third £30, 3s. 9d.; find the price of each.

61. A, B, and C contributed £109, 18s. 7¼d. to a charity; A and B contributed £61, 3s. 3½d. and A's contribution was £21, 10s. 10½d. less than C's: how much did each contribute?

62. A bankrupt's debts amount to £19,728, 15s. 7½d. and his effects to £12,899, 17s. 8¾d.; how much is he deficient?

63. A gentleman dying left £17,584, 17s. 6d.; to his widow he left £3756, 18s. 9d.; to each of his three sons, £2573, 7s. 6d.; to each of his two daughters, £2000, 14s. 3d.; and the remainder to his other relatives: how much was this?

64. A bankrupt owes to A, £329, 10s. 7½d.; to B, £748, 17s. 11¾d.; to C, £876, 17s. 10½d.; to D, £1783, 17s. 11½d.; to E, £578, 19s. 3¾d.; to F, £1047, 18s. 6¾d.; and to G, £1270, 8s. 8½d.: at the same time he has in cash, £520, 17s. 8½d.; in bills, £325, 16s. 10½d.; goods valued at £984, 17s. 6d.; H owes him £44, 16s. 7½d.; I, £72, 11s. 7¾d.; K, £84, 13s. 4½d.; and L, £105, 17s. 11¾d. How much will his creditors lose by him?

65. A tax of £975, 17s. 10½d. is raised from 5 towns; the first town pays £190, 14s. 8½d.; the second, £204, 15s. 7¾d.; the third, £199, 17s. 8¾d.; and the fourth, £219, 15s. 3½d.: how much does the fifth town pay?

66. A merchant laid out £756, 18s. 9½d. on wheat, barley, and oats; the sum laid out on wheat and barley was £437, 6s. 2d., and on barley and oats, £540, 12s. 1½d.: how much was laid out on each?

COMPOUND MULTIPLICATION.

CASE I. When the multiplier is not greater than 12.

Ex. Multiply £8, 17s. 9¼d. by 9. Ans. £79, 19s. 11¼d.

SOL. 9 times 1f. = 9f. or 2¼d.; write down ¼d., and carry 2d. 9 times 9d. are 81d. and 2d. are 83d. or 6s. 11d.; write down 11d., and carry 6s. 9 times 7s. are 63s. and 6s. are 69s.; write down 9s. and carry 6 9 times 1 are 9 and 6 are 15 ten s. pieces = £7, 10s.; write down 1 before 9s. and carry £7. 9 times £8 are £72 and £7 are £79.

£8	17s.	9¼d.
		9
£79	19	11¼

1. Multiply £27, 17s. 8¼d. by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
2. Multiply £36, 15s. 11¾d. by 7, 5, 2, 9, 6, 11, 4, 10, 8, 12, 3.

CASE II. When the multiplier does not exceed 156.

Ex. Multiply £3, 16s. 7¼d. by 16 and by 26.

1. £3 16s. 7¼d. × 16 = 4 × 4

		4	
15	6	5	= 4 times.
		4	
£61	5	8	= 16 times.

2. £3 16s. 7¼d. × 26 = 5 × 5 + 1

		5	
19	3	0½	= 5 times.
		5	
95	15	1½	= 25 "
3	16	7¼	= 1 "
£99	11	8½	= 26 times.

	£	s.	d.		
1.	27	11	4¼	×	14, 18, 20
2.	31	17	2¾	×	24, 27, 30
3.	19	18	6½	×	32, 25, 36
4.	34	14	11¼	×	42, 45, 48
5.	28	19	10½	×	49, 54, 55
6.	74	13	8¾	×	56, 60, 64
7.	16	19	11½	×	63, 66, 72
8.	35	0	0¾	×	70, 77, 81
9.	54	19	0¼	×	80, 90, 96
10.	47	13	11½	×	108, 121, 144
11.	45	15	6¾	×	110, 99, 132
12.	39	17	10¼	×	84, 77, 81

	£	s.	d.		
13.	42	18	6½	×	17, 23, 26
14.	36	15	11¼	×	29, 31, 34
15.	25	13	10¾	×	38, 43, 39
16.	38	11	0¼	×	47, 59, 68
17.	45	12	8½	×	67, 69, 74
18.	56	18	6¼	×	75, 76, 79
19.	73	16	4¾	×	83, 87, 86
20.	84	19	11¾	×	89, 93, 98
21.	91	13	4½	×	94, 103, 107
22.	94	15	2¼	×	115, 95, 106
23.	96	17	8¾	×	117, 127, 139
24.	99	19	11¾	×	148, 126, 137

CASE III. When the multiplier exceeds 156.

Ex. Multiply £2, 13s. 4¾d. by 536. Ans. £1431, 0s. 2d

£2	13s.	4¾d.	×6 =	£16	0s.	4½d.	=	6 times.
		10						
26	13	11½	×3 =	80	1	10½	=	30 times.
		10						
£266	19	7	×5 =	1334	17	11	=	500 times.
				£1431	0	2	=	536 times.

	£	s.	d.			£	s.	d.		
1.	5	18	11¾	×	583, 742	5.	7	19	10¾	× 7384, 6472
2.	6	5	2¼	×	879, 986	6.	10	11	11½	× 5809, 4365
3.	3	13	4½	×	1004, 2963	7.	13	16	8¼	× 9416,10738
4.	4	17	9¾	×	3125, 7518	8.	16	17	10½	×27580,74087

Find the price of,

1. 27 cwt. of sugar at £3, 16s. 6d. per cwt.
2. 38 tons of steel at £25, 17s. 11d. per ton.
3. 45 quarters of wheat at £3, 6s. 7½d. per quarter.
4. 67 dozen Madeira at £6, 8s. 11¾d. per dozen.
5. 53 gallons whisky at 12s. 2¾d. per gallon.
6. 86 acres of turnips at £17, 16s. 8d. per acre.
7. 57 cwt. butter at £4, 5s. 8¼d. per cwt.
8. 67 lbs. tea at 7s. 11½d. per lb.
9. 58 acres of grass at £7, 8s. 7½d. per acre.
10. 75 cwt. Carolina rice at £2, 15s. 7½d. per cwt.
11. 46 sugar loaves, each 17½ lbs., at 11½d. per lb.
12. 17 boxes pimento, each 87 lbs. at 11¼d. per lb.
13. 19 cwt. potashes at £1, 7s. 11¾d. per cwt.
14. 116 cwt. tallow at £2, 10s. 7¼d. per cwt.
15. 73 gallons rum at 18s. 6½d. per gallon.
16. 59 ounces of gold at £3, 17s. 11½d. per oz.
17. 153 bushels malt at 7s. 4½d. per bushel.
18. The daily pay of a foot soldier is 1s. 1d.; how much is this yearly?
19. A farm of 379 acres is rented at £3, 10s. 7½d. per acre; how much is the whole rent?
20. A merchant bought 25 pieces of cloth, each containing 20 yards at £1, 2s. 7½d. a-yard, and sold the whole for £612, 10s.; what was his gain?

21. If the weekly forage of a horse be 14s. 6½d.; what sum will be required to keep a regiment of 750 horses for a year?

22. The rent of a house is £1, 10s. 6½d. per week; how much is that in the year?

23. How much will a farmer pay for cutting down his crop, if he employs 53 reapers for 3 weeks at 2s. 11¾d. each per day?

24. If an hospital contains 80 boys, and each on an average costs 1s. 3½d. a-day for food and clothing; how much will each, and also the whole, cost in the year?

25. How much will a tax on property of £8746 yearly value amount to, at 2s. 2¾d. per pound?

26. A clerk's salary is £2, 17s. 9d. a-week; how much is it yearly?

27. Find the price of 7 pieces of cloth, each 45 yards, at £1, 2s. 7½d. per yard.

28. The pay of an Ensign in the Foot Guards is 5s. 6d. per day; what is it yearly?

29. A bankrupt owes his creditors £4876, and pays them 8s. 6½d. per pound; how much does he pay in all?

30. How much does the pay of a regiment of 895 men amount to in a year, at the rate of 1s. 1½d. to each man per day?

31. Find the value of a lac of rupees, that is 100,000, at 1s. 11¾d. each.

32. How much will a farmer receive for a field of wheat containing 16 acres, if each acre produces 7½ quarters, and the price of wheat is £2, 16s. 7d. per quarter?

33. A farmer has a field of potatoes containing 1000 drills; now if each drill produces 19 bushels, how much will he receive for each drill, and also for the whole, at the rate of 4s. 7½d. per bushel?

34. A butcher purchases 4 oxen for 49 guineas, and sells the beef, which amounted to 165 stones, at 6s. 11¾d. per stone, and he gets besides £2, 3s. 5¾d. for the hide, &c. of each; what is his net gain?

35. The weekly receipts of a railway are £1768, 17s. 8½d.; how much is this per annum?

36. Find the value of 17 tons of coal at 15s. 3d. per ton.

37. What should 7 chests of tea, each containing 74 lb., cost, at 3s. 10d. per lb. ?

38. An hospital contains 165 boys, and each requires for food and clothing 1s. 2½d. a-day; the governor's salary is £368, 7s. 6d. yearly, and 4 teachers have each £182, 14s. 8d. yearly; the porters' and servants' wages and board amount to £215, 11s. 6d. per annum; and the treasurer's salary amounts to £400 yearly: what is the annual income of the hospital, supposing the yearly surplus to be £597, 18s. 9d. ?

COMPOUND DIVISION.

CASE I. When the divisor does not exceed 12.

Ex. Divide £27, 13s. 7¼d. by 5. Ans. £5, 10s. 8½d. ⅗

SOL. 5 in £27 is 5 times and £2 over; £2 = 40s. and 13s. are 53s. 5 in 53s. is 10 times and 3s. over; 3s. = 36d. and 7d. are 43d. 5 in 43d. is 8 times and 3d. over; 3d. = 12f. and 1f. are 13f. 5 in 13f. is 2 times and 3 over.

5)£27 13s. 7¼d.
£5 10 8½ ⅗
Proof £27 13 7¼ 5

1. Divide £35, 17s. 8½d. by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
2. " 74 15 7½ by 3, 5, 7, 9, 11, 2, 4, 6, 8, 10, 12.

CASE II. When the divisor is found in the table.

Ex. Divide £30, 11s. 8¼d. by 18. Ans. £1, 13s. 11¾d. ⅜.

2)£30 11s. 8¼d. ÷ 18 = 2 × 9
9)15 5 10¼ – 1 quot. by 2.
£1 13 11¾ – 1 " by 18.
1 × 2 + 1 = 2 + 1 = 3 rem.

	£	s.	d.		£	s.	d.
1.	374	16	8½ ÷ 16, 21, 25	9.	612	16	3½ ÷ 80, 84, 90
2.	456	18	7½ ÷ 24, 27, 28	10.	714	13	10½ ÷ 70, 121, 144
3.	354	11	10¾ ÷ 32, 35, 40	11.	896	11	2½ ÷ 20, 42, 81
4.	729	19	9¼ ÷ 30, 36, 44	12.	968	17	9¾ ÷ 88, 108, 132
5.	847	17	11¾ ÷ 45, 48, 49	13.	742	16	8¼ ÷ 63, 72, 81
6.	783	11	9 ÷ 54, 55, 56	14.	845	17	9½ ÷ 120, 44, 56
7.	874	14	10½ ÷ 60, 63, 64	15.	874	5	6¾ ÷ 36, 88, 108
8.	956	15	4¾ ÷ 50, 66, 72	16.	997	19	11¼ ÷ 121, 132, 144

CASE III. When the divisor is not contained in the table.

Ex. Divide £27, 13s. 7½d. by 17. Ans. £1, 12s. $6\frac{3}{4}$d. $\frac{3}{17}$.

17)£27, 13s. 7½d. (£1 12s. $6\frac{3}{4}$d. $\frac{3}{17}$

17 × 1 =	17		4
	10	6 10 3	= 4 times.
Mult. by	20		4
	213 s.	26 1 0	= 16 "
17 × 1 =	17	1 12 $6\frac{3}{4}$	= 1 "
	43	$\frac{3}{4}$	Rem.
17 × 2 =	34	£27 13 7½	Proof.
	9		
Mult. by	12		
	115 d.		
17 × 6 =	102		
	13		
Mult. by	4		
	54 f.		
17 × 3 =	51		
	3 rem.		

	£	s.	d.		£	s.	d.	
1.	476	13	$8\frac{1}{2}$ ÷	13, 19, 23	9. 9873	18	$11\frac{3}{4}$ ÷	571, 843
2.	764	17	$8\frac{1}{2}$ ÷	17, 26, 29	10. 3725	17	6 ÷	219, 343
3.	1387	11	$4\frac{1}{2}$ ÷	37, 46, 58	11. 4876	11	$5\frac{3}{4}$ ÷	432, 563
4.	7480	16	$10\frac{1}{2}$ ÷	67, 78, 89	12. 5983	13	$8\frac{1}{2}$ ÷	729, 984
5.	5387	14	$1\frac{3}{4}$ ÷	47, 58, 69	13. 6473	12	$4\frac{3}{4}$ ÷	8463, 1729
6.	6892	17	$4\frac{1}{4}$ ÷	53, 57, 59	14. 7893	17	$10\frac{1}{4}$ ÷	2748, 9740
7.	9673	8	$11\frac{1}{2}$ ÷	73, 75, 79	15. 8739	16	$11\frac{1}{2}$ ÷	5490, 6753
8.	2723	4	$1\frac{1}{4}$ ÷	83, 91, 95	16. 9378	11	$7\frac{3}{4}$ ÷	4386, 9897

CASE IV. To divide one sum of money by another.

Ex. How often does £99, 8s. 5½d. contain £1, 11s. $6\frac{3}{4}$d.

£1, 11s. $6\frac{3}{4}$d.) £99, 8s. 5½d.

20	20
31 s.	1988 s.
12	12
378 d.	23861 d.
4	4
1515 f.	)95445 f. (63 times.
	9090
	4545
	4545

	£	s.	d.		£	s.	d.
1.	113	12	6 ÷	2	10		6
2.	51	7	3 ÷	0	12		$2\frac{3}{4}$
3.	630	7	$8\frac{1}{2}$ ÷	1	14		$6\frac{1}{2}$
4.	248	17	$3\frac{1}{2}$ ÷	7	2		$2\frac{1}{2}$
5.	484	19	$4\frac{1}{2}$ ÷	13	17		$1\frac{1}{2}$
6.	2855	7	$0\frac{3}{4}$ ÷	27	14		$5\frac{1}{4}$
7.	2673	1	6 ÷	7	13		$7\frac{1}{2}$
8.	8866	0	$0\frac{1}{2}$ ÷	1	5		$0\frac{1}{2}$

	£	s.	d.	£	s.	d.
9.	402	2	0 ÷	4	3	$9\frac{1}{4}$
10.	103	14	$0\frac{1}{4}$ ÷	0	18	$4\frac{1}{4}$
11.	308	15	0 ÷	2	7	6
12.	9093	12	0 ÷	2	12	$7\frac{1}{2}$
13.	201	9	$9\frac{1}{2}$ ÷	3	9	$5\frac{3}{4}$
14.	4349	1	$7\frac{1}{4}$ ÷	6	3	$8\frac{3}{4}$
15.	4539	8	4 ÷	0	18	$7\frac{1}{4}$
16.	4574	15	$3\frac{1}{2}$ ÷	2	11	$2\frac{3}{4}$

17. How many moidores, each 27s., are in £149, 17s. sterling?

18. How many francs, each $9\frac{3}{4}$d., are equal to £9, 15s.?

19. How many books at 3s. 6d. are equal in value to 868 at 1s. 9d.?

20. £1, 3s. 4d. was distributed among a number of boys, each received 1s. 8d.; how many were there?

21. How many pounds Irish, each 21s. 8d., are equal to 1404 pounds Scotch, each 1s. 8d.?

22. The railway fares of a certain number of passengers amounted to £26, 12s. 6d.; the fare of each was 35s. 6d.: how many were there?

SUPPLEMENT TO COMPOUND MULTIPLICATION AND DIVISION.

Ex. £4 17s. $6\frac{1}{2}$d. × $4\frac{2}{3}$

	£	s.	d.	
			$4\frac{2}{3}$	
3)	9	15	1	= 2 times.
	3	5	$0\frac{1}{4}\frac{1}{3}$	= $\frac{2}{3}$ "
	19	10	2	= 4 "
	£22	15	$2\frac{1}{4}\frac{1}{3}$	= $4\frac{2}{3}$ times.

Ex. £27, 10s. $11\frac{1}{4}$d. ÷ $4\frac{2}{3}$.

$4\frac{2}{3}$) £27 10s. $11\frac{1}{4}$d.

5 5

22 (2)137 14 $8\frac{1}{4}$ = 5 times.

(11)68 17 $4\frac{2}{3}$ -1) 5

£6 5 $2\frac{1}{3}$ -2) 22

	£	s.	d.			£	s.	d.		
1.	4	8	$7\frac{1}{6}$	×	$4\frac{1}{3}$,	5	$\frac{3}{4}$			
2.	6	17	$10\frac{3}{4}$	×	$6\frac{3}{4}$,	8	$\frac{5}{8}$			
3.	7	14	$11\frac{1}{4}$	×	$7\frac{1}{3}$,	5	$\frac{2}{5}$			
4.	8	19	$7\frac{1}{4}$	×	$8\frac{5}{7}$,	9	$\frac{3}{7}$			
5.	9	12	$7\frac{1}{4}$	×	$11\frac{2}{3}$,	12	$\frac{5}{11}$			
6.	12	14	$7\frac{1}{4}$	×	$16\frac{9}{10}$,	27	$\frac{4}{11}$			
7.	17	18	$11\frac{3}{4}$	×	$19\frac{2}{5}$,	26	$\frac{4}{7}$			
8.	24	11	$7\frac{1}{8}$	×	$46\frac{5}{13}$,	52	$\frac{8}{17}$			

	£	s.	d.			£	s.	d.		
1.	270	18	$11\frac{3}{4}$	÷	$4\frac{1}{2}$,	5	$\frac{1}{3}$			
2.	384	13	$10\frac{1}{2}$	÷	$9\frac{1}{4}$,	11	$\frac{3}{8}$			
3.	487	11	$5\frac{1}{2}$	÷	$9\frac{3}{4}$,	10	$\frac{4}{5}$			
4.	592	13	$1\frac{3}{4}$	÷	$11\frac{3}{7}$,	13	$\frac{3}{8}$			
5.	756	17	$11\frac{3}{4}$	÷	$16\frac{1}{3}$,	29	$\frac{2}{7}$			
6.	847	11	$9\frac{1}{2}$	÷	$47\frac{3}{5}$,	59	$\frac{1}{6}$			
7.	967	11	$6\frac{1}{2}$	÷	$84\frac{3}{13}$,	97	$\frac{5}{19}$			
8.	989	17	$11\frac{1}{4}$	÷	$81\frac{3}{17}$,	89	$\frac{4}{15}$			

1. Divide £746, 11s. 6d. equally among 48 men.

2. If 38 cwt. sugar cost £108, 16s. 8d.; what is that per cwt.?

3. If 32 quarters of wheat cost £110, 11s. 6d.; what is that per quarter?

4. A gentleman spends £960 a-year; what is that a-week, and a-day?

5. A gentleman's income is £1000; what should his daily expenses be to save £340 a-year?

6. A labourer earns 15s. 7½d. per week, but he must save £12 a-year for house-rent and clothes; how much may he spend per week?

7. If 46½ lbs. tea cost £18, 17s. 6½d.; what is that per lb.?

8. If 27¾ gallons Cognac brandy cost £33, 17s. 6d.; what is that per gallon?

9. If 34 men gain £1360 in a year; what does each gain per week, and per day?

10. Divide £255, 17s. 6d. among 7 marines and 75 sailors, giving each marine twice as much as a sailor.

11. A farm of 156 acres is let for £375, 18s. 3d.; what is that per acre?

12. A joint-stock company consists of 527 shares, and the capital is £500,000; what is the value of a share?

13. A merchant bought 6 pieces of cloth, each 56 yards, for £308, 12s. 6d., and sold it at 19s. 11¾d. per yard; how much did he gain upon the whole, and per yard?

14. How much cloth at 15s. 6½d. per yard can be bought for £95, 11s. 7½d.?

15. How much wine at £2, 2s. 6d. per dozen can be purchased for £297, 10s.?

16. In £59, 17s., how many crowns, half-crowns, and florins, and of each an equal number? Ans. 126 of each.

SOL. 1 crown = 60d. £59, 17s.
1 h.-cr. = 30 20
1 florin = 24 1197s.
114d.)14364d.
126 of each.

17. How many guineas, half-guineas, crowns and florins, and of each an equal number, are in £25, 6d.?

18. How many gallons of brandy can be bought for £625, 19s. 6d. at 36s. 6d. the gallon?

19. The revenues of an hospital amount to £1807, 8s. yearly; how many boys will it maintain, if each costs £18, 16s. 6½d.?

20. A gentleman distributed £19, 14s. 6d. among some poor people, giving each 10s. 11½d.; how many poor were there?

21. Divide £73, 7s. 4½d. among 3 men, 5 women, and 10 boys, giving each man twice a woman's share, and each woman 3 times a boy's share.

22. If a man gains 2s. 6d. a-day, and spends 1s. 10½d.; how many days must he labour to pay a debt of £11, 7s. 6d.?

23. A farmer, who employed 49 reapers for 4 weeks to cut down his crop, paid them in all £158, 12s. 9d.; how much was that to each reaper, and what was the daily wages of each?

24. A merchant pays for gas £12, 17s. 6d. yearly, at the rate of 10s. per 1000 cubic feet; how many cubic feet does he consume in the year?

25. The wages of an equal number of men, women, and children amounted to £24, 7s. 6d.; each man earned 1s. 6d., each woman 1s., and each child 9d.: how many were there of each?

26. A house and its furniture are worth £3750, 16s. 8d., but the house is worth 7 times as much as the furniture; what is the value of each?

27. If 1000 muskets are worth £3333, 6s. 8d.; what is the price of each?

28. A corn merchant lays out £581, 17s. on equal quantities of wheat at 42s. per quarter, barley at 36s. 6d. per quarter, and oats at 29s. 3d. per quarter; what quantity of each did he buy?

29. How many gallons of ale at 3s. 6d. a-gallon should be exchanged for 75 gallons brandy at 38s. 6d. per gallon?

30. A person spends £8, 12s. 6d. weekly; what must his daily income be that in 12 years he may lay by £312?

BILLS OF PARCELS.

Mr James Scott

Edinburgh, Jan. 2, 1858.

Bought of William Oliver,

14 gallons malt aqua	@ 15/6	£
13 ..... rum	.. 18/6	
12 ..... hollands	.. 24/6	
9 ..... brandy	.. 55/6	
15 dozen port wine	.. 47/6	
16 ..... sherry	.. 36/6	
		£

Mr Andrew Turnbull

Bought of John Smart & Co.

27½ yards superfine black cloth	@ 21/8	£
17¾ ..... blue do.	.. 23/6	
15⅔ ..... olive do.	.. 14/9	
23¼ ..... mixt do.	.. 17/10	
34⅜ ..... bl. cassimere	.. 6/4½	
31½ ..... drab do.	.. 5/9¼	
		£

Mr John Williamson

Bought of J. & W. Allan,

17 reams large thick post HP.	@ 41/7	£
23 ..... small do. do.	.. 32/9	
13 ..... foolscap ruled	.. 20/3	
16 ..... coloured yellow	.. 25/8¼	
18 ..... do. green	.. 24/11½	
21 ..... marbled	.. 19/11	
		£

Mr John Anderson

Bought of William Tod,

13¼ lbs. green tea	@ 6/6½	£
17¼ ..... hyson skin	.. 5/3½	
26¾ ..... souchong	.. 4/11½	
19½ ..... pekoe	.. 5/8½	
27 ..... raw sugar	.. 6½	
35 ..... refined do.	.. 8	
		£

Mr William Brown

Bought of Drysdale & Co.

56 cwt. raw sugar	@ 50/8	£
29 boxes oranges	.. 34/11½	
5 ..... lemons	.. 19/4¼	
150 sugar loaves ea. 13¼ lbs.	.. 8¾ p. lb.	
52⅞ cwt. of molasses	.. 17/6 p. cwt.	
A chest of black tea, 87½ lbs.	.. 4/3½ p. lb.	
		£

Mr George Thomson

Bought of David Wright,

54½ yds. superfine Brussels carpet	@ 4/10½	£
71 ..... fine do. do.	.. 3/9	
67¾ ..... superfine English do.	.. 2/11¼	
29¼ ..... fine do. do.	.. 2/1¾	
17⅛ ..... floor-cloth	.. 5/7½	
15¼ ..... ¼ crumb-cloth	.. 8/9½	
		£

Mr David Simpson

Bought of Richard Davidson,

52 quarters wheat	@ 46/6	£
47 ..... barley	.. 43/5	
39 ..... oats	.. 27/8	
17 ..... pease	.. 45/3	
19 ..... beans	.. 46/8	
117 stones hay	.. 9¼	
		£

Miss Murray

Bought of Thomas Watson,

14⅛ yds. pink sarcenet	@ 3/7½	£
17⅜ ..... green silk	.. 4/2½	
25 ..... printed calico	.. 1/2¼	
23¾ ..... Norwich crape	.. 3/2½	
19 ..... gingham	.. 11¾	
24⅛ ..... do. striped	.. 10½	
27⅜ ..... silk velvet	.. 14/8½	
		£

II. WEIGHTS AND MEASURES.

REDUCTION.

Ex. Red. 3 lb. 4 oz. 5 dwt. to grs.

Mult. by 12 and add 4 oz.

40 oz.

Mult. by 20 and add 5 dwt.

805 dwt.

Mult. by 24

19320 grs.

Ex. Red. 8472 grs. to lb.

24) 4)8472 grs.
6)2118

2,0)35,3 dwt.

12)17 oz. 13 dwt.

1 lb. 5 oz. 13 dwt.

1. Reduce 27 lbs.; 14 lbs. 10 oz. 13 dwts.; 57 lbs. 8 oz. 12 dwts. 16 grs.; 82 lbs. 3 oz. 15 dwts. 20 grs. troy respectively to grains.

2. Reduce 27653 dwts.; 476890 grs.; 478670 oz.; 72586 grs.; 514760 dwts.; and 738469 grs. to pounds.

3. Reduce 29 lbs. 2 oz. 3 drs. 1 scr. 18 grs.; 18 lbs. 4 drs.; 46 lbs. 4 oz. 2 scrs.; and 205 lbs. 15 grs. to grains apothecaries' weight.

4. Reduce 4968 drs.; 72190 scrs.; 518764 grs.; 5489 oz.; 73864 drs.; and 892164 grs. to pounds.

5. Reduce 24 tons; 6 tons, 3 cwt. 2 qrs. 14 lbs. 12 oz. 12 drs.; 15 cwt. 27 lbs. 14 drs.; 27 lbs. 13 oz. 15 drs. to drams avoirdupois.

6. Reduce 21704736 drs.; 41876 lbs.; 219864 oz., 518764 lbs.; 21983 qrs.; 714867846 drs. to tons.

7. Reduce 3 fur. 34 po. 3 yds. 2 ft.; 17 miles, 2 fur. 28 po. 2 yds. 9 in.; and 81 mls. 1 fur. 26 po. 3 yds. 2 ft. 6 in. to inches.

8. Reduce 71846 yds.; 4189628 inches; 4596327 ft.; 8476 po.; 51486973 in.; and 7184896 ft. to miles.

9. Reduce 4 yds. 2 qrs. 1 nl.; 24 yds. 3 nls.; 25 Eng. ells, 3 qrs. 2 nls.; 53 Fle. ells, 2 qrs. 3 nls.; 56 yds. 3 qrs. 3 nls. to nails.

10. Reduce 41764 nls.; 5174 qrs.; 318769 inches; 49864 nls.; 217384 inches; and 8172144 nls. to yards and English ells.

11. Reduce 27 ac. 3 ro. 16 per.; 84 ac. 2 ro. 24 per. 28 yds.; 108 ac. 1 ro. 36 per. 25 yds. 5 ft. 84 in. to square inches.

12. Reduce 147847684 sq. inches; 218764 yds.; 5189764 ft.; 31874 per.; and 84726084 inches to acres.

13. Reduce 48 cub. yds.; 403 cub. yds. 21 ft. 908 in.; 700 tons of ship.; 572 loads of hewn timber; and 876 do. of rough, to cubic inches.

14. Reduce 17486936 cu. in.; 784693 cu. ft.; 874869684 cu. in.; and 784627 cu. ft. to cubic yards and tons of shipping.

15. Reduce 8 qrs. 3 bu. 2 pk. 1 ga.; 208 qrs. 7 bu. 3 pk. 1 ga. 3 qts.; 409 bu. 2 pk. 1 ga. 3 qts. 1 pt. to pints.

16. Reduce 7486984 pts.; 87634 pks.; 918764 gals.; 8176 bu.; 514876 pts.; and 784673 qts. to quarters.

17. Reduce 208 galls. 3 qts. 1 pt.; 476 galls. 2 qts.; and 749 galls. 1 qt. 1 pt. to pints.

18. Reduce 74869 pints; 586476 pints; 3486 qts.; and 79040 pints to gallons.

19. Reduce 42 signs 39° 36′; 81^s 15° 49′ 59″; 208^s 20° 56′ 28″; and 315^s 19° 34′ 38″ to seconds.

20. Reduce 718460″; 87654′; 374°; 8178640″; 71860′; 7186940″; and 7184° to signs and circles.

21. Reduce 36 co. ye. 219 da. 18 ho. 15 min. 27 sec.; 380 co. ye. 219 da. 23 ho. 29 min. 36 sec.; and 7184 Julian years to seconds.

22. Reduce 71847630 sec.; 48196219 min.; 81468 ho.; 31817640 sec.; and 7187210 min. to com. and Jul. years.

23. How long would it require to count 800 millions of sovereigns, at the rate of 120 in a minute?

24. How many seconds have elapsed since the birth of Christ or in 1858 Jul. years?

25. The distance of Jupiter from the sun is 494,513,000 miles; express this in feet.

26. Saturn revolves round the sun in 10,756 days, 5 ho. 16 m. 32 sec.; how many seconds is this?

27. In Scotland there are 29,167 square miles; how many acres does it contain?

28. The polar axis of the Earth is 41,706,360 feet; express this in miles, &c.

29. Light travels at the rate of 192,000 miles per sec.; in what time will it travel between the Sun and Saturn, the distance being 906,643,000 miles?

COMPOUND ADDITION.

TROY WEIGHT.

1.				2.				3			
lbs.	oz.	dwt.	gr.	lbs.	oz.	dwt.	gr.	lbs.	oz.	dwt.	gr.
27	10	11	18	31	10	19	23	67	8	13	22
36	11	16	17	53	8	17	19	76	9	18	20
41	8	18	23	35	4	15	20	18	11	15	23
34	9	10	12	20	3	4	6	81	4	12	14
26	5	8	19	25	9	16	17	15	3	13	13
37	11	16	15	48	11	19	21	56	11	4	8
47	10	18	22	84	10	16	18	9	10	8	17

APOTHECARIES' WEIGHT.

4.				5.				6.			
lbs.	oz.	dr.	scr.	oz.	dr.	sc.	gr.	lbs.	oz.	dr.	scr.
18	9	4	1	11	7	2	19	56	10	7	2
17	8	7	2	10	4	1	15	84	11	5	1
26	5	4	0	8	3	2	18	96	10	6	2
62	11	7	2	7	5	1	17	31	8	4	1
25	10	4	1	9	4	2	15	28	9	7	2
64	11	2	2	11	6	1	18	86	11	7	2

AVOIRDUPOIS WEIGHT.

7.				8.				9.			
ton.	cwt.	qrs.	lbs.	cwt.	qrs.	lbs.	oz.	qrs.	lbs.	oz.	dr.
74	18	2	25	27	2	18	14	14	14	14	14
87	16	3	27	31	3	26	15	27	26	15	15
65	13	1	20	46	1	24	13	38	22	13	12
29	11	0	18	49	2	27	11	47	11	12	13
94	17	3	26	37	0	24	12	31	18	15	11
38	14	2	19	84	3	16	10	72	27	13	15
45	19	1	27	93	1	27	15	29	22	10	4

LINEAL MEASURE.

10.				11.				12.			
mls.	fu.	po.	yds.	fu.	po.	yds.	ft.	po.	yds.	ft.	in.
45	3	27	4	17	18	2	1	39	2	1	7
76	7	39	5	25	36	1	2	45	4	2	11
64	5	29	3	64	31	3	1	53	3	1	10
85	6	34	2	45	39	5	2	32	5	2	8
58	7	26	4	74	26	4	0	25	4	2	9
69	3	37	2	55	34	5	2	74	5	2	11
73	5	33	4	79	18	1	1	43	2	1	8

CLOTH MEASURE.

13.				14.				15.			
yds.	qrs.	nls.	in.	En.ell.	qrs.	nls.	in.	Fr.ell.	qrs.	nls.	in.
27	3	3	2	45	3	2	1	48	5	3	2
73	1	0	1	36	4	3	2	76	3	2	0
48	0	2	0	75	2	1	1	51	4	1	1
86	2	1	1	64	4	3	2	36	5	3	2
74	2	3	2	38	4	1	2	71	4	1	0
39	1	2	0	76	3	3	1	67	1	0	2
76	1	3	2	69	4	2	2	84	5	3	2

SQUARE OR LAND MEASURE.

16.				17.				18.			
ac.	ro.	pe.	yds.	ro.	pe.	yds.	ft.	pe.	yds.	ft.	in.
36	3	39	30	14	27	18	4	27	29	8	67
45	2	33	24	25	11	19	8	31	30	4	96
72	3	27	29	32	17	21	4	27	27	1	99
85	1	36	30	36	38	29	7	38	11	7	84
96	3	38	27	48	28	26	5	29	26	3	47
71	2	31	25	86	39	30	8	36	30	8	98
78	3	39	30	74	36	28	7	39	30	8	99

MEASURE OF CAPACITY.

19.				20.				21.			
qrs.	bu.	pe.	ga.	bu.	pe.	ga.	qt.	pe.	ga.	qt.	pt.
56	7	3	1	56	2	1	2	74	1	3	1
74	6	2	1	39	1	0	3	38	1	2	0
45	3	1	1	47	3	1	2	84	1	3	1
63	7	3	1	76	1	1	1	48	1	2	1
34	6	2	1	79	3	0	3	56	1	3	0
47	7	3	1	34	1	1	0	75	0	2	1
38	5	2	1	49	3	1	3	63	1	3	1

TIME.

22.					23.				24.			
co.ye.	da.	ho.	m.		da.	ho.	m.	sec.	da.	ho.	m.	sec.
28	96	18	15		84	12	56	59	55	18	54	11
38	27	16	53		96	18	41	36	73	19	49	56
45	99	23	59		72	23	59	59	85	16	46	55
76	84	11	52		67	22	48	45	98	17	41	36
35	219	16	18		36	21	18	47	87	22	28	39
74	361	15	55		79	20	29	55	76	20	18	49
84	278	11	46		93	23	51	42	65	23	54	51

25. A corn merchant bought 208 qrs. 3 bu. 1 pk. of barley; 336 qrs. 2 pk. of wheat; 236 qrs. 4 bu. of oats; 125 qrs. 1 bu. 3 pks. of rye; 86 qrs. 1 bu. 1 pk. of pease; and 79 qrs. 2 bu. 2 pk. of beans: how many quarters did he buy?

26. The distance from A to B is 2 ml. 1 fu. 30 po. 5 yds.; from B to C, 7 fu. 4 yds; from C to D, 1 ml. 25 po.; and from D to E, 3 ml. 1 fu. 2 yd.: find the distance from A to E.

27. A clothier, at various times, bought 28 yds. 2 qrs. 1 nl. of cloth; 37 yds. 2 qrs.; 47 yds. 1 nl.; 37 yds. 1 qr. 2 nl.; and 67 yds. 2 qrs. 2 nl.: how much did he buy in all?

28. London is in latitude 51° 30′ 48″ N., and Sydney is in lat. 33° 51′ 40″ S.; what is the difference?

COMPOUND SUBTRACTION.

TROY WEIGHT.

1.				2.				3.			
lb.	oz.	dwt.	gr.	lb.	oz.	dwt.	gr.	lb.	oz.	dwt.	gr.
96	10	13	14	36	5	17	21	82	2	1	16
47	10	19	21	19	7	18	23	79	11	14	20

APOTHECARIES' WEIGHT.

4.				5.				6.			
lb.	oz.	dr.	scr.	lb.	oz.	dr.	scr.	oz.	dr.	scr.	gr.
39	2	3	1	52	7	7	0	41	6	2	18
29	7	5	2	46	8	7	1	34	7	1	19

AVOIRDUPOIS WEIGHT.

7.				8.				9.			
ton.	cwt.	qrs.	lb.	cwt.	qrs.	lb.	oz.	qrs.	lb.	oz.	dr.
84	13	2	11	46	1	23	12	17	21	11	10
69	14	3	25	29	2	22	15	9	22	13	14

LINEAL MEASURE.

10.				11.				12.			
mls.	fu.	po.	yds.	fu.	po.	yds.	ft.	po.	yds.	ft.	in.
84	3	22	4	35	33	4	1	39	2	2	8
65	3	25	5	17	36	4	2	19	4	2	10

CLOTH MEASURE.

13.				14.				15.			
yds.	qrs.	nls.	in.	E.ell.	qrs.	nls.	in.	Fr.ell.	qrs.	nls.	in.
72	2	1	1	93	4	2	1	81	4	2	1
56	2	1	2	63	4	3	2	41	5	3	2

SQUARE OR LAND MEASURE.

16.				17.				18.			
ac.	ro.	pe.	yds.	ro.	pe.	yds.	ft.	pe.	yds.	ft.	in.
65	2	31	21	53	18	27	3	25	21	4	10
36	3	31	24	19	28	29	5	8	29	4	11

MEASURE OF CAPACITY.

19.				20.				21.			
qrs.	bu.	pe.	ga.	bu.	pe.	ga.	qt.	pe.	ga.	qt.	pt.
21	3	2	0	54	2	1	2	18	0	3	0
18	4	3	1	49	2	1	3	9	1	3	1

TIME.

22.				23.				24.			
co.ye.	da.	ho.	m.	da.	ho.	m.	sec.	da.	ho.	m.	sec.
41	138	14	25	90	13	43	21	70	19	15	55
18	147	16	46	40	18	25	46	31	22	15	59

25. The latitude of Edinburgh is 55° 57′ 23″ N., and the latitude of Pekin is 39° 54′ 13″ N.; find the difference.

26. Mars revolves round the sun in 686 da. 23 ho. 30 m. 41 sec., and Venus in 224 da. 16 ho. 49 m. 10 sec.; find the difference.

27. Three farms contain 4536 ac. 3 ro. 25 per.; the 1st and 2d contain 3327 ac. 30 per., and the 1st and 3d 2752 ac. 15 per.; what is the size of each?

28. A merchant bought 756 qrs. 3 bu. 2 pk., and sold to A 208 qrs. 3 bu. 1 pk., and to B 315 qrs. 2 bu. 2 pk.; what quantity has he left?

29. A piece of silk measured 43 yds. 2 qrs. 1 nl. 1 in.; after 27 yds. 3 qrs. 2 nl. 2 in. have been sold: how much remains?

30. A traveller arrived at a railway station at 26 min. and 32 sec. past 1 o'clock, and found that the train did not start until a quarter past 2 o'clock; how long had he to wait?

COMPOUND MULTIPLICATION.

1. 17 lb. 8 oz. 15 dwt. 21 grs.	×25, 27, 29, 47
2. 32 lb. 11 oz. 17 dwt. 19 grs.	×16, 24, 31, 38
3. 25 lb. 4 oz. 3 drs. 2 scr. 18 grs.	×18, 22, 34, 43
4. 47 lb. 9 oz. 7 drs. 1 scr. 13 grs.	×20, 28, 37, 41
5. 36 ton. 14 cwt. 2 qrs. 21 lb. 11 oz. 13 drs.	×30, 32, 39, 46
6. 43 ton. 16 cwt. 3 qrs. 26 lb. 13 oz. 15 drs.	×33, 35, 47, 51
7. 21 mls. 5 fu. 29 po. 2 yds. 1 ft. 11 in.	×36, 40, 52, 57
8. 37 mls. 7 fu. 36 po. 3 yds. 2 ft. 8 in.	×42, 45, 53, 58
9. 56 yds. 3 qrs. 2 nls. 2 inches	×54, 56, 67, 71
10. 73 E. ells, 4 qrs. 3 nls. 1 inch	×60, 64, 68, 17
11. 47 Fr. ells, 5 qrs. 2 nls. 2 inches	×66, 70, 69, 73
12. 38 Fl. ells, 2 qrs. 1 nl. 1 inch	×72, 77, 19, 13
13. 56 ac. 2 ro. 31 pe. 23 yds. 5 ft. 47 in.	×44, 48, 59, 61
14. 87 ac. 3 ro. 39 pe. 27 yds. 8 ft. 126 in.	×49, 50, 62, 65
15. 43 qrs. 3 bu. 2 pe. 1 gal. 3 qts. 1 pint	×80, 81, 75, 78
16. 76 qrs. 4 bu. 1 pe. 0 gal. 2 qts. 1 pint	×84, 88, 79, 82
17. 34 co. ye. 156 da. 21 ho. 56 min. 57 sec.	×90, 96, 86, 98
18. 71 Ju. ye. 213 da. 19 ho. 42 min. 49 sec.	×108, 121, 107

19. A sovereign weighs 5 dwt. 3 grs. nearly; find the weight of 1000 sovereigns.

20. What is the weight of 35 brass guns, each weighing 6 cwt. 3 qrs. 9 lbs.?

21. How far will a postman travel in a year, if he walks 9 mls. 3 fu. 8 po. 5 yds. daily?

22. How much grain will a farm of 25 fields, each 12 acres, produce at the rate of 8 qrs. 7 bu. 2 pk. 1 gal. per acre?

23. A cubic foot of water weighs 2 qrs. 6 lbs. 8 oz.; what weight of water is there in a cistern whose content is 72 cubic feet?

24. How much cloth would be required to make coats for a regiment of 875 soldiers, allowing 3 yds. 1 qr. 1 nl. to each?

25. A cartload of coal weighs 19 cwt. 2 qr. 18 lb.; how much will 37 cartloads weigh?

26. Find the content of 17 farms of 14 fields, each containing 9 ac. 3 ro. 19 per. 4 yds.

COMPOUND DIVISION.

1. 387 lb. 4 oz. 13 dwts. 18 grs.	÷16, 18, 23, 19
2. 496 lb. 11 oz. 19 dwts. 22 grs.	÷15, 14, 17, 29
3. 576 lb. 10 oz. 4 drs. 2 scr. 18 grs.	÷20, 22, 31, 26
4. 765 lb. 8 oz. 7 drs. 1 scr. 12 grs.	÷30, 42, 39, 34
5. 876 ton. 15 cwt. 3 qr. 20 lb. 13 oz. 12 dr.	÷28, 25, 37, 39
6. 987 ton. 18 cwt. 2 qr. 26 lb. 15 oz. 8 dr.	÷27, 32, 38, 41
7. 475 mls. 7 fu. 38 po. 3 yd. 2 ft. 11 in.	÷33, 40, 43, 47
8. 754 mls. 3 fu. 25 po. 2 yd. 1 ft. 10 in.	÷35, 36, 46, 51
9. 375 yds. 3 qrs. 2 nls. 1 inch	÷44, 45, 53, 57
10. 573 E. ells, 4 qrs. 3 nls. 2 inches	÷48, 49, 52, 87
11. 876 Fr. ells, 5 qrs. 2 nls. 2 inches	÷50, 54, 98, 117
12. 768 Fl. ells, 2 qrs. 1 nl. 1 inch	÷55, 56, 273, 181
13. 476 ac. 3 ro. 36 pe. 25 yds. 4 ft. 96 in.	÷60, 63, 371, 811
14. 674 ac. 2 ro. 24 pe. 28 yds. 5 ft. 102 in.	÷64, 70, 713, 645
15. 987 qrs. 7 bu. 3 pe. 1 gal. 2 qts. 1 pint	÷66, 72, 298, 364
16. 879 qrs. 4 bu. 2 pe. 0 gal. 3 qts. 1 pint	÷77, 80, 756, 643
17. 578 co. ye. 134 da. 15 ho. 44 m. 58 sec.	÷81, 84, 209, 316
18. 488 Ju. ye. 341 da. 21 ho. 56 m. 58 sec.	÷88, 90, 369, 691

19. 14 hhds. Jamaica sugar weigh 234 cwt. 2 qr. 14 lb.; find the weight of each.

20. How many canisters, each containing 1 qr. 7 lb., can be filled from 37 cwt. 21 lb.?

21. 133 bars of silver weigh 156 lb. 3 oz. 17 dwt. 2 grs.; what is the weight of each?

22. Find the circumference of a wheel which revolves 5267 times on a road 8 mls. 7 fu. 32 po. 5 yds. long.

23. An estate contains 5837 ac. 2 ro. 29 per.; into how many farms, each containing 32 ac. 3 ro. 37 per., may it be divided?

24. A spring yields 72 gallons of water an hour, and supplies 675 families; how much may each family use daily?

25. How many steps, each $2\frac{1}{2}$ feet, will a man take in walking 9 miles?

26. In 2 cwt. 2 qr. 5 lb. 4 oz. 8 drs.; how many parcels of 4 oz. 5 drs., 5 oz. 6 drs., 7 oz. 8 drs., and 8 oz. 5 drs., and of each an equal number?

MISCELLANEOUS EXERCISES.

1. A was born in 1805, and B 20 years after; when was B born, and what are their present ages?

2. A general, commanding an army of 45,550 men, fought a battle, in which 5217 were killed, 11,781 wounded, and 518 amissing; he likewise threw 2157 into one garrison, and 1786 into another; how many effective men remained under his command in the field?

3. What number being divided by 374 will give 8647369 for the quotient, and 76 for the remainder?

4. The product is 78469468, and one of the factors 4876; what is the other?

5. Two persons start from the same place, and travel the one 35 miles, and the other 42 miles a-day; how far will they be distant from one another at the end of 44 days if they both travel the same way, and how far if they travel in opposite directions?

6. A person, after paying to A £71, to B £84, to C £121, to D £118, to E £217, and to F £196, has still remaining £254; how much had he at first?

7. In leap year how many days in each of the 12 calendar months, and what is their sum?

8. How many days from March 3d to November 19th?

9. How many days from April 1st to December 29th?

10. A man was born in the year 1821, when will he be 85 years of age?

11. A man was born in 1815, what was his age in 1858?

12. A boy can point 16,000 pins in an hour, how many at that rate will 16 boys point in a year of 365 days, if they work ten hours each day?

13. If the population of the globe is taken at one billion, how many die yearly, if we suppose a generation to last 36 years?

14. At a game of cricket A, B, and C score 112 runs, A and B score 79 runs and B and C 70 runs; how many did each score?

15. The Iliad contains 15683 lines, and the Æneid 9882 lines, now if a boy reads 112 lines daily; in how many days will he finish them?

16. A merchant lodged in the bank on Monday £744, 11s. 7½d., and drew out on Tuesday £579, 18s. 6¾d.; lodged on Wednesday £1054, 17s. 8d., drew on Thursday £873, 19s.

9½d.; lodged on Friday £1786, 13s. 10½d., and drew out on Saturday £1297, 13s. 11¾d.; how much remained on Tuesday, Thursday, and Saturday after drawing?

17. If a yard of cloth costs £1, 2s. 6½d., what cost 85 yards?

18. If 74 yards of cloth cost £84, 17s. 6d., what cost 1 yard?

19. If 25 yards cost £24, 5s. 10d., what cost 5 yards?

20. What cost 93 cwt. of sugar at £2, 16s. 8½d. per cwt.?

21. What cost 1 lb. of tea at £96, 11s. 8½d. for 275 lb.?

22. How many letters in a book of 21 volumes, each 840 pages, each page 48 lines, and each line 41 letters?

23. If a mason gains 18s. 6d. per week, and lays up 2s. 7½d. per week; how much does he spend, and how much does he lay up in a year?

24. How many revolutions does a wheel, which is 2½ yards in circumference, make in 3½ miles?

25. A traveller walks 25 miles a-day, after travelling 75 miles, another follows him at the rate of 30 miles a-day; in how many days will the second overtake the first?

26. If a man's wages are 21s. per week, how much may he spend weekly to save £13, 13s. a-year?

27. A farm of 96 acres is let for £96, 16s. 6½d., what is that per acre?

28. Gained £274, 19s. 8½d., but afterwards lost £189, 19s. 11¾d.; what is my net gain?

29. How much will a labourer earn in 219 days at 2s. 1½d. per day?

30. A labourer earns £35, 17s. 10½d. a-year, how much is that per week?

31. 16 men purchased a lottery ticket for £25, which turned out a prize of £3150; how much of the ticket did each pay, and how much did each receive of the prize?

32. A merchant has in cash £2385, 17s. 11¾d., in bills £12,748, 16s. 6d., tea valued at £748, 16s. 11¾d., raw sugar £289, 17s. 6¾d., refined sugar £112, 17s. 8½d., whisky £348, 17s. 10d., rum £240, 11s. 7¾d., brandy £497, 11s. 7¾d., gin £241, 11s. 7½d., wines £1298, 3s. 4¾d., porter £84, 11s. 11½d., ale £73, 16s. 9d., in other articles £876, 13s. 9½d., and debts owing to him £2381, 11s. 11d.; at the same time he owes to A £481, 17s. 11¾d., to B £973, 16s. 7½d., to C £876, 16s. 10d., to D £584, 16s. 4¾d., to E £683. 13s. 3½d., to F £297, 16s. 10½d., and in bills £7348, 16s. 7¾d.; what is his net worth?

33. In £23, 2s., how many shillings, sixpences, and fourpences, and of each an equal number?

34. What quantity of tea at 3s. 9½d. per lb. should be exchanged for 728 lbs. of sugar at 6½d. per lb.?

35. A took to market with him £148, 17s. 10¾d., and he there received from B £741, 11s. 10½d., from C £629, 16s. 8½d., from D £946, 11s. 6d., from E £493, 16s. 11¾d., from F £748, 16s. 9½d., from G £387, 10s. 6¾d., and from H £876, 11s. 7½d.; but in coming home he was robbed of £2587, 11s. 8¾d.: how much did he bring home with him?

36. A person paid for a feu to build a house £1276, 17s. 6¾d.; the mason's bill amounted to £1485, 17s. 3¾d., the joiner's to £487, 16s. 9¾d., the plasterer's to £184, 19s. 9½d., the slater's to the same, the painter's to £120, 11s. 7¾d., the plumber's to £56, 11s. 10½d., besides other charges to £37, 11s. 9½d.; now he wants to sell it so as to gain £470, 11s. 9½d.: how much does he expect for it?

37. A person gains £1, 5s. 7½d. per week, and spends 19s. 8½d. per week; how much does he save in the year?

38. A person gains £1, 2s. 7½d. per week, and spends £45, 17s. 1¾d. in the year; how much does he save in the week?

39. Divide 91 lb. 7 oz. 11 dr. of tea among 12 men and 24 women, giving each man ⅔ of the share of a woman.

40. A merchant began business with a capital of £950, 17s. 6d.; at the end of the year he had in cash £350, 11s. 8½d., in bills £256, 17s. 8½d., in goods £850, 11s. 2¾d., and debts owing to him £572, 11s. 7¾d.; at the same time he owed in bills £381, 17s. 2½d., to A £340, 18s. 7½d., to B £120, 11s. 4¾d., to C £49, 17s. 6¾d., to D £36, 17s. 8½d., to E £49, 11s. 2½d., and to sundries £134, 18s. 6d.: whether has he gained or lost, and how much?

41. Bought 24 pieces of cloth, each containing 30 yards, for £840, 17s. 6d., and sold 400 yards at £1, 4s. 3d. per yard; how must I sell the remainder per yard to gain £84, 2s. 6d. upon the whole?

42. Bought 480 yards of cloth for £560, 6s. 8d., but 120 yards being damaged, I am obliged to sell them at a loss of £20, 13s. 4d.; how must I sell the remainder per yard so as to gain £60, 16s. 8d. upon the whole, and what did the damaged part sell at per yard?

43. A merchant clears by his trade £1590, 17s. 6¾d. yearly; his household expenses amount to £580, 17s. 7¾d., house rent £120, 11s. 9½d., taxes £45, 17s. 8¾d., shop rent £140, 11s. 9½d., taxes £56, 17s. 8¾d., servants' wages £175, 11s. 11¾d., tradesmen's accounts £170, 11s. 9¾d., and incidental expenses £49, 17s. 8¾d.; what is his net gain?

44. What is the value of $12\frac{3}{8}$ gallons of rum at 18s. 4d. per gallon?

45. Bought sugar at £3, 16s. 6d. per cwt., how much was that per lb.?

46. After paying at one time £847, 11s. $8\frac{3}{4}$d., at another £650, 10s. $4\frac{1}{2}$d., at a third £549, 16s. $7\frac{1}{4}$d., at a fourth £729, 18s. $4\frac{3}{4}$d., at a fifth £1084, 19s. $8\frac{1}{2}$d., and at a sixth £1578, 15s. $5\frac{1}{4}$d., there remained due £2196, 17s. $10\frac{3}{4}$d.; what was the original debt?

47. What is the stock of a banking company, which consists of 154 shares, each £578, 17s. $8\frac{1}{4}$d.?

48. Divide £17, 12s. 11d. among 3 men, 4 women, and 5 children, giving each man 2 times the share of a woman, and each woman 3 times the share of a child.

49. A gentleman gave £10, 10s. to pay for his lodging from 1st May till 10th July, at 1s. $11\frac{1}{2}$d. per night; what change should be returned to him?

50. The longitude of New York is 74° 0′ 3″ W., and of Calcutta, 88° 20′ 27″ E.; find the difference.

51. Discounted six bills; the first amounted to £340, 17s. $8\frac{1}{4}$d., the second to £473, 11s. $9\frac{3}{4}$d., the third to £576, 17s. $8\frac{1}{4}$d., the fourth to £605, 15s. $4\frac{1}{4}$d., the fifth to £680, 17s. $2\frac{1}{4}$d., and the sixth to £720, 1s. $9\frac{1}{4}$d.; the discount upon each was respectively £7, 19s. $10\frac{3}{4}$d.; £9, 12s. $11\frac{1}{2}$d.; £11, 18s. $8\frac{3}{4}$d.; £12, 16s. $8\frac{1}{2}$d.; £12, 19s. $9\frac{1}{4}$d.; and £13, 5s. $11\frac{1}{2}$d.: what was the net proceeds of each, and of the whole?

52. A gentleman's yearly income is £1560, 16s. $8\frac{1}{4}$d.; how much may he spend monthly, weekly, and daily, to save £500 a-year?

53. A gentleman gave his daughter for her fortune an escritoire, containing 12 drawers, each drawer was divided into 18 compartments, in each of which was £24, 17s. $6\frac{3}{4}$d.; what was the daughter's fortune?

54. Divide £1120, 10s. 6d. among 10 men and 3 boys, giving each boy only $\frac{1}{2}$ of a man's share.

55. How many guineas, half-guineas, crowns, and florins, and of each an equal number, are contained in £36, 11s. 6d.?

56. Divide 886 ac. 3 ro. 25 per. of land among A, B, and C, giving A 32 ac. 2 ro. 35 per. less than C, and B 98 ac. 3 ro. 15 per. more than C.

57. The freights received for a voyage were, from A £127, 6s. $8\frac{1}{4}$d., from B £141, 11s. $7\frac{3}{4}$d., from C £174, 17s. $10\frac{1}{4}$d., from D £84, 11s. $9\frac{3}{4}$d., from E £79, 12s. $4\frac{1}{4}$d., from F £112, 13s. $6\frac{1}{4}$d., and from G £14, 11s. $2\frac{1}{4}$d.; how much was the whole freight?

58. A merchant bought 87 yards of blue cloth for £1, 2s. 2½d. per yard; how must he sell it per yard to gain £12, 13s. 6d. on the whole?

59. The rent of a shop, including taxes, is £95, 19s. 7½d. a-year; how much is that weekly and daily?

60. Bought 9 pieces of cloth, each 35 yards, for £164, 12s. 9¼d., and sold 108 yards at 11s. 2d. per yard; how must I sell the remainder per yard to gain £47, 8s. 7¾d. in all?

61. In 20 lbs. 11 oz. 14 drs. of sugar, how many packages, containing 2 lb., 9 oz., and 4 oz., and of each an equal number?

62. A common consists of 440 ac. 2 ro. 20 per.; into how many fields, each containing 5 ac. 3 ro. 20 per. can it be divided?

63. Bought 44 pipes of wine for £2640, and gained by selling them as much as 11 pipes cost me; what was a pipe of it sold for?

64. A ship's company took a prize of £17,240, 11s. 9d.; the captain got $\frac{1}{8}$ of the whole, the 2 lieutenants got each $\frac{1}{18}$ of the remainder, the 3 midshipmen got each $\frac{1}{40}$ of what was left, and the remainder was equally divided among 8 crew of 218 men; what was the share of each?

65. Divide £172, 18s. 3d. among 4 men, 7 women, and 13 children, giving each man 3 times the share of a woman, and each woman 5 times the share of a child.

66. A father divides his estate among his 3 sons; the eldest gets £6000, the second $\frac{3}{4}$ of the eldest, and the third $\frac{5}{8}$ of the second; what was the value of the estate, and the shares of the two younger sons?

67. A bankrupt who owed his creditors £7856, paid them only £3250, 12s. 6d.; what was that per pound?

68. A and B gain jointly £56, 17s. 11¾d., A and C £48, 17s. 10¼d., and B and C £60, 11s. 8¼d.; what is the whole gain, and the share of each?

69. Received 147 yards of cloth at 14s. 6d. per yard in exchange for 441 lbs. of tea; find the price of the tea per lb.

70. An equal number of men, women, girls, and boys, are employed at a manufactory, each man receives 1s. 6d. per day, each woman 1s. 3d., each girl 7½d., and each boy 6d.; now the sum required to pay their daily wages amounts to £15, 6s. 1½d.: how many of each are employed?

71. A merchant purchased 245 yards of cloth at 16s. 7½d. per yard, now 20 yards became worthless from being damaged; he sold the remainder for 18s. 9d.: what did he gain?

72. 14 lbs. of tea at 3s. 10d. per lb., 16 lbs. at 4s. 2d., 23

lbs. at 4s. 6d., and 35 lbs. at 5s. 3d. are mixed together; what should it be sold for per lb.?

73. How many packages of coffee, containing respectively 2 lb., 1 lb., $\frac{3}{4}$ lb., and $\frac{1}{2}$ lb., and of each an equal number, can be made from 16 cwt. 10 lbs.?

74. A prize of £2982, 14s. 2d. is divided among a captain, 2 lieutenants, 3 ensigns, and 120 soldiers; the captain is to have 5 shares, each lieutenant 4 shares, each ensign 2 shares, and each soldier one share: how much should each receive?

75. A father left to his eldest son 4500 guineas more than he left to his second son, to the second 12500 crowns more than to his third son, and to the third he left 9000 guineas; find each son's portion.

76. Divide £786, 13s. 6$\frac{1}{2}$d. among 3 persons, giving the first £140, 16s. 10d. more than the second, and the second £90, 18s. 10d. more than the third.

77. A merchant bought 145 gallons of whisky at 15s. 6d. a gallon; how many gallons of water must he add to it, that he may gain £7, 12s. 6d., and reduce the price to 12s. 6d. per gallon?

78. £5, 19s. 2d. is to be divided among 3 classes of poor people, there are 8 in the first class, 9 in the second, and 10 in the third; the share of the first class is to be 1$\frac{1}{2}$ time that of the second, and the second twice the third: find the share of each class.

79. The weekly wages of A and B are £3, 7s. 9d.; of A and C £3, 12s. 3d.; of B and C £3, 13s.: what are the daily wages of each?

80. Mercury revolves round the sun in 87 da. 23 ho. 15 min. 44 sec.; Venus in 224 da. 16 ho. 49 min. 10 sec.; Mars in 686 da. 23 ho. 30 min. 41 sec.; Jupiter in 4332 da. 14 ho. 2 min. 8 sec.; and Saturn in 10,756 da. 5 ho. 16 min. 32 sec.: how many revolutions has each of these planets performed in 1858 solar years?

DECIMAL COINAGE.

In anticipation of a Decimal Coinage being introduced into this country, the system most likely to be adopted is shown in the following

TABLE OF DECIMAL MONEY.

1 mil (m.)			= £$\frac{1}{1000}$	= $\frac{2}{3}$f.
10 mils =	1 cent (c.)		= £$\frac{1}{100}$	= $2\frac{2}{3}$d.
100 mils =	10 cents =	1 florin (fl.)	= £$\frac{1}{10}$	= 2s.
1000 mils =	100 cents =	10 florins	= £1	= 20s.

6d. = 25m. = 2c. 5m.; 1s. = 50m. = 5c.; 2s. 6d. = 125m. = 1fl. 2c. 5m.; 5s. = 250m. = 2fl. 5c.; 10s. = 500m. = 5fl., etc.

The pound sterling, which is now divided into 960 parts, would thus be divided into 1000 parts, and calculations in money would be performed as in the Simple Rules, by placing a point after the pounds, and making the florins occupy the *first* place after the point, the cents the *second*, and the mils the *third* place; thus:—

£24, 2fl. 7c. 5m. would be written decimally, £24·275
£36, 7c. " " " £36·070
£48, 6fl. 5m. " " " £48·605

Express decimally,

1.	£25,	5fl.	5.	£27,	5fl.	3c.	9.	£150,	5fl.	8c.	4m.
2.	57	8	6.	30	9	2	10.	490	0	2	5
3.	90	3	7.	17	0	4	11.	708	0	5	0
4.	76	1	8.	0	4	0	12.	910	4	0	2

Read in £'s, florins, etc.

13. £20·450	15. £47·825	17. £99·005	19. £210·065
14. 36·050	16. 90·605	18. 100·725	20. 102·708

ADDITION AND SUBTRACTION.

Ex. 1. £8, 2fl. 5c. + £7, 5fl. 7c. 5m. + £8, 3fl. 8m. Ans. £24·133 = £24, 1fl. 3c. 3m.

Ex. 2. £85, 3fl. 5m. — £58, 4fl. 3c. 6m. Ans. £26·869.

SOL. Write the amounts decimally under each other, then proceed as in Simple Numbers, and in the result place a point below the other points.

Ex. 1.	£8·250
	7·575
	8·308
Sum,	£24·133

Ex. 2.	£85·305
	58·436
Diff.	£26·869

1.				2.				3.			
£	fl.	c.	m.	£	fl.	c.	m.	£	fl.	c.	m.
5	4	3	2	14	5	0	6	75	8	2	0
6	7	0	4	18	8	9	5	67	0	9	5
8	0	6	5	24	0	9	7	50	6	0	0
9	5	9	0	30	0	0	6	39	7	6	6
10	7	1	2	45	2	4	9	30	0	2	0
15	0	0	9	53	7	2	5	24	5	0	8

4. £	fl.	c.	m.	5. £	fl.	c.	m.	6. £	fl.	c.	m.
150	6	0	5	234	5	0	2	100	0	0	1
127	9	6	5	342	0	4	0	140	6	2	5
217	6	0	9	423	6	5	7	104	2	5	6
363	0	5	4	432	7	1	0	110	0	3	9
460	4	5	0	243	9	7	5	101	2	0	0
604	0	0	8	324	0	0	9	104	2	7	5

7. £	fl.	c.	m.	8. £	fl.	c.	m.	9. £	fl.	c.	m.
185	4	2	5	197	0	4	6	567	8	2	3
67	5	0	9	179	3	5	7	498	9	3	5

10. £	fl.	c.	m.	11. £	fl.	c.	m.	12. £	fl.	c.	m.
759	6	3	2	842	1	0	6	975	0	2	0
599	7	6	5	483	2	0	6	586	6	3	5

MULTIPLICATION AND DIVISION.

Ex. 1. £75, 5fl. 5m. × 42. Ans. £3171·210 = £3171, 2fl. 1c.
Ex. 2. £185, 2c. 5m. ÷ 25. Ans. £7·401 = £7, 4fl. 1m.

Ex. 1.

£75·505
42
151010
302020
Product, £3171·210

Ex. 2.

25 { 5 | £185·025
5 | 37·005
Quotient, £7·401

SOL. Multiply or divide the amount, expressed decimally, by the multiplier or divisor, and point off *three* figures from the right of the result.

1. £75, 3fl. 5c. × 25, 45
2. £63, 7fl. 6c. 5m. × 16, 63
3. £97, 6c. 8m. × 77, 96
4. £84, 7fl. 5m. × 63, 81
5. £145, 5fl. 2c. 5m. × 26, 31
6. £415, 2c. 4m. × 79, 85
7. £154, 4fl. 8m. × 101, 163
8. £514, 3fl. 8c. 9m. × 695, 2045

9. £184, 2fl. 7c. 5m. ÷ 25, 45
10. 127 5 7 5 ÷ 63, 81
11. 129 7 4 5 ÷ 35, 55
12. 126 5 8 8 ÷ 33, 77
13. £359, 4fl. 5c. 5m. ÷ 29, 37
14. 641 2 3 2 ÷ 61, 73
15. 783 1 1 8 ÷ 122, 131
16. 3083 8 8 5 ÷ 365, 355

17. How much will a man's wages amount to in a year, at £1, 1fl. 2c. 5m. per week?

18. Divide £68, 3fl. 5c. 5m. among 3 men, 5 women, and 7 children, giving each woman twice the share of a child, and each man thrice the share of a woman.

19. A man gains 1fl. 2c. 5m. in a day, and spends 1fl. per day; how many days must he work to pay a debt of £9·375?

THE END.

EDINBURGH: PRINTED BY OLIVER AND BOYD.

ARITHMETIC

FOR

ADVANCED CLASSES;

BEING A CONTINUATION OF

TROTTER'S LESSONS IN ARITHMETIC
FOR JUNIOR CLASSES:

CONTAINING

VULGAR AND DECIMAL FRACTIONS; SIMPLE AND COMPOUND PROPORTION, WITH THEIR APPLICATION; SIMPLE AND COMPOUND INTEREST, INVOLUTION AND EVOLUTION, ETC.

By ALEXANDER TROTTER,
TEACHER OF MATHEMATICS, ETC., IN EDINBURGH,
Author of "A Key to Trotter's Complete System of Arithmetic," etc.

New Edition.

EDINBURGH:
OLIVER AND BOYD, TWEEDDALE COURT.
LONDON: SIMPKIN, MARSHALL, AND CO.

1872.

SCHOOL-BOOKS BY JAMES TROTTER,

LATE OF THE SCOTTISH NAVAL AND MILITARY ACADEMY.

LESSONS in ARITHMETIC for Junior Classes. 6d.

A COMPLETE SYSTEM of ARITHMETIC, Theoretical and Practical. 3s.

TROTTER'S EDITION of HUTTON'S BOOK-KEEPING. 2s.

A COMPLETE SYSTEM of MENSURATION, by Ingram & Trotter. 2s.

INGRAM and TROTTER'S EUCLID; containing the Elements of Plane Geometry and Trigonometry. 1s. 6d.

INGRAM'S CONCISE SYSTEM of MATHEMATICS. Revised by Mr Trotter. 4s. 6d.

TROTTER'S LOGARITHMS and PRACTICAL MATHEMATICS. 3s.

INGRAM and TROTTER'S ELEMENTS of ALGEBRA. 3s.

EDINBURGH: OLIVER AND BOYD,
TWEEDDALE COURT.

ADVERTISEMENT.

THIS work is designed for those Pupils who have thoroughly mastered the Simple and Compound Rules; and it has been the Author's aim to adopt as simple language as possible in the explanatory remarks.

Each subject is accompanied by an example fully worked out and minutely explained, and has been treated as amply and carefully as its importance demanded.

The Exercises, which are all new, are numerous and practical; and Answers to them are published in a separate form.

CONTENTS.

TABLES OF MONEY, WEIGHTS, AND MEASURES.

MONEY.

qrs.	d.		
4	1	s.	
48	12	1	£
960	240	20	1

TROY WEIGHT.

Grs.	Dwt.		
24	1	Oz.	
480	20	1	Lb.
5760	240	12	1

Gold, silver, and jewels are weighed by Troy Weight.

APOTHECARIES' WEIGHT.

Gr.	Scr.			
20	1	Dr.		
60	3	1	Oz.	
480	24	8	1	Lb.
5760	288	96	12	1

Used only for medical prescriptions.

AVOIRDUPOIS WEIGHT.

Dr.	Oz.				
16	1	Lb.			
256	16	1	Qr.		
7168	448	28	1	Cwt.	
28672	1792	112	4	1	To.
573440	35840	2240	80	20	1

7000 grs. = 1 lb. avoir.; 14 lb. = 1 stone.

This table is used for all articles, except gold, silver, and jewels.

LINEAL MEASURE.

In.	Ft.				
12	1	Yd.			
36	3	1	Pol.		
198	16½	5½	1	Fur.	
7920	660	220	40	1	Ml.
63360	5280	1760	320	8	1

4 inches = a hand; 6 feet, or 2 yds. = a fathom; 3 miles = a league.

CLOTH MEASURE.

In.	Nl.		
2¼	1	Qr.	
9	4	1	Yd.
36	16	4	1

3 qrs. = 1 Flemish ell: 5 qrs. = 1 English ell; 6 qrs. = 1 French ell; 4 qrs. 1 inch, or 37 in. = 1 Scotch ell.

SQUARE OR LAND MEASURE.

Sq. in.	Sq. ft.				
144	1	Sq.yd.			
1296	9	1	Per.		
39204	272¼	30¼	1	Ro.	
1568160	10890	1210	40	1	Ac.
6272640	43560	4840	160	4	1

36 sq. yds. = a rood of building, and 100 square feet = a square of flooring.

Land is measured by a chain 66 feet in length, divided into 100 links, each = 7·92 inches. 10,000 square links = 1 square chain, and 100,000 sq. links, or 10 square chains, = 1 acre.

CUBIC OR SOLID MEASURE.

1728 cubic inches = 1 cubic foot, and 27 cubic feet = 1 cubic yard; 40 cubic feet of rough, or 50 cubic feet of hewn timber, = a load; 42 cubic feet = a ton of shipping; 5 cubic feet = a barrel bulk.

ANGULAR MEASURE.

"	′	°	
60	1		
3600	60	1	Circ.
1296000	21600	360	1

MEASURE OF CAPACITY.

Pts.	Qt.				
2	1	Gal.			
8	4	1	Pk.		
16	8	2	1	Bu.	
64	32	8	4	1	Qr.
512	256	64	32	8	1

TIME.

Min.	Ho.		
60	1	Da.	
1440	24	1	Co. Ye.
525600	8760	365	1

60 secs. = 1 min.; 7 da. = 1 wk.; 4 wks. = 1 co. mo.; 52 wks. and 1 da. = 1 co. ye.; 365¼ da. = 1 Julian ye.; 366 da. = 1 leap ye.; 365 da. 5 ho. 48 m. 50 sec. = 1 solar or tropical year.

FLOUR & BREAD WEIGHT.

A peck-loaf = 17 lb. 6 oz. avoird.
A half-peck do. = 8 11 —
A quarter-loaf = 4 5½ —

A peck of flour is 14·44 lb., or 14½ lb. nearly, and a bushel 57¾ lb. very nearly. Five bushels = a sack, which ought to weigh 288·8 lb. avoirdupois.

HAY AND STRAW WEIGHT.

36 lb. avoir. = 1 truss of straw
56 lb. = 1 truss of old hay
60 lb. = 1 truss of new hay
36 trusses = 1 load

Hay sold between the beginning of June and the end of August, of that year's growth, is reckoned new.

QUARTERLY TERMS.

In England.		*In Scotland.*	
Lady-day,	March 25.	Candlemas,	February 2.
Midsummer,	June 24.	Whitsunday,	May 15.
Michaelmas,	September 29.	Lammas,	August 1.
Christmas,	December 25.	Martinmas,	November 11.

MISCELLANEOUS TABLE.

24 sheets	= 1 quire of paper	500 herrings	= 1 barrel
20 quires	= 1 ream	500 red do.	= 1 cade
10 reams	= 1 bale	1000 sprats	= 1 cade
12 articles	= 1 dozen	60 herrings	= 1 keg
20 articles	= 1 score	100 lb. avoir.	= 1 barrel gunpowder
12 dozen	= 1 gross	56 lb.	= 1 firkin of butter
12 gross	= 1 great gross	64 lb.	= 1 firkin of soap
120 articles	= 1 great hundred	256 lb.	= 1 barrel of soap
500 bricks	= 1 load	112 lb.	= 1 barrel of raisins
1000 tiles	= 1 load	19½ cwt.	= 1 fodder of lead

ARITHMETIC

THE GREATEST COMMON MEASURE.

THE greatest common measure or divisor of two or more numbers is the greatest number which divides them without any remainder.

Ex. Find the G. C. M. of 201 and 469. Ans. 67.

SOLUTION. Divide the greater number (469) by the less (201), and the last divisor (201) by the remainder (67) continually until there is no remainder; the last divisor (67) is the greatest common measure of the two numbers.

201) 469 (2
402
67) 201 (3
201

The G. C. M. of three numbers is obtained by finding that of two of them, and afterwards that of the result and the third number.

Find the G. C. M. of,

1. 126 & 777
2. 584, 803
3. 2449, 2573
4. 5727 & 7802
5. 5824, 13376
6. 1557, 2249
7. 16531, 31659
8. 3247, 4393
9. 42039, 23701

THE LEAST COMMON MULTIPLE.

THE least common multiple of several numbers is the least number which contains each of them an exact number of times.

Ex. Find the least common multiple of 4, 6, 10, 18, and 30. Ans. 180.

SOL. Arrange the numbers after each other in one line; divide by 2 as often as any of the numbers will divide by 2, then by 3 in the same way, again by 5, and so on by all the prime numbers; the continued product of all the divisors ($2\times2\times3\times3\times5$) is the least common multiple of the numbers.

2	4, 6, 10, 18, 30
2	2, 3, 5, 9, 15
3	1, 3, 5, 9, 15
3	1, 1, 5, 3, 5
5	1, 1, 5, 1, 5
	1, 1, 1, 1, 1

Find the L. C. M. of,

1. 7, 12, 14, 15, 24
2. 8, 16, 20, 24, 36
3. 4, 10, 14, 21, 28
4. 8, 16, 14, 10, 35
5. 27, 32, 36, 72, 108, 144
6. 12, 15, 32, 60, 64, 120
7. 8, 11, 104, 52, 88, 143
8. 11, 26, 34, 52, 68, 187

VULGAR FRACTIONS.

A FRACTION consists of one or more parts of unity, and is expressed by two numbers, the one placed above the other with a line between them; thus, $\frac{4}{9}$ $\begin{matrix}\text{Numerator.}\\ \text{Denominator.}\end{matrix}$

The lower number is called the denominator, and shows into how many equal parts the unit is divided; the upper number is called the numerator, and shows how many of those equal parts have been taken to make up the fraction —the two together are called the terms of the fraction.

A fraction also indicates an unperformed division; thus $\frac{14}{9}$ signifies 14 divided by 9.

A proper fraction is one whose numerator is less than its denominator, as $\frac{3}{4}$, $\frac{2}{3}$, $\frac{5}{13}$.

An improper fraction is one whose numerator is equal to or greater than its denominator, as $\frac{7}{7}$, $\frac{5}{3}$, $\frac{42}{5}$.

A mixed number consists of a whole number (or integer) and a fraction, as $3\frac{4}{11}$, $39\frac{6}{7}$.

A compound fraction is a fraction of a fraction, as $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{1}{3}$ of $1\frac{2}{3}$ of $\frac{7}{4}$.

A complex fraction is one which has a fraction for its numerator or denominator, or both, as $\frac{\frac{2}{3}}{\frac{3}{4}}$, $\frac{1\frac{1}{2}}{3}$, $\frac{3\frac{3}{5}}{4\frac{2}{3}}$.

An integer has *one* for its denominator, as $12 = \frac{12}{1}$.

A fraction is multiplied by *multiplying* its numerator or by dividing its denominator, and is divided by dividing its numerator or *multiplying* its denominator.

The value of a fraction is not altered by multiplying or dividing its terms by the same number.

REDUCTION OF VULGAR FRACTIONS.

CASE I. To reduce a fraction to its lowest terms.

Ex. Reduce $\frac{144}{156}$ to its lowest terms. Ans. $\frac{12}{13}$.

SOL. 1. Divide the terms of the fraction (144 and 156) by those numbers which measure them exactly (3 and 4), until no number can be found that does so, the fraction is then reduced to its lowest terms ($\frac{12}{13}$).

$$\frac{144\div3}{156\div3} = \frac{48\div4}{52\div4} = \frac{12}{13}$$

SOL. 2. Find the G. C. M. (12) of the terms of the fraction, and divide them by it for the lowest terms ($\frac{12}{13}$) of the fraction. $\frac{144\div12}{156\div12} = \frac{12}{13}$ as before.

Reduce to their lowest terms,

1. $\frac{116}{174}$; $\frac{240}{1584}$; $\frac{117}{468}$; $\frac{1728}{1872}$; $\frac{292}{657}$; $\frac{637}{1001}$; $\frac{772}{1351}$; $\frac{1804}{2132}$; $\frac{1812}{2567}$.

2. $\frac{1017}{1921}$; $\frac{7455}{8165}$; $\frac{2599}{2938}$; $\frac{6789}{8103}$; $\frac{10363}{13498}$; $\frac{19769}{25737}$; $\frac{2736}{5184}$; $\frac{6188}{17836}$.

3. $\frac{542945}{709249}$; $\frac{67067}{73073}$; $\frac{243309}{279972}$; $\frac{675488}{862136}$; $\frac{57285}{75582}$; $\frac{118813}{171351}$.

CASE II. To reduce a mixed number to an improper fraction.

Ex. Reduce $5\frac{6}{11}$ to an improper fraction. Ans. $\frac{61}{11}$.

SOL. Multiply the integer (5) by the denominator (11), and to the product (55) add the numerator (6), then under the sum (61) place the denominator (11) for the fraction ($\frac{61}{11}$).

$5\frac{6}{11} = \frac{5\times11+6}{11} = \frac{55+6}{11} = \frac{61}{11}$

Reduce to improper fractions,

$4\frac{2}{3}$; $6\frac{3}{7}$; $9\frac{5}{11}$; $12\frac{13}{14}$; $15\frac{7}{18}$; $17\frac{13}{20}$; $25\frac{16}{17}$; $33\frac{11}{13}$; $45\frac{7}{22}$; $57\frac{9}{31}$; $113\frac{6}{35}$; $237\frac{11}{999}$; $69\frac{14}{153}$; $147\frac{18}{147}$; $178\frac{16}{101}$; $273\frac{141}{1001}$.

CASE III. To reduce an improper fraction to a whole or mixed number.

Ex. Reduce $\frac{157}{12}$ to a mixed number. Ans. $13\frac{1}{12}$.

SOL. Divide the numerator (157) by the denominator (12), and to the quotient (13) annex the remainder (1) with the denominator below it ($\frac{1}{12}$) for the fraction ($13\frac{1}{12}$).

$\frac{157}{12} = 157 \div 12 = 13\frac{1}{12}$

Reduce to whole or mixed numbers,

$\frac{15}{3}$; $\frac{21}{7}$; $\frac{16}{5}$; $\frac{29}{8}$; $\frac{54}{9}$; $\frac{69}{13}$; $\frac{89}{14}$; $\frac{116}{17}$; $\frac{157}{21}$; $\frac{256}{23}$; $\frac{342}{24}$; $\frac{419}{34}$; $\frac{697}{43}$; $\frac{1459}{175}$.

CASE IV. To reduce a compound fraction to a simple one.

Ex. Reduce $\frac{3}{4}$ of $1\frac{2}{3}$ of $\frac{4}{5}$ to a simple fraction. Ans. $\frac{5}{5}$.

SOL. 1. Multiply all the numerators together and all the denominators together, and reduce the resulting fraction ($\frac{60}{108}$) to its lowest terms ($\frac{5}{9}$).

$\frac{3}{4}$ of $1\frac{2}{3}$ of $\frac{4}{5} = \frac{3}{4}$ of $\frac{5}{3}$ of $\frac{4}{5} = \frac{60}{108} = \frac{5}{9}$

SOL. 2. Strike out all those factors which are common to the numerators and denominators, and proceed with the numbers that are left, as in Sol. 1, for the fraction in its lowest terms.

$\frac{\cancel{3}}{\cancel{4}}$ of $\frac{5}{\cancel{3}}$ of $\frac{\cancel{4}}{9} = \frac{5}{9}$

NOTE. Mixed numbers must be reduced to improper fractions before multiplying.

Reduce to simple fractions,

$\frac{4}{9}$ of $\frac{3}{5}$ of $\frac{5}{16}$; $\frac{3}{11}$ of $\frac{22}{17}$ of $\frac{1}{4}$; $\frac{3}{5}$ of $\frac{3}{4}$ of $1\frac{7}{9}$; $\frac{3}{14}$ of $3\frac{1}{16}$ of $\frac{8}{9}$ of $\frac{7}{12}$; $\frac{6}{13}$ of $7\frac{2}{9}$ of $13\frac{1}{5}$; $\frac{7}{18}$ of $12\frac{3}{5}$ of $3\frac{1}{3}$; $\frac{4}{17}$ of $5\frac{2}{3}$ of $13\frac{1}{4}$; $\frac{3}{2\frac{3}{3}}$ of $12\frac{7}{9}$ of $\frac{4}{11}$; $\frac{13}{17}$ of $6\frac{3}{8}$ of $3\frac{3}{32}$; $\frac{4}{7}$ of $8\frac{3}{4}$ of 5.

CASE V. To reduce fractions having different denominators to others of equal value having the least common denominator.

Ex. Reduce $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{3}{4}$, $\frac{4}{9}$, $1\frac{5}{7}$ to their least common denominator.

SOL. $\left|\begin{array}{l}\frac{2}{3}\text{ of }\frac{3}{4},\frac{3}{4},\frac{4}{9},1\frac{5}{7}=\frac{1}{2},\frac{3}{4},\frac{4}{9},\frac{12}{7}=\frac{1\times126}{2\times126},\frac{3\times63}{4\times63},\frac{4\times28}{9\times28},\frac{12\times36}{7\times36}=\\ \text{Reduce the compound to simple and the mixed numbers to improper fractions; find the L. C. M. (252) of the denominators for the required one, and divide it by each of the denominators; then multiply the quotients (126, 63, 28, and 36) by the respective numerators (1, 3, 4, 12) for the required numerators.}\\ \frac{126}{252},\frac{189}{252},\frac{112}{252},\frac{432}{252}\end{array}\right.$

The fractions must all be in their lowest terms before proceeding as directed.

Reduce to their least common denominator,

1. $\frac{2}{3}$, $\frac{4}{5}$, $\frac{5}{9}$, $\frac{7}{15}$, $\frac{9}{20}$
2. $\frac{4}{9}$, $\frac{2}{3}$ of $\frac{3}{4}$, $\frac{11}{16}$, $\frac{13}{15}$
3. $\frac{6}{11}$, $\frac{7}{11}$ of $\frac{13}{49}$, $\frac{16}{21}$, $\frac{2}{3}$ of $5\frac{1}{6}$
4. $\frac{13}{14}$, $\frac{17}{18}$ of $\frac{63}{88}$, $\frac{19}{23}$ of $\frac{69}{133}$, $\frac{17}{20}$
5. $\frac{3}{9}$, $\frac{4}{12}$, $\frac{3}{8}$, $\frac{14}{21}$, $\frac{14}{56}$, $\frac{3}{7}$ of $4\frac{2}{3}$
6. $4\frac{1}{2}$, $\frac{6}{11}$ of $\frac{44}{27}$, $5\frac{6}{7}$, $\frac{9}{10}$
7. $1\frac{2}{9}$ of $\frac{12}{25}$, $\frac{2}{12}$, $\frac{5}{17}$, $\frac{2}{3}$ of $\frac{6}{85}$
8. $\frac{8}{27}$, $\frac{4}{15}$, $\frac{17}{45}$, $\frac{19}{36}$, $\frac{111}{108}$
9. $\frac{5}{28}$, $\frac{4}{5}$ of $\frac{35}{184}$, $\frac{7}{21}$, $\frac{8}{9}$ of $\frac{57}{64}$
10. $\frac{13}{35}$, $\frac{15}{60}$, $\frac{6}{30}$, $\frac{7}{42}$, $\frac{17}{136}$

CASE VI. To reduce fractions from one denomination to another without altering their value.

Ex. 1. Reduce £$\frac{5}{9}$ to the fraction of a penny, *i. e.* from a higher to a lower name. Ans. $\frac{400}{3}$d.

SOL. Multiply the *numerator* by the number of the lower name contained in the higher (240), and reduce the fraction to its lowest terms. $\left|\ £\frac{5}{9}=\frac{5\times240}{9}\text{d.}=\frac{1200}{9}\text{d.}=\frac{400}{3}\text{d.}\right.$

Ex. 2. Reduce $\frac{4}{9}$ lb. to the fraction of a cwt., *i. e.* from a lower to a higher name. Ans. $\frac{1}{252}$ cwt.

SOL. Multiply the *denominator* by the number of the lower name contained in the higher (112.) $\left|\ \frac{4}{9}\text{ lb.}=\frac{4}{9\times112}\text{ cwt.}=\frac{1}{252}\text{cwt.}\right.$

Ex. 3. Reduce $£\frac{3}{4}$ to the fraction of a guinea. Ans. $\frac{5}{7}$ gu.

Sol. $£\frac{3}{4} = \frac{3\times20}{4}\text{s.} = \frac{3\times20}{4\times21}\text{gu.} = \frac{5}{7}$ gu.

1. Red. $\frac{3}{4}$ qr., $\frac{6}{7}$d., $\frac{7}{11}$s., $\frac{5}{8}$ cr., & 14s. $7\frac{1}{2}$d. to fractions of a pound
2. " $£\frac{6}{11}$, $\frac{3}{5}$d., $\frac{1}{3}\frac{3}{6}$s., $\frac{5}{8}$gu., & $\frac{4}{11}$ of 3s. 3d. " " a farthing
3. " $\frac{3}{5}$lb., $\frac{4}{11}$ to., $1\frac{7}{8}$oz., $1\frac{4}{7}$qr., & 1 cwt. 21 lb. " 3 cwt.
4. " $\frac{6}{7}$ml., $\frac{5}{9}$fu., $1\frac{4}{5}$yd., $\frac{2}{3}$ft., & 4 ft. $7\frac{1}{2}$ in. " " a pole
5. " $£\frac{5}{8}$, $\frac{5}{7}$cr., 13s. 4d., $\frac{3}{5}$ of 7s. 6d., & $\frac{3}{4}$ of 3 h. cr. " a guinea
6. " $\frac{5}{7\,3}$Co. ye., $\frac{1}{1\,5}$mi., $\frac{6}{7}$sec., & 5 h. 48 m. 50 s. " a day
7. " $\frac{4}{7}$E.E., $\frac{1}{1\,1}\frac{6}{0}$Fr. E., $\frac{3}{5}$Fl.E., $\frac{4}{7}$Sc.E., & 3qr. 3nl. " a yard

Case VII. To find the value of a fraction in units of lower names.

Ex. 1. Find the value of $\frac{5}{8}$ ml. Ans. 4 fu. 17 p. 4 yd. 10 in.

Here, 5 ml. 0 fu. 0 po. &c. $\div$ 9 = 4 fu. 17 po. 4 yd. 10 in.

Sol. Divide the numerator, as so many of the given name, by the denominator, as in Compound Division.

Ex. 2. Find the value of $\frac{2}{3}$ of 7s. 6d. Ans. 5s.

Sol. 7s. 6d. $\times$ 2 = 15s. and 15s. $\div$ 3 = 5s.

Find the values of,

1. $£\frac{7}{11}$, $\frac{5}{9}$s., $\frac{2}{3}$d., $\frac{5}{7}$ cr., $\frac{3}{1\,0}$gu., and $\frac{3}{4}$ of 16s. 8d.
2. $\frac{9}{1\,8}$ cwt., $\frac{1}{1}\frac{0}{3}$ qr., $\frac{6}{7}$ lb., $\frac{7}{9}$ ml., $\frac{1}{1}\frac{4}{5}$ yd., $\frac{6}{7}$ of 2 ml. 50 yds.
3. $\frac{4}{7}$E.E., $\frac{1}{1}\frac{0}{1}$Fl.E., $\frac{8}{9}$ac., $\frac{5}{7}$ro., $\frac{7}{8}$s. per., $\frac{1}{1}\frac{0}{5}$ of 4 ac. 3 ro.
4. $\frac{8}{1\,1}$to., $\frac{4}{1\,3}$ac., $\frac{3}{1\,1}$ of 3 qr. 3 b., $\frac{4}{7}$ml., $\frac{5}{1\,1}$lb.tr., $\frac{6}{1\,1}$ of 18s. $9\frac{1}{2}$d.
5. $\frac{3}{7}$ of 5s. $6\frac{1}{2}$d., $\frac{4}{9}$ of $\frac{3}{1\,6}$ of $3\frac{3}{5}$ gu., $\frac{7}{1\,9}$ co. ye., $\frac{6}{1\,1}$ Jul. ye.
6. $\frac{1}{8}$ of $\frac{2}{3}$ of $3\frac{1}{5}$cr., $\frac{1}{1\,7}$ of $\frac{6}{8}\frac{1}{4}$ of $18\frac{3}{4}$ bu., $\frac{5}{9}$ of a S. ye., $\frac{6}{7}$ of $2\frac{1}{2}\frac{3}{6}$ of $4\frac{1}{3}$°

ADDITION OF VULGAR FRACTIONS.

Ex. 1. $\frac{7}{9} + \frac{5}{6}$ of $\frac{1}{2}\frac{8}{5} + \frac{5}{2\,1} = \frac{7}{9} + \frac{3}{5} + \frac{5}{2\,1} = \frac{245+189+75}{315}$

$= \frac{5}{3}\frac{0}{1}\frac{9}{5} = 1\frac{1}{3}\frac{9}{1}\frac{4}{5}$.

Sol. Reduce the fractions to their least common denominator by Case V., then add the numerators, and below the sum (509) place the denominator (315).

Ex. 2. $£\frac{3}{8} + \frac{5}{2\,4}$s. $+ \frac{4}{5}$d. = 7s. 6d. $+ 2\frac{1}{2}$d. $+ \frac{1}{4}$d. $\frac{7}{9}$

= 7s. $8\frac{3}{4}$d. $\frac{7}{9}$.

Sol. Find the values of the fractions by Case VII., and add as in Compound Addition.

1. $\frac{1}{2} + \frac{4}{9} + \frac{5}{12}$
2. $\frac{2}{3} + \frac{5}{16} + \frac{7}{12}$
3. $3\frac{1}{4} + 6\frac{7}{18} + 8\frac{5}{6}$
4. $5\frac{2}{9} + 11\frac{1}{3} + 13\frac{4}{15}$
5. $4\frac{1}{6} + 5\frac{10}{11} + \frac{7}{12} + \frac{5}{33}$
6. $7\frac{1}{8} + 6\frac{4}{9} + 9\frac{5}{6} + 8\frac{11}{16}$
7. $\frac{7}{14} + 3\frac{6}{18} + 3\frac{2}{12} + \frac{17}{68}$
8. $3\frac{2}{9} + 7\frac{4}{5} + 6\frac{2}{3} + 9\frac{6}{7}$
9. $\frac{3}{11}$ of $\frac{2}{16} + \frac{7}{9} + \frac{3}{20}$ of 4
10. $6\frac{1}{3}$ of $\frac{5}{38} + 1\frac{3}{5} + \frac{3}{25}$ of $\frac{1}{4}$
11. $1\frac{6}{7}$ of $1\frac{4}{39} + \frac{2}{3}$ of $\frac{9}{10} + 11\frac{1}{4}$
12. $2\frac{1}{3}$ of $1\frac{13}{14} + \frac{3}{11}$ of $\frac{3}{4} + \frac{3}{4}$ of $\frac{8}{9}$
13. £$\frac{3}{5}$ + $\frac{2}{5}$s. + $\frac{3}{4}$d.
14. £$1\frac{15}{16}$ + $\frac{2}{3}$s. + $\frac{4}{11}$d.
15. £$\frac{7}{9}$ + £$\frac{5}{13}$ + $\frac{3}{5}$s.
16. $\frac{4}{7}$ cwt. + $\frac{3}{4}$ qr. + $4\frac{1}{2}$ lb.
17. $\frac{7}{21}$ ton + $\frac{3}{14}$ cwt. + $\frac{9}{10}$lb.
18. $\frac{4}{10}$ ac. + $\frac{6}{11}$ ro. + $8\frac{3}{4}$ per.
19. £$\frac{2}{5}$ + $\frac{5}{9}$ gu. + $\frac{3}{4}$ cr. + $\frac{1}{2}$ of 8s. $10\frac{1}{2}$d.
20. $\frac{3}{16}$ qr. + $\frac{3}{8}$ bu. + $\frac{2}{11}$ pk. + $\frac{5}{22}$ of 9 qr. 4 bu.
21. $\frac{7}{15}$ ye. + $\frac{3}{20}$ da. + $\frac{7}{40}$ ho. + $\frac{5}{13}$ of 85 da. 1 ho.

SUBTRACTION OF VULGAR FRACTIONS.

Ex. 1. $\frac{2}{5}$ of $2 - \frac{13}{18} = \frac{4}{5} - \frac{13}{18} = \frac{72-65}{90} = \frac{7}{90}$

Sol. Prepare the fractions as in Addition, and subtract the numerators.

1. $\frac{3}{4} - \frac{2}{3}$
2. $\frac{4}{7} - \frac{6}{11}$
3. $14\frac{2}{5} - 6\frac{1}{4}$
4. $3\frac{1}{2} - 2\frac{1}{27}$
5. $6 - \frac{6}{7}$
6. $15 - 7\frac{4}{11}$
7. $19 - 12\frac{5}{13}$
8. $42 - 24\frac{18}{25}$
9. $10\frac{7}{13} - 2\frac{4}{11}$
10. $\frac{2}{3}$ of $4\frac{1}{2} - \frac{7}{8}$ of $\frac{45}{49}$
11. $\frac{8}{11}$ of $\frac{15}{16} - \frac{7}{12}$ of $\frac{36}{49}$
12. $7\frac{1}{3}$ of $\frac{19}{22} - 6\frac{1}{2}$ of $\frac{4}{19}$
13. $8\frac{3}{4}$ of $\frac{16}{21} - 4\frac{1}{13}$ of $1\frac{7}{18}$
14. $4\frac{7}{13}$ of $1\frac{1}{2} - 2\frac{1}{4}$ of $\frac{7}{9}$
15. $13\frac{5}{7}$ of $1\frac{1}{6} - \frac{3}{11}$ of $1\frac{4}{7}$
16. $21\frac{6}{17}$ of $2\frac{1}{3} - \frac{5}{13}$ of $3\frac{6}{11}$

Ex. 2. $\frac{7}{16}$ cwt. $- \frac{2}{3}$ qr. $= 1$ qr. 21 lb. $- 18\frac{2}{3}$lb. $= 1$ qr. $2\frac{1}{3}$lb.

Sol. Find the values of the fractions by Case VII., and subtract them as in Compound Subtraction.

17. £$\frac{5}{9}$ − $\frac{15}{16}$s.
18. $1\frac{3}{14}$ gu. − £$\frac{11}{16}$
19. $\frac{3}{10}$ cwt. − $\frac{4}{7}$ qr.
20. $\frac{9}{11}$ lb. − $\frac{8}{9}$ oz. tr.
21. $\frac{4}{11}$ ml. − $17\frac{6}{11}$ po.
22. $\frac{11}{12}$ yd. − $\frac{2}{3}$ E. E.
23. $\frac{19}{20}$ Fr. E. − $\frac{7}{16}$ yd.
24. $\frac{3}{11}$ ac. − $\frac{2}{5}$ of 2 ro.
25. $\frac{7}{18}$ of $\frac{12}{16}$ ye. − $\frac{4}{7}$ of $\frac{21}{48}$ ye.

MULTIPLICATION OF VULGAR FRACTIONS.

Ex. $\frac{4}{11} \times \frac{165}{164} \times \frac{41}{25} = \frac{27060}{45100} = \frac{3}{5}$; or $\frac{4}{11} \times \frac{165}{164} \times \frac{41}{25} = \frac{1}{1} \times \frac{3}{1} \times \frac{1}{5} = \frac{3}{5}$.

Sol. 1. Multiply all the numerators ($4 \times 165 \times 41$) together for the numerator (27060), and all the denominators

$(11 \times 164 \times 25)$ together for the denominator (45100); then reduce the fraction $(\frac{2}{4}\frac{7}{5}\frac{6}{1}\frac{8}{0}\frac{0}{0})$ to its lowest terms $(\frac{8}{5})$.

Sol. 2. Strike out all the factors that are common to the numerators and denominators, and proceed with those numbers that are left as in Sol. 1.

1. $\frac{3}{4} \times \frac{6}{7} \times \frac{7}{8}$
2. $\frac{7}{11} \times \frac{5}{6} \times \frac{6}{7}$
3. $\frac{4}{9} \times \frac{6}{8} \times \frac{7}{10}$
4. $\frac{1\,3}{1\,5} \times \frac{5}{2\,6} \times \frac{4}{5}$
5. $27 \times \frac{2}{3}$ of $\frac{6}{7}$
6. $37 \times \frac{4}{11}$ of $\frac{3\,3}{1\,6}$
7. $54 \times \frac{8}{9}$ of $6\frac{3}{4}$
8. $98 \times \frac{5}{8}$ of $\frac{6}{11}$
9. $\frac{7}{1\,6}$ of $\frac{9}{2\,1} \times \frac{4}{1\,1}$ of $6\frac{3}{5}$
10. $8\frac{1}{3}$ of $14\frac{2}{7} \times 7\frac{2}{5}$ of $6\frac{4}{1\,1}$
11. $(12\frac{1}{5} + 6\frac{7}{9}) \times (4\frac{7}{8} - 2\frac{2}{3})$
12. $(21\frac{3}{8} - 14\frac{5}{1\,2}) \times (6\frac{3}{1\,3} + 7\frac{1}{2})$

13. Val. $5\frac{1}{2}$yd. & $16\frac{2}{3}$yd. @ $11\frac{1}{3}$d., 1s. $9\frac{3}{4}$d., & 2s. $6\frac{3}{5}$d. p. yd.
14. " $174\frac{5}{6}$lb. & $212\frac{7}{1\,2}$lb. @ $10\frac{1}{8}$d., 1s. $7\frac{1}{1\,2}$d., & 3s. $4\frac{1}{8}$d. p. lb.

DIVISION OF VULGAR FRACTIONS.

Ex. $\frac{4}{7}$ of $\frac{5}{6} \div \frac{1\,3}{1\,4} = \frac{1\,0}{2\,1} \div \frac{1\,3}{1\,4} = \frac{1\,0}{2\,1} \times \frac{1\,4}{1\,3} = \frac{2\,0}{3\,9}$.

Sol. Invert the divisor $(\frac{1\,3}{1\,4})$, and proceed as in Multiplication.

1. $\frac{9}{1\,1}$ of $\frac{2}{3} \div \frac{2}{5}$
2. $\frac{8}{1\,3}$ of $\frac{3}{4} \div \frac{7}{9}$
3. $\frac{7}{1\,2} \div \frac{4}{9}$ of $\frac{3}{5}$
4. $\frac{9}{1\,6} \div \frac{2\,7}{4\,0}$ of $\frac{2}{3}$
5. $25 \div \frac{4}{1\,1}$ of $\frac{3\,3}{1\,6}$
6. $37 \div \frac{5}{1\,2}$ of $\frac{2\,4}{2\,5}$
7. $42 \div \frac{7}{1\,3}$ of $\frac{3\,9}{4\,2}$
8. $56 \div \frac{5}{1\,4}$ of $\frac{6\,3}{6\,5}$
9. $\frac{4}{9}$ of $\frac{2\,7}{3\,2} \div \frac{5}{7}$ of $\frac{2\,1}{2\,5}$
10. $\frac{8}{3}$ of $\frac{9\,1}{1\,2\,8} \div 2\frac{4\,5}{1\,5}$ of $\frac{2\,5}{5\,7}$
11. $(6\frac{2}{3} + 7\frac{1}{8}) \div (7\frac{1}{8} - 2\frac{3}{5})$
12. $(8\frac{2}{9} - 4\frac{1}{2}) \div (4\frac{3}{4} + 2\frac{4}{5})$

13. £375, 6s. $10\frac{1}{1\,2}$d. $\div 14\frac{2}{3}$, $16\frac{7}{9}$, $21\frac{3}{7}$, $24\frac{5}{1\,2}$, $26\frac{7}{1\,3}$, & $32\frac{1\,1}{1\,5}$
14. 672cwt. 3qr. $14\frac{3}{4}$lb. $\div 11\frac{3}{7}$, $12\frac{5}{8}$, $15\frac{4}{9}$, $18\frac{9}{1\,0}$, $23\frac{5}{1\,4}$, & $27\frac{1\,3}{1\,7}$

MISCELLANEOUS EXERCISES IN VULGAR FRACTIONS.

1. Find the sum, difference, product, and quotient of $\frac{7}{1\,1}$ of $6\frac{3}{4}$ and $\frac{5}{8}$ of $\frac{2\,2}{2\,5}$.

2. A can do a piece of work in 8 days which B can do in 9 days; what part will they do together in 1 day?

3. What number added to $\frac{3}{7}$ of $5\frac{1}{2}$ gives $14\frac{2}{3}$?

4. What part of $3\frac{3}{4}$ is $\frac{2}{5}$ of $\frac{3}{5}$?

5. What number is that $\frac{2}{3}$ of which is equal to 30?

6. A and B can do a piece of work in 8 days which A alone can do in 12 days; what part of it can each do alone in one day?

7. A gentleman having $\frac{2}{5}$ of a ship, worth £3115, purchases another person's share which is $\frac{1}{3}$ of $\frac{3}{7}$ of it; what part has he now, and what is its value?

8. What number divided by $\frac{4}{11}$ of $7\frac{1}{3}$ gives 240?

9. How many chests of tea, each containing $124\frac{3}{4}$ lbs., can be filled from 73 cwt. 2 qrs. $1\frac{1}{2}$ lb.?

10. What number is that $\frac{5}{11}$ of which is equal to 25?

11. What part of 5 guineas is $\frac{2}{3}$ of £3?

12. A farmer went to market with $£2\frac{5}{8}$; he received there $£73\frac{5}{16}$, $£89\frac{7}{12}$, and $£49\frac{9}{40}$: with what sum did he return?

13. What number multiplied by $\frac{7}{9}$ of $7\frac{1}{8}$ gives $\frac{8}{9}$ of $15\frac{3}{4}$?

14. Divide £4125 among 4 men, 6 women, and 12 children, giving each woman $\frac{5}{8}$ of a man's share, and each child $\frac{2}{5}$ of a woman's share.

15. Two persons, by trading, gained a certain sum, the first lodged $\frac{2}{5}$ of the capital, and received £200 as his share of the gain; what was the whole gain, and the second's share?

16. What number is that from which if $\frac{7}{12}$ of it be taken there remains 35?

17. Two places are 72 miles distant from each other: A starts from the one at the rate of $12\frac{2}{3}$ mls. an hour, and at the same time B starts from the other, to meet A, at the rate of $18\frac{2}{3}$ miles in 2 hours; when and where will they meet?

18. A gentleman's income is $\frac{4}{11}$ of $\frac{3}{6}\frac{3}{4}$ of £7560, and he spends $\frac{3}{4}$ of $\frac{5}{8}$ of it; how much does he lay up?

19. A person spends $\frac{1}{3}$ of his money + £2, and has left $\frac{1}{2}$ of it + £3; what sum had he at first?

20. What number is that from which $\frac{4}{5}$ of it being taken there remains 40?

21. $\frac{2}{5}$ of the trees in an orchard are pear trees, $\frac{1}{3}\frac{3}{5}$ are apple trees, and there are 50 cherry trees; what is the number of trees?

22. A man's present age is 65 years, 5 years since his son's age was $\frac{2}{5}$ of his; what is the son's present age?

23. A cistern can be filled by two pipes in 24 and 25 minutes respectively, and can be emptied by a third in 32 min.; what part of it will be filled in 12 min., the three pipes being all open?

24. A person has $\frac{2}{3}$ of a ship worth £4200, and he sells $\frac{3}{7}$ of his share; what part has he left, and what is its value?

25. A and B can do a piece of work in 6 days, A and C the same in 8 days, and B and C in 12 days; what part could the three together perform in 5 days?

26. A ship and its cargo are together worth £23750, and the cargo is $5\frac{1}{3}$ times more valuable than the ship; find the value of each.

27. Simplify $(14\frac{5}{9} + 6\frac{7}{12} - 2\frac{1}{36}) \times \frac{42}{96} \div 5\frac{1}{12}$.

28. A father left $\frac{9}{16}$ of his estate to one son, and the remainder to another; the difference of their fortunes was £750: what was the estate worth?

29. Divide £2000 among A, B, and C, giving A $\frac{2}{5}$ of the whole, B $\frac{3}{4}$ of A's share, and C the rest; find also what fraction of the whole C receives.

30. What number multiplied by $\frac{2}{3}$ of $\frac{7}{10}$, and the product divided by $\frac{4}{13}$ of $5\frac{1}{2}$, will give for the quotient $\frac{7}{11}$ of $6\frac{2}{3}$ of 4?

RATIOS AND PROPORTION.

In comparing two numbers of the same kind, their ratio or relation to one another is found by dividing the first by the second; thus, the ratio of 4 to 2, generally written 4 : 2, is $4 \div 2 = 2$; of 3 mls. to 6 mls. is $3 \div 6 = \frac{1}{2}$.

The first number is called the antecedent, and the second the consequent; the two together are called the terms of the ratio.

Proportion consists in the equality of ratios; thus, since $4 : 2 = 8 : 4$, the numbers 4, 2, 8, and 4, constitute a proportion: they are generally written 4 : 2 :: 8 : 4, and are read as 4 is to 2 so is 8 to 4.

In every proportion the product of the 1st and 4th terms (or of the extremes as they are called) is equal to the product of the 2d and 3d terms (or of the means); thus in the proportion 4 : 2 :: 8 : 4 we have $4 \times 4 = 2 \times 8$. Hence the first three terms of a proportion being given, the 4th is found by dividing the product of the 2d and 3d terms by the 1st.

SIMPLE PROPORTION OR THE RULE OF THREE.

WHEN three terms of a proportion are given, the object of this rule is to find its 4th or last term.

Of the three given numbers, two are always of the same kind, and the remaining one is of the same kind as that which is required.

Ex. 1. If 16 men earn £32 in a week; what sum will 72 men earn in the same time? Ans. £144.

SOL. 1. Place that term which is of the same kind as the answer is to be, for the third or right-hand term (£32).

2. Consider from the nature of the question whether the answer is to be greater or less than the term written down: if greater (as in this Ex.), place the greater of the two remaining terms (72) in the middle, and the other on the left (16); but if less, place the less of the two like terms in the middle, and the other upon the left.

Men 16 : 72 : : £32

32

16)2304

£144

3. When none of the terms is compound (as in this Ex.), multiply the 2d and 3d terms together (72 × 32), and divide the product (2304) by the 1st or left hand-term (16) for the answer, in the same name as the 3d or right-hand term (£'s).

1. If 25 yds. of velvet cost £30; what should 750 yds. of the same cost?

2. If 14 cwt. of sugar cost £42; what should be paid for 207 cwt.?

3. A train runs at the rate of 73 mls. in 3 hours; in how many hours will it run 438 mls.?

4. A person spends £500 yearly; how much will he spend in 146 days?

5. If 7 men do a piece of work in 36 days; in how many days will 9 men do the same?

6. What cost 162 copies of a book, when 171 copies cost £19?

Ex. 2. If 6 cwt. 3 qrs. of tea cost £170, 2s.; what should 27 cwt. 3 qrs. of the same cost? Ans. £699, 6s.

SOL. State the question as before. Reduce the 3d term to the lowest name in it (shil.), and the 1st and 2d terms to the lowest name in either (qrs.); then multiply the 2d and 3d

terms together (111 × 3402), and divide the product (377622) by the 1st term (27) for the answer, in that name to which the 3d term was reduced (shil.).

6 cwt. 3 qr. : 27 cwt. 3 qr. : : £170, 2s.
4 4 20
27 qrs. 111 qrs. 3402s.
3402
27)377622
2,0)1398,6s.
£699, 6s.

7. What cost 4 yds. 3 qrs. 2 nls. of cloth, when 15 yds. 2 qrs. cost £8, 3s. 4¾d.?

8. If 13 cwt. 14 lbs. of coffee cost £131, 13s. 9d.; how much may be bought for £13, 3s. 4½d.?

9. If a person walks 14 mls. 2 fu. 28 po. in 4 ho. 6 min. 40 sec.; how far will he walk in 9 ho. 3 min. 20 sec.?

10. How many yds. of linen at 3s. 6d. a-yd. should be given for 136 yds. of muslin at 2s. 7½d. a-yd.?

11. If 4 yds. of cloth cost 84s. 4d.; what will 27 yds. 2 qrs. cost?

12. Find the value of 2 qrs. 3 pks. of wheat, when 36 qrs. 2 bu. 2 pks. cost £76, 5s. 1½d.

Ex. 3. If 14 lbs. of tobacco cost 73s. 6d.; what cost 10 lbs. of the same? Ans. £2, 12s. 6d.

Obs. When the first and either of the other terms can be divided without remainder by the same number, the quotients may be used in place of the original numbers.

14 lb. : 10 lb. : : 73s. 6d.
7 5 $\$\not{8}\not{2}$d.
126
5
£2, 12s. 6d. = 630d.

13. A courier travels 176 miles in 4 days; how far will he travel in 15 days?

14. How much sugar may be bought for £95, at the rate of 28 lbs. for 14s. 3d.?

15. A man's wages are £37, 2s. 6d. a-year; what should he receive for 219 days' service?

16. If the 8d. loaf weigh 4 lbs. 5½ oz.; what should the shilling loaf weigh?

17. How many pairs of stockings, at 14s. 6d. per doz. pairs, may be bought for £30, 19s. 10½d.?

18. Find the value of 1 cwt. of sugar, when 3 cwt. 14 lbs. cost £10, 18s. 9d.

19. What cost 5 pieces of silver, each 3 lbs. 4 oz. 12 dwt., at 5s. 9d. per oz.?

20. If the quartern loaf costs $10\frac{1}{2}$d. when wheat is at £3, 10s. per qr.; what should it cost when wheat is at £2, 3s. 4d. per qr.?

21. A bankrupt's effects amount to £3528, and he compounds with his creditors for 12s. 3d. per £1; what is the amount of his debts?

22. If 16 men consume £10 worth of beef when the price is $7\frac{1}{2}$d. per lb.; what value of beef will they consume in the same time when the price is $10\frac{1}{2}$d. per lb.?*

23. Sound moves at the rate of 1142 ft. in a second, and the report of a gun is heard $14\frac{3}{4}$ sec. after seeing the flash; how far distant is the gun?

24. How many paces of a man, each $2\frac{1}{2}$ ft., are equal to 150 steps of a horse, each $2\frac{3}{4}$ ft.?

25. A bankrupt's debts amount to £7428, and he compounds with his creditors for 10s. $9\frac{3}{4}$d. per £1; find the amount of his effects.

26. Find the value of 8 cheeses, each $26\frac{1}{2}$ lbs., at $7\frac{1}{4}$d. per lb.

27. At what time between 6 and 7 o'clock are the hour and minute hands of a watch exactly together? Sol. (11 : 12 : : 6 hours.)

28. Bought 17 yds. 2 qrs. of cloth for £16, 2s. $3\frac{1}{2}$d.; what should 4 yds. 3 qrs. be sold for to gain £2, 5s. $2\frac{1}{4}$d. on the whole?

29. If 36 gallons of whisky, worth 17s. 6d. a-gallon, be mixed with 4 gallons of water; what should be the price of a gallon of the mixture?

30. A person pays £65, 6d. for income-tax, at the rate of 1s. 4d. per £1; what is his income?

31. Required the circumference of a circle whose diameter is 22035 mls., the ratio of the diameter to the circumference of a circle being as 113 is to 355. Sol. (113 : 355 : : 22035 mls.)

32. A pound troy of standard gold is coined into £46, 14s. 6d.; find the weight of a sovereign.

* When the same term is twice mentioned in a question, that term must be altogether excluded.

33. The ratio of standard to pure gold being 22 to 24; what is the value of an ounce of pure gold?

34. A garrison of 3300 men have provisions for 12 months; how long would the same provisions serve 4950 men?

35. A 16 gun-battery discharges 1760 cwt. of shot in a certain time; how much will an 18 gun-battery discharge in the same time?

36. The chain of 66 ft. for measuring land is divided into 100 links; what is the length of a wall measuring 1760 links?

37. What is the commission on £477, 2s. 6d., at £2½ per £100?

38. A pound troy of standard silver is coined into 66s.; find the weight of half-a-crown, and of a florin.

39. The ratio of standard to pure silver is 37 to 40; what is the value of a lb. of pure silver?

40. From a garrison of 2000 men with provisions for 9 months, 500 are sent out; how long will the provisions serve the remaining men?

41. If 250 men dig a trench in 5 da. 5 ho., working 12 hours a-day; in how many days would they do the same, working 11 hours a-day?

42. If 49 men do a piece of work in 3⅗ days; in how many days will 48 men do the same?

43. A garrison being besieged, has 49 days' provisions, at the rate of 15 oz. a-day for each man; how long will they be able to hold out if each receives 10½ oz. a-day?

44. Required the charge for 12125 cubic feet of gas, at 5s. 10d. per 1000 cubic feet.

45. The rent of a farm of 350 ac. 3 ro. 20 per. is £1710, 10s. 3¾d.; what should be the rent of another of equal quality, containing 525 ac. 1 ro. 20 per.?

46. If £14, 8s. be the interest on £360 for a year; what sum will gain £33, 12s. in the same time and at the same rate per cent.?

47. A garrison of 2500 men, with provisions for 7 months at the rate of 21 oz. a-day for each, is reinforced by 1000 men; how many ounces a-day must each be allowed that the provisions may last that time? and if

each receives the full allowance, how long will the provisions serve?

48. Find the value of 5 bars of steel, each weighing 4 cwt. 3 qrs. 14 lbs., at £12, 14s. 4d. for 10 cwt. 3 qrs. 21 lbs.

49. In what time would 6 battalions of foot, each 375 ft. in length, march through a town $1\frac{3}{4}$ mile long, at the rate of 75 paces of $2\frac{1}{2}$ ft. per minute?

50. A piece of work can be done by 45 men in 13 days; now at the end of 6 days, 10 men leave: in how many days will the remaining men finish the work?

51. What is the price of $6\frac{3}{5}$ Fr. ells, at £66, 11s. for $72\frac{3}{5}$ Eng. ells?

52. What is the price of 7 pieces of cloth, each $16\frac{2}{3}$ yds., at £3, 4s. 9d. for $3\frac{1}{2}$ Scotch ells?

53. A bankrupt's debts amount to £4020, and his assets to £3266, 5s.; how much will this afford his creditors per £, and how much will A lose, whose claim is £560, 13s.?

54. A gentleman's income is £3867, 15s. per annum; his expenses amount to £1050, and he wishes to save £500: how much may he spend between Whitsunday and Martinmas?

55. How many yards at 4s. $1\frac{1}{2}$d. are equal in value to $123\frac{3}{4}$ yards at 12s. $7\frac{1}{2}$d. per yd.?

56. If 4 to. 5 cwt. 14 lbs. of lead cost £50, 17s. 6d.; what should be given for 20 to. 11 cwt. 49 lbs. of the same?

57. A cubic foot of chalk weighs 2784 oz., and a cubic foot of basalt 2860 oz.; how many cubic feet of the former are equal in weight to 7830 cubic feet of the latter?

58. A column of chalk weighs 20 cwt. 2 qrs. 24 lbs.; required the weight of a column of basalt of the same dimensions.

59. How much wheat can be bought for £101, 5s. when 7 qr. 4 bu. 3 pks. cost £20, 10s. $0\frac{3}{4}$d.?

60. What should be paid for 102 qrs. 3 bu. 2 pks. of oats, at the rate of £5, 4s. $11\frac{1}{4}$d. for 4 qrs. 2 bu. 2 pks.?

61. How much water must be mixed with 250 gallons of whisky, at 14s. 6d. per gal. to reduce the price to 12s. 6d. per gal.?

62. How much water must be mixed with whisky at 15s. a-gal. to fill a cask of 360 gals., so that a gallon of the mixture may be worth 13s. 4d.?

63. If the rent of $4\frac{1}{4}$ acres be £7, 13s.; what will be the rent of $5\frac{1}{3}$ acres?

64. An express train runs 58 mls. in 1 h. 30 m. with two stoppages of 3 minutes each; in what time will it run 435 miles with 5 stoppages of 4 minutes each?

65. What quantity of linen at 2s. 6d. a-yard should be exchanged for 5 dozen pairs of shoes at 11s. a-pair?

66. A and B barter, A has oats at 24s. per qr., which he rates at 27s. 6d. to B for sugar at 75s. per cwt.; at what should B rate his sugar to be even with A, and how many cwts. should he give for 175 qrs. of oats?

67. If 78 qrs. 5 bu. of barley be given for 53 qrs. 1 bu. of wheat at 64s. 9d. per qr.; what is the barley valued at per qr.?

68. A grocer mixes 56 lbs. of tea at 4s. per lb. with 44 lbs. at 5s.; how should he sell 11 lbs. of the mixture to gain £5, 1s. 10d. on the whole?

69. At what time after 2 o'clock are the hour and minute hands of a watch exactly together?

70. Find the diameter of the earth, whose circumference is 24850 miles nearly.

71. B gives to C 12 gallons of brandy at 37s. 6d. per gal. and £14, 12s. 6d., and receives from him tea at 4s. 6d. per lb. and 7 cwt. 2 qrs. of sugar at £3, 5s. per cwt.; what quantity of tea did B receive?

72. Find the weight of 600000 sovereigns, 1869 sovereigns weighing 40 lbs. troy.

73. Lent a friend £455 for 6 months; how long should he lend me £630 to return the favour?

74. If $\frac{5}{7}$ cwt. cost £$5\frac{1}{4}$; what should $\frac{3}{4}$ cwt. cost?

75. If $\frac{3}{11}$ of a ship be worth £420; what should $\frac{3}{5}$ of it cost?

76. What velocity will a falling body have at the end of $7\frac{1}{2}$ sec., if it acquires a velocity of $168\frac{7}{8}$ ft. in $5\frac{1}{4}$ sec.?

77. A hare starts 140 yards before a greyhound, but while the hare runs 5 yds. the dog runs 7; how far must the dog run to catch the hare?

78. If $\frac{5}{11}$ of an estate be worth £500; what is the value of $\frac{2}{5}$ of it?

79. If 30 horses be maintained for 5 months on a certain value of oats when the price is 22s. 6d. per qr.; how many horses may be fed for the same sum and time when oats are at 25s. per qr.?

80. A person, after paying income-tax at 1s. 4d. per £, has remaining £665; required his income.

81. How long would a cannon-ball with a velocity of 2000 ft. per second take in passing from the earth to the moon, a distance of 237630 miles?

82. The distance of Jupiter from the sun is 494513000 mls.; what is the length of its orbit, supposing it circular?

83. The same planet performs its revolution round the sun in $4332\frac{3}{5}$ days; what is his mean motion in $365\frac{1}{4}$ days?

84. If a tower 150 ft. 4 in. high cast a shadow of 181 ft. 1 in.; what length of a shadow will a pole 38 ft. 6 in. high cast at the same time?

85. How many revolutions will a coach-wheel $3\frac{1}{2}$ ft. in diameter make in 4 miles?

86. The weight of an 18-pounder iron gun being 41 cwt. 2 qrs., and the weight of a 12-pounder 33 cwt. 2 qrs.; how many 12-pounders will be equal in weight to 469 18-pounders?

87. What should be paid for 15 cwt. 1 qr. $14\frac{1}{2}$ lbs. of lead, when 14 cwt. 3 qrs. 16 lbs. cost £17, 7s. 6d.?

88. A person whose annual income is £650, spends £15, 2s. 6d. a-week for the first 20 weeks; what should his daily expenses be during the rest of the year, to save £55?

89. Bought 7 pieces of cloth, each containing 61 yds., for £424, 6s. $7\frac{1}{2}$d.; what should 241 yds. of the same be sold for to gain £5, 6s. 9d. on the whole?

90. A can do a piece of work in 9 days which B can do in 12 days; in how many days would they be able to finish the work, working together?

91. A cistern has two spouts, by one of which it can be filled in 3 months, and by the other it can be emptied in 8 months; in what time will it be full, supposing it empty and both spouts running?

92. A can do a piece of work in 6 days, which B can do in 8 days; after A has been working 2 days, B comes to help him; in what time will they finish the work together?

93. A starts from a certain place at the rate of 5 miles an hour; after 2 hours, B starts from the same place at the rate of $6\frac{1}{4}$ miles an hour; when will B overtake A, and how far will each have travelled?

94. A grocer uses a weight of $15\frac{7}{8}$ oz. instead of the pound avoirdupois; how much does he cheat his customers by selling 365 such pounds?

95. A cistern, containing 399 gallons, is emptied in a certain time by a pipe which discharges $4\frac{3}{4}$ gals. per minute, and another is emptied in the same time by a pipe which discharges $7\frac{3}{8}$ gals. per minute; how many gallons does the last cistern contain?

96. A wine merchant uses a measure containing $122\frac{1}{4}$ cub. in. instead of $131\frac{1}{8}$ c. in.; of how many gallons, each $277\frac{1}{4}$ c. in., does he defraud the public by selling $739\frac{1}{3}$ such measures?

COMPOUND PROPORTION.

When a question requires for its solution two or more statements of Simple Proportion, the method of finding the answer by one operation is called Compound Proportion.

Ex. 1. If 30 men eat £9 worth of bread in 12 days, when the price of the loaf is 8d.; what value will 64 men eat in 10 days, when the loaf is at 6d.? Ans. £12.

Sol. 1. Place upon the right hand that term which is of the same kind as the answer is to be (£9).

2. Take from the question two terms that are like one another (30 men and 64 men) and state them, without any reference to the other similar terms, as in Simple Proportion; in the same way, take other two similar terms (12 da. and 10 da.), and state them as in Simple Proportion below the last pair, and proceed thus till all the terms are stated.

Men, 30 : 64 : : £9
Days, 12 : 10
Price, 8 : 6

2880 : 3840 : : £9
9

2880)34560
£12 worth

3. Multiply all the left-hand terms together, and also the middle terms, then work out the resulting Proportion (2880 : 3840 : : £9) as in Simple Proportion for the answer (£12).

When some of the terms are Compound, they must be reduced as in Simple Proportion; the work may be greatly abridged by cancelling.

Ex. 2. If 14 persons spend £5, 5s. in 10 days; how long will £42 serve 16 persons? Ans. 70 da.

Sol. State the question as in Ex. 1, and reduce £5, 5s. and £42 to sh. Arrange the middle and the right-hand terms, with the sign of Multiplication between them above a line, and the left-hand terms below it; then cancel the upper and under numbers as much as possible, as in fractions, and divide the product of the remaining numbers above the line by the product of those below for the answer.

£5, 5s.		£42	
105s.	:	840s.	: : 10 da.
Persons 16	:	14	

$$\frac{\overset{8}{\cancel{840}} \times \overset{1}{\cancel{14}} \times 10}{\underset{2}{\cancel{16}} \times \cancel{105}} = \frac{1 \times 7 \times 10}{1} = 70 \text{ da.}$$

1. If 45 men cut down 120 acres of grass in 7 days; how many acres will 84 men cut down in 10 days?

2. If 300 soldiers consume 4 barrels of flour in 10 days; how many soldiers will 12 barrels serve for 15 days?

3. If 48 yds. of cloth, 4 quarters wide, cost £24, 12s.; what should be paid for 36 yds. of the same, 6 quarters wide?

4. What is the interest on £383, 5s. for 325 days at 4½ per cent. per annum?

5. If 30 men consume £7 worth of bread in 10 days, when the price of the loaf is 8d.; what value of bread will 40 men consume in 15 days, when the loaf is at 7½d.?

6. If 30 men can do a piece of work in 12 days of 10 hours each; in how many days of 8 hours each will 45 men do a piece of work 6 times as large?

7. If 63 cwt. be carried 42 mls. for £3, 10s., when the rate of carriage is ½d. per mile per cwt.; what distance should 142 cwt. be carried for £8, 17s. 6d., when the rate is 1d. per mile per cwt.?

8. At 2½ per cent. per annum £375 was lent, and it now amounts to £431, 5s.; how long has it been lent?

9. The pound weight of standard gold is coined into £46, 14s. 6d. (22 carats in 24 being pure gold); what is the value of 3 ounces of pure gold?

10. If 3 men or 5 boys do a piece of work in 8 days of 10 hours each; in how many days of 9 hours each would 4 men and 10 boys do a piece of work 3 times as large?

11. If 40 masons build a wall 56 yds. long in 10 days of 10½ hours each; how many hours a-day must 60 masons work to build a wall 120 yds. long in 20 days?

12. If 120 men can dig a trench 150 yds. long, 4 yds. wide, and 2 deep, in 7½ days of 10 hours each; what length of a trench, 5 yds. wide and 3 deep, will 200 men dig in 15 days of 12 hours each?

13. If 14 horses plough 112 acres in 40 days; how many horses would plough 64 acres in 16 days?

14. If 30 men earn £80, 14s. in 15 days; how many men will earn £107, 12s. in 12 days?

15. A traveller completes a journey of 240 miles in 3 days of 12½ hours; in how many days will he complete a journey of 360 miles, travelling 9 hours a-day?

16. If the 8d. loaf weighs 3 lbs. 4 oz. when wheat is at 64s. per qr.; what should the shilling loaf weigh when wheat is at 72s. per qr.?

17. Required the avoirdupois weight of 600000000 sovereigns, there being 1869 sovereigns in 40 lbs. troy, and 7000 grains in a pound avoirdupois.

18. A certain value of bread is sufficient to serve 3200 men for 44 days when the loaf is at 9d., allowing each man 16 oz. a-day; how many men will 7 times the value serve for 112 days, at 20 ounces each per day, when the loaf is at 11d.?

19. If 135000 bricks, 8 in. long, 3½ in. broad, and 2¾ in. thick, be required to build the walls of a magazine; how many bricks, 14 in. long, 4 in. broad, and 3 in. thick, would be sufficient for the same?

20. If 7 compositors set up a volume of 12 sheets in 21 days of 12 hours each; how many would be required to set up 3 volumes of 10 sheets in 35 days of 9 hours each?

21. 35 masons build 48 yds. of a wall which is to be 192 yds. long in 12 days of 12 hours each; how many additional masons will be required to finish the wall in 18 days of 10 hours each?

22. If 15 men build a wall, 80 ft. long, $3\frac{1}{2}$ ft. thick, and 9 ft. high, in 27 days of 10 hours each; in how many days of 12 hours each will 25 men build a wall 100 ft. long, $2\frac{1}{3}$ ft. thick, and 8 ft. high?

23. A garrison of 4050 men, with provisions for 5 months at the rate of 32 oz. a-day for each, is reinforced by 750 men, and cannot be relieved for 8 months; how many oz. a-day must each man be allowed that the provisions may last that time?

24. The cost of papering a room with paper 3 qrs. wide, at $3\frac{3}{4}$d. a-yard, is £2, 3s. 9d.; what would be the cost if the paper were $1\frac{1}{4}$ yd. wide, and the price $4\frac{1}{2}$d. a-yard?

25. A block of marble, 5 ft long, 4 wide, and 1 ft. 3 in. thick, weighs 39 cwt. 2 qrs. 8 lbs. 13 oz.; what is the weight of another block, 8 ft. long, $4\frac{1}{2}$ wide, and 2 ft. 4 in. thick?

26. In what time will the interest of £750, 12s. 6d. be sufficient to pay a debt of £112, 11s. $10\frac{1}{2}$d. at 4 per cent. per annum?

27. Find the interest of £1418, 0s. 6d. for 375 days, at $3\frac{1}{2}$ per cent. per annum.

28. If the 6d. loaf weighs 3 lb. $4\frac{1}{2}$ oz. when the wheat is at 56s. a-quarter; what is the price of wheat per qr. when the 8d. loaf weighs 3 lb. $13\frac{1}{4}$ oz.?

29. If 18 men working 9 hours a-day, or 36 boys working 6 hours a-day, can do a piece of work in 8 days; in how many days would 10 men and 24 boys do a piece of work 5 times as large, all working 8 hours a-day?

30. A contractor engages to construct $3\frac{1}{2}$ mls. of a road in 90 days, and for this purpose he employs 120 men, who work 8 hours a-day, but after 60 days, he finds they have only accomplished 2 mls. of the road; how many additional men must he employ to finish the work in the appointed time, the men working 9 hours a-day?

PRACTICE

Is an expeditious method of finding the values of goods by means of aliquot parts.

A less number is said to be an aliquot part of a greater when the less is contained an exact number of times in the greater; thus 3 is an aliquot part of 24, which contains it exactly 8 times; so also is 2s. 3d. of 18s., which contains it exactly 8 times.

TABLE OF ALIQUOT PARTS.

10s.	=	£$\frac{1}{2}$	$1\frac{1}{2}$d.	= $\frac{1}{4}$ of 6d.	= $\frac{1}{3}$ s.
6s. 8d.	=	£$\frac{1}{3}$	1d.	= £$\frac{1}{240}$	= $\frac{1}{12}$ s.
5s.	= $\frac{1}{2}$ of 10s.	= £$\frac{1}{4}$	$\frac{3}{4}$d.	= $\frac{1}{8}$ of 6d.	= $\frac{1}{16}$ s.
4s.	=	£$\frac{1}{5}$	$\frac{1}{2}$d.	=	= $\frac{1}{24}$ s.
3s. 4d.	= $\frac{1}{3}$ of 10s.	= £$\frac{1}{6}$	$\frac{1}{4}$d.	= £$\frac{1}{960}$	= $\frac{1}{48}$ s.
2s. 6d.	= $\frac{1}{4}$ of 10s.	= £$\frac{1}{8}$			
2s.	= $\frac{1}{5}$ of 10s.	= £$\frac{1}{10}$			
1s. 8d.	= $\frac{1}{4}$ of 6s. 8d.	= £$\frac{1}{12}$			
1s. 4d.	=	£$\frac{1}{15}$			
1s. 3d.	= $\frac{1}{6}$ of 10s.	= £$\frac{1}{16}$			
1s.	=	£$\frac{1}{20}$			
6d.	= $\frac{1}{2}$s.	= £$\frac{1}{40}$			
4d.	=	$\frac{1}{3}$s.			
3d.	=	$\frac{1}{4}$s.			
2d.	=	$\frac{1}{6}$s.			

AVOIRDUPOIS WEIGHT.

10 cwt.	=	$\frac{1}{2}$ ton
5 cwt.	=	$\frac{1}{4}$ ton
4 cwt.	=	$\frac{1}{5}$ ton
2 cwt.	=	$\frac{1}{10}$ ton
2 qr.	=	$\frac{1}{2}$ cwt.
16 lb.	=	$\frac{1}{7}$ cwt.
14 lb.	= $\frac{1}{2}$ qr.	= $\frac{1}{8}$ cwt.
7 lb.	= $\frac{1}{4}$ qr.	= $\frac{1}{16}$ cwt.
4 lb.	=	$\frac{1}{7}$ qr.

This table should be extended by the pupil.

CASE I. When the price is an aliquot part of £1, 1s., or 1d.

Ex. Find the price of 2744 yds. at 4d. and 3s. 4d. per yd.

SOL. 1. Since 4d. = $\frac{1}{3}$s. the value at 4d. = $\frac{1}{3}$ of the va. at 1s.; now 2744 yd. at 1s. = 2744s., hence $\frac{1}{3}$ of 2744s. = 914s. 8d., or £45, 14s. 8d. is the value at 4d.

4d. = $\frac{1}{3}$s.) 2744s. = val. at 1s.
2,0) 914s. 8d. val. at 4d.
Va. at 4d. = £45, 14s. 8d.

SOL. 2. Since 3s. 4d. = £$\frac{1}{6}$, the va. at 3s. 4d. = $\frac{1}{6}$ of the va. at £1; now the va. at £1 is £2744, hence $\frac{1}{6}$ of £2744 = £457, 6s. 8d. = va. at 3s. 4d.

3s. 4d. = £$\frac{1}{6}$) £2744 va. at £1
£457, 6s. 8d. va. at 3s. 4d.

Find the values of,

1. 7459 oz. at $\frac{1}{2}$d., $\frac{3}{4}$d., 1d., $1\frac{1}{2}$d., 2d., 3d., 4d., & 6d. per oz.

2. 1786 yds. at 1s., 1s. 3d., 1s. 4d., 1s. 8d., 2s., 2s. 6d., 3s. 4d., and 6s. 8d. per yd.

3. 3457 lbs. at 10s., 5s., 4s., 3s. 4d., 1s. 8d., 1s. 4d., 6d., and 4d. per lb.

CASE II. When the price is not an aliquot part of £1, 1s., or 1d.

Ex. Find the value of 575 lbs. at 3s. 9d. per lb.

SOL. 3s. 9d. = 2s. 6d. + 1s. 3d.; now the va. at 2s. 6d. by Case I. is £71, 17s. 6d., and since 1s. 3d. = $\frac{1}{8}$ of 2s. 6d., the va. at 1s. 3d. = $\frac{1}{8}$ of the va. at 2s. 6d. = $\frac{1}{2}$ of £71, 17s. 6d., or £35, 18s. 9d. The sum of the values at 2s. 6d. and 1s. 3d. = the value at 3s. 9d.

2s. 6d. = £$\frac{1}{8}$) £575 va. at £1

£71, 17s. 6d. va. at 2s. 6d.

1s. 3d. = $\frac{1}{2}$ of 2s. 6d. £35, 18s. 9d. " 1s. 3d.

£107, 16s. 3d. " 3s. 9d.

NOTE. When there are £'s in the price, multiply the quantity by them, and take aliquot parts for the s. and d.

Find the values of,

4. 375 at 4s. 4d., 4s. 8d., 5s. 6d., 6s. 3d., 7s. 4d., 8s. 4d., 10s. 10d., and 13s. 4d. each.

5. 692 at 12s. 4½d., 13s. 9½d., 14s. 4d., 15s. 7½d., 18s. 10d., 19s. 5d., 19s. 7½d., and 19s. 10d.

6. 1476 at 1¼d., 2½d., 3¾d., 4½d., 6¾d., 7¼d., 8¼d. & 10½d.

7. 297 at £1, 14s. 8d., £1, 18s. 10d., £2, 5s. 7d., £3, 15s. 11¼d., £5, 17s. 10d., £6, 16s. 6d., £7, 11s. 9d. & £9, 18s. 4½d.

8. 379 at £2, 2s. 2d., £3, 3s. 3d., £7, 7s. 7d., £11, 11s. 11d., and £11, 16s. 7½d.

CASE III. When the price consists of £ and s. only.

Ex. Find the value of 493 cwt. at 39s. per cwt.

SOL. Multiply the quantity (493) by half the number of shillings (19½); then double the right-hand figure of the product (3½) for shillings (7s.), and the rest (961) are £'s.

493

19½

9613½ = £961, 7s.

Find the values of,

9. 1476 at 2s., 3s., 7s., 9s., 11s., 13s., 17s., 19s., 29s., 43s., and 47s.

10. 1729 at 16s., 18s., 21s., 37s., 95s., £5, 5s., £5, 11s., £16, 4s., and £17, 11s.

CASE IV. When the quantity contains a fraction.

Ex. Find the value of 579¾ yds. at 21s. 3d. per yd.

SOL. 1. 1s. 3d. = £$\frac{1}{16}$) £579 value at £1
36, 3s. 9d. va. at 1s. 3d.
¾ of 21s. 3d. = 15s. 11¼d.
Val. of 579¾ yds. = £615, 19s. 8¼d.

SOL. 2. $\frac{579\frac{3}{4} \times 4}{}$

1s. 3d. = £$\frac{1}{16}$) £2319 value at £1
144, 18s. 9d. va. at 1s. 3d.
4) £2463, 18s. 9d. va. of 4 × 579¾
£615, 19s. 8¼d. va. as before.

Find the values of,

11. 476⅔ and 549⅔ at 14s. 8d., 15s. 5d., 17s. 8d., & 19s. 6d.
12. 375¼ and 742⅝ at 13s. 9d., 12s. 8d., 14s. 11d., & 17s. 6d.
13. 1146$\frac{2}{7}$ & 1763$\frac{3}{11}$ at 26s. 4d., 37s. 9d., 46s. 7½d., & 76s. 4¼d.
14. 2986$\frac{5}{9}$ and 4863$\frac{7}{12}$, at £4, 17s. 5d., £6, 14s. 7¼d., £7, 2s. 2½d., and £10, 11s. 9d.

CASE V. When the quantity is compound, and the price of one of the highest name is given.

Ex. Find the price of 4 cwt. 3 qrs. 14 lbs. at £3, 16s. 7½d. per cwt.

SOL. Find the value of the quantity of the highest name given, then take aliquot parts for the lower names, and add. Thus, 2 qr. = ½ cwt., va. of 2 qr. = ½ of £3, 16s. 7½d.;

2 qr. = ½ cwt.) £3	16	7½	va. of 1 cwt.
		4	
15	6	6	va. of 4 cwt.
1	18	3¾	" 2 qr.
1 qr. = ½ of 2 qr.	19	1⅞	" 1 qr.
14 lb. = ½ qr.	9	6⅞	" 14 lb.
£18	13	6¼	va. of 4 cwt. 3 qr. 14 lb.

1 qr. = ½ of 2 qr., va. of 1 qr. = ½ of £1, 18s. 3¾d.; and 14 lb. = ½ qr., va. of 14 lb. = ½ of 19s. 1⅞d. ½. The sum of the separate values gives the whole value.

Find the values of,

15. 3 cwt. 3 qrs. and 6 cwt. 2 qrs. 21 lbs. at £4, 5s. 4d. and £4, 7s. 6d. per cwt.

16. 7 cwt. 1 qr. 16 lbs. and 21 cwt. 2 qrs. 18 lbs. at £5 16s. 8d. and £6, 17s. 8d. per cwt.

17. 12 lbs. 3 oz. 15 dwt. and 27 lbs. 5 oz. 6 dwt. at £3, 3s. 4d. and £5, 16s. 8d. per lb.

18. 17 yd. 3 qr. 2 nl. and 37 yd. 2 qr. 3 nl. at £1, 3s. 6d. and £1, 17s. 6d. per yd.

19. 27 ac. 3 ro. 12 per. and 47 ac. 2 ro. 25 per. at £4, 11s. 8d. and £5, 15s. per acre.

20. 33 qr. 3 bu. 3 pk. and 67 qr. 1 bu. 2 pk. at £2, 2s. 4d. and £2, 7s. 4d. per qr.

21. 14 bu. 3 pk. 1 gal. and 17 bu. 2 pk. 1 gal. at £2, 4s. and £2, 12s. per qr.

22. 45 ac. 3 ro. 24 per. and 67 ac. 1 ro. 14 per. at £5, 13s. 4d. and £6, 8s. 4d. per ac.

MISCELLANEOUS EXERCISES.

1. Find the price of 116 cwt. of sugar at £3, 14s. 8d. and £4, 11s. 9d. per cwt.

2. Required the value of 1147⅛ yds. of cloth at £1, 2s. 7½d. and £1, 4s. 8¼d. per yd.

3. What should be given for 18 cwt. 3 qr. 21 lbs. and 27 cwt. 2 qr. 21⅞ lbs. of tea, at £25, 7s. 6d. and £27, 19s. 8d. per cwt.?

4. A bankrupt's debts amount to £1250, and he compounds with his creditors for 11s. 10½d. per £1; find his effects.

5. How much sterling money is equal to 1000 francs, each 9¾d. sterling?

6. Find the cost of digging a ditch, the solid content of which is 6753 cubic yds., at 1s. 8¾d. per cubic yd.

7. The daily pay of a foot-soldier is 1s. 1d.; how much does it take to pay a regiment of 750 men for a year at that rate?

8. The annual cost of the Police of Paris amounts to 5335295 francs of 9¾d. each; express this in sterling money.

9. How much sterling money is equal to 2000 rupees, each 2s. 1⅞d.?

10. Required the income-tax on £975, 17s. 6d. at 1s. 4d. per £1.

11. The annual rent of a parish is £36750, and a tax is

assessed for the poor at 2s. 1½d. per £; how much will it amount to?

12. In 1856, the expenses of the British Postal Service were £1660229, and the net revenue was £1207725; express each of these in francs and rupees of 1s. 10½d.

13. Sold 273 qrs. 5 bu. of wheat at £2, 15s. per qr.; 159 qrs. 3 bu. of barley at 42s. 8d. per qr.; and 79 qrs. 6 bu. of oats at 22s. 7d. per qr.; find what sum was received in all.

14. Find the value of 14 cwt. 3 qrs. 16 lbs. of tobacco at £23, 7s. 10d. per cwt.

15. A farm, containing 675 ac. 3 ro. 24 per., is let at £1, 17s. 6d. per acre; what is the whole rent?

16. Edinburgh, May 15th, 1871. James Drummond, Esq., bought of Robert Hunter, 163¾ lbs. tea at 3s. 9d. per lb., 167½ lbs. sugar at 7½d., 147¼ lbs. coffee at 1s. 8d., 11 cheeses, each 56 lbs., at 8½d. per lb.; what is the whole value?

17. Leith, April 17th, 1871. Alexander Clark bought of Scott and Co., 179⅓ doz. sherry at 27s. 6d., 185¼ doz. port at 36s., 163 gals. aqua at 17s. 6d., 17 gals. brandy at 36s. 6d., and 21 doz. claret at 47s. 6d.; what is the whole value?

18. The number of sovereigns coined in 1855 was 8448482, each weighing 5 dwt. $3\frac{3}{11}$ grs.; required the whole weight.

19. The number of shillings coined in 1855 was 1368499, each weighing 3 dwt. $15\frac{3}{11}$ grs.; required the whole weight.

20. What is the value of 3 casks of molasses, each 7 cwt. 3 qr. 3½ lb., at 12s. 7½d. per cwt., and duty 4s. 2d. per cwt.?

21. A gentleman has 3 farms; the first contains 450 ac. 3 ro. 24 per., and is let at £1, 13s. 4d. per ac.; the second contains 564 ac. 1 ro. 36 per., and is let at £1, 16s. per ac.; and the third contains 635 ac. 2 ro. 16 per., and is let at £2, 1s. 8d. per ac.; the taxes which he pays upon each are respectively 5s., 6s. 8d., and 3s. 4d. per ac.: what is the full rent of all his farms, the amount of taxes which he pays, and his net income?

22. A bankrupt owes £7580, and he can pay 15s. 7¼d. per £; what are his effects worth?

DECIMAL FRACTIONS.

A FRACTION which has unity with one or more ciphers after it for its denominator is called a Decimal fraction; as, $\frac{4}{10}$, $\frac{412}{1000}$. Such fractions are expressed without their denominators by pointing off, from the right of the numerators, as many figures as there are ciphers in the denominators; thus, $\frac{4}{10}$, $\frac{169}{100}$, $\frac{412}{1000}$ are written ·4, 1·69, ·412. When the number of figures in the numerators is less than the number of ciphers, the deficiency is made up by prefixing ciphers to the numerators; thus, $\frac{4}{100} = ·04$, $\frac{251}{100000} = ·00251$.

Ciphers on the right of a decimal do not alter the value; thus, $·040 = \frac{40}{1000}, = \frac{4}{100} = ·04$.

The first figure after the point indicates tenths; the second figure, hundredths; the third, thousandths, and so on; that is, in decimals, as in integers, the value increases in a tenfold ratio from right to left. Decimals are therefore operated upon in the same way as integers, due attention being paid to the placing of the point.

REDUCTION OF DECIMALS.

CASE I. To reduce a vulgar fraction to a decimal.

Ex. Reduce $\frac{7}{80}$ to a decimal. Ans. ·0875.

SOL. Divide the numerator (7) by the denominator (80), annexing ciphers to the numerator until the division terminates or repeats; then point off as many figures from the right of the quotient (875) as there were ciphers annexed (4), and make up the deficiency (if any) in the quotient by prefixing ciphers to it.

80) 7·0000

$\frac{7}{80} = ·0875$

When the division terminates, the result is called a Finite decimal; if not, it is called a Repeating or Circulating decimal, according as one or several figures recur, and a dot is placed above the repeater, or above the first and last figures of the circulate; as, $\frac{2}{3}, = ·\dot{6}$; $\frac{1}{7} = ·\dot{1}4285\dot{7}$ (see p. 34).

Reduce to decimals,

1. $\frac{1}{4}$, $\frac{3}{4}$, $\frac{5}{8}$, $\frac{13}{16}$, $\frac{27}{32}$, $\frac{231}{176}$, $\frac{19}{64}$, $\frac{511}{448}$, $\frac{17}{128}$, $\frac{23}{256}$, $\frac{197}{256}$, and $\frac{1001}{1408}$.

2. $\frac{7}{85}$, $\frac{19}{125}$, $\frac{173}{645}$, $\frac{153}{1125}$, $\frac{11}{275}$, $\frac{183}{1525}$, $\frac{214}{3125}$, $\frac{363}{1875}$, $\frac{279}{9375}$, $\frac{87}{15625}$.

3. $\frac{1}{3}$, $\frac{4}{9}$, $\frac{7}{24}$, $\frac{6}{7}$, $\frac{25}{126}$, $\frac{5}{13}$, $\frac{36}{2240}$, $\frac{54}{1760}$, $\frac{121}{5760}$, $\frac{143}{4840}$, $\frac{15}{444}$, & $\frac{111}{1644}$.

CASE II. To reduce a finite decimal to a vulgar fraction.

Ex. Reduce ·0375 to a vulgar fraction. Ans. $\frac{3}{80}$.

SOL. Write the given decimal (·0375) as the numerator of the fraction, and for the denominator write *unity*, with as many ciphers after it as there are figures in the decimal (4); then reduce the fraction $(\frac{375}{10000})$ to its lowest terms $(\frac{3}{80})$.

Reduce to vulgar fractions,

1. ·5; ·25; ·75; ·625; ·3125; ·03125; ·18725; ·096875; ·000575
2. ·48; ·364; ·4248; ·0672; ·4152; ·04096; ·03136; ·00048
3. ·525; 6·0425; ·00675; 8·0864; ·0001875; 1·04264; 2·18575

CASE III. To reduce a compound quantity to the decimal of a higher name.

Ex. Reduce 4 cwt. 3 qr. 21 lb., or 553 lb., to the decimal of a ton. Ans. ·246875 ton.

SOL. Reduce the given quantity (553 lb.) to the fraction of the required name (by Case VI., p. 8), and again (by Case I. of dec.) reduce the fraction $(\frac{553}{2240})$ to a decimal (·246875).

1. Reduce 2s. 6d., 3s. 9d., 5s. 6d., 12s. 8¼d., 15s 9¾d., and 10¼d., to the decimal of £1.
2. Reduce 3 qr. 21 lb., 2 cwt. 14 lb., 4 cwt. 17½ lb., 14 lb., 2 qr. 14 lb., and 98 lb., to the dec. of 1 ton.
3. Reduce 2 ml. 7 fu., 4 ml. 16 po., 37 po. 5½ yd., 7 fu. 34 po., 8 ml. 16 po., and 374 yd., to the dec. of 9 ml.
4. Reduce 2 ac. 3 ro., 3 ac. 24 per., 2 ro. 121 yd., 17 per. 15⅕ yd., 1 ac. 363 yd., and 363 yd., to the dec. of 3 ac.
5. Reduce 4 oz. 1 dwt., 19 dwt. 15 gr., 21 gr., 11 oz. 15 gr., 10 oz. 10 dwt., and 1 dwt., to the dec. of 1 lb. tr.
6. Reduce 14s. 7d., 16s. 11d., 3 cr., 4 half-cr., ¾ of 14s. 5¼d., and 3½d., to the dec. of 1 guinea.
7. Reduce £14, 5s. 10d., and £16, 17s. 6d., to the dec. of 20 guineas.

CASE IV. To find the value of a dec. in lower names.

Ex. Find the value of 1·375 ac. Ans. 1 ac. 1 ro. 20 per.

SOL. Multiply the given decimal (·375) by the number of the next lower name contained in that given (4), and point off, from the right hand of the product, as

1·375 ac. × 4
1·$\overline{500}$ ro. × 40
20·$\overline{000}$ per.

many figures as are in the decimal (3); again, multiply the decimal part of the last product (·500) by the number of the next lower name contained in this last name (40), and point off as before; proceed in the same way as far as necessary. The figures on the left of the points are integers of the respective names.

Find the values of,

1. £·4625; ·3725s.; ·6875 gu.; ·3425 cr.; £·7725; ·925s.
2. ·3775 cwt.; ·4275 ton; ·68725 qr.; ·3975 cwt.; ·4375 ton; ·465 lb.
3. ·8975 ml.; ·3875 ac.; ·496725 da.; ·8975 co. ye.; ·1875 bu.; ·3875 ro.
4. ·4725 Eng. E.; ·45875 yd.; ·2875°; ·9875 Ju. ye.; £8·6775; 9·725 gu.
5. ·242242 da.; £·8794; 8·746 ton; 10·12125 ac.; 11·6874 ml.; 14·72 yd.

CASE V. To reduce shillings and pence to the decimal of £1 mentally.

Ex. 1. Reduce 4s. 10¾d. to the dec. of £1 mentally.
Ans. £·24375.

SOL. Divide the shillings by 2 for the first figure of the decimal (·2); the farthings in the pence and farthings (42), increased by their 24th part ($1\frac{3}{4}$ or $1\frac{3}{4}$), gives the next two figures (43); then to the third figure annex the remainder ($\frac{3}{4}$), reduced to a decimal (75), for the value (£·24375).

Ex. 2. Reduce 15s. 8¼d. to the decimal of £1.
Ans. £·784$\frac{9}{24}$, or £·784375.

When the shillings are odd, 50 must be added to the farthings, increased as above.

Reduce to the decimal of £1 mentally,

1. 7s. 6d.; 10s. 7½d.; 14s. 8¼d.; 15s. 9d.; 19s. 8½d.; 12s. 7½d; 18s. 9½d.
2. 11s. 8d.; 12s. 4d.; 13s. 5d.; 14s. 11¼d.; 16s. 8¾d.; £1, 17s. 9d.; £3, 18s. 7d.

CASE VI. To value the decimal of £1 mentally.

Ex. Value £·6354 mentally. Ans. 12s. 8½d.

SOL. Divide the first two figures (63) of the dec. by 5 for shillings (12); to the remainder, if any, annex the third

figure (5), and this number (35) diminished by its 25th part (1) gives farthings (34), which must be reduced to pence (8½d.)

NOTE. Since three places of the decimal only are required, call the third figure one more than it is, when the fourth is 5 or upwards, otherwise reject it.

Find mentally the values of,

1. £·525; £·972; £·496; £·896; £1·8914; £11·7364
2. ·675; ·873; ·785; ·999; 6·4377; 22·8976

ADDITION AND SUBTRACTION OF FINITE DECIMALS.

Ex. Find the sum and difference of 7·96752 and ·0478.

SOL. Arrange the numbers so that the decimal points may be directly under each other, and proceed as in integers; then place the point in the result directly under the other points.

	7·96752
	·0478
Sum	8·01532
Diff.	7·91972

Find the sum of,

1. ·25, 4·675, ·00475, 84, 96·23725
2. ·0046, 217, ·284, ·0478, 3·44756
3. ·728921, ·00043, 211·2, 86·114875
4. ·00867, 1·432, 247, ·00083, ·674
5. 9·732, ·048076, ·1234, 6·7289, ·214, ·7
6. ·6498, ·37293, 311·4, 21·72, ·00875
7. ·046, 36·479, 2·101, ·111, ·04789
8. ·3596, ·24798, ·35, 37, ·00705
9. £375, 16s. 6d., £331, 14s. 9d., £375, 18s. 9¾d., £157, 7s. 8¼d., £97, 4s. 6d., 5s. 9d.
10. 47·98625—13·97846; 7·0423—·4789; 28·23546—16·479258
11. 29·46537—21·57698; 8·2458—·0034; ·6728934—·00628575
12. 1·4386—·004289; ·04657—·00827; ·4798231—·46991482
13. 17 cwt. 2 qr. 14 lb.—14 cwt. 3 qr. 21 lb.; 29 qr. 5 bu. 2 pk. —23 qr. 7 bu. 3 pk.

MULTIPLICATION OF FINITE DECIMALS.

Ex. Multiply 4·7025 by ·0025. Ans. ·01175625.

SOL. Multiply the factors together, as in integers, disregarding the point; then, from the right hand of the product, point off as many figures as there are decimal places in both factors (8), making up the deficiency (if any) by prefixing ciphers (1) to the product.

4·7025
·0025
235125
94050
·01175625

NOTE. A decimal is multiplied by 10, 100, 1000, &c. by removing the point *one*, *two*, *three*, &c. places to the right; as, $2{\cdot}134 \times 10000 = 21340$.

1. $4{\cdot}6275 \times 4{\cdot}63$, $5{\cdot}75$, $\cdot046$, $\cdot824$, $86{\cdot}4$, $\cdot005$, 1000, 10001
2. $\cdot00796 \times 37{\cdot}8, 42{\cdot}89, 7{\cdot}824, \cdot046, \cdot3724, 1{\cdot}738, 100, 10101$
3. $27{\cdot}8372 \times 8{\cdot}434, 96{\cdot}429, \cdot00429, \cdot7426, 3{\cdot}14152, \cdot001, 1001$
4. Val. 27yd. 3qr. 2nl., at 2/6, $4/9\frac{3}{4}$, $23/4\frac{1}{2}$, $27/10\frac{1}{2}$, $31/11\frac{1}{4}$ p.yd.

DIVISION OF FINITE DECIMALS.

Ex. Divide $3{\cdot}146$ by $42{\cdot}8$. Ans. $\cdot073505$ nearly.

SOL. Make the decimal places in both numbers alike by annexing ciphers (2) to that which has the least number; then divide as in integers, and to the remainder (if any) annex ciphers to carry on the division: the number of ciphers last annexed (6) is the number of decimal places in the answer ($\cdot073505$).

$$42800)3146{\cdot}000000(\cdot073505$$

NOTE. A decimal is divided by 10, 100, 1000, &c. by removing the point *one*, *two*, *three*, &c. places towards the left; as, $2{\cdot}134 \div 100 = \cdot02134$.

1. $382{\cdot}8825 \div \cdot55, 1{\cdot}36, 31{\cdot}5, \cdot325, \cdot1309, \cdot00119, 2{\cdot}75, 81{\cdot}9, 100$
2. $24{\cdot}22728 \div 1{\cdot}15, 85{\cdot}5, \cdot805, \cdot0368, 103{\cdot}5, 369{\cdot}6, \cdot01539, 1000$
3. $\cdot0483923 \div 20{\cdot}35, 475{\cdot}6, 8{\cdot}584, \cdot03157, \cdot002552, 1{\cdot}221, \cdot0019721$
4. £4779, 17s. $8\frac{1}{4}$d. $\div 17{\cdot}5$, $4{\cdot}375$, $281{\cdot}25$, $687{\cdot}5$, $\cdot03125$, $\cdot1875$

INTERMINATE DECIMALS.

IN reducing vulgar fractions to decimals, when one or more figures of the quotient recur, the result is called an Interminate decimal.

Decimals consisting of one or more figures which recur, are called *pure* repeating or circulating decimals; as, $\dot{3}$, $\cdot\dot{1}42857\dot{}$.

Decimals consisting of a non-recurring and a recurring part are called mixed repeating or circulating decimals; as, $\cdot4\dot{6}$, $\cdot379\dot{6}$: the non-recurring parts (4 and 37) are generally called the *finite* parts of the decimals ($\cdot4\dot{6}$ and $\cdot379\dot{6}$.)

REDUCTION OF INTERMINATE DECIMALS.

CASE I. To reduce a pure repeater or circulate to a vulgar fraction.

EX. Reduce $\cdot\dot{7}\dot{5}$ to a vulgar fraction. Ans. $\frac{75}{99}$ or $\frac{25}{33}$.

SOL. Write the given decimal for the numerator, and below it, for the denominator, place as many *nines* (2) as there are decimal places; then reduce the fraction ($\frac{75}{99}$) to its lowest terms ($\frac{25}{33}$).

Reduce to vulgar fractions,

1. $\cdot\dot{3}$, $\cdot\dot{6}$, $\cdot\dot{4}$, $\cdot\dot{9}$, $\cdot\dot{2}\dot{7}$, $\cdot\dot{3}\dot{6}$, $\cdot\dot{3}\dot{9}\dot{6}$, $\cdot\dot{5}\dot{9}\dot{4}$, $\cdot\dot{1}\dot{8}\dot{5}$, $\cdot\dot{2}\dot{5}\dot{9}$, $\cdot\dot{0}\dot{6}\dot{3}$, $\cdot\dot{0}\dot{0}\dot{7}\dot{2}$

2. $\cdot\dot{5}71428\dot{3}$, $\cdot\dot{1}53846\dot{3}$, $\cdot\dot{1}90476\dot{3}$, $\cdot 17\dot{1}$, $\cdot\dot{4}28571\dot{4}$, $\cdot 0\dot{9}5238\dot{3}$

CASE II. To reduce a mixed recurring decimal to a vulgar fraction.

EX. Reduce $\cdot 04\dot{7}\dot{6}$ to a vulgar fraction.

Ans. $\frac{476-4}{9900} = \frac{472}{9900} = \frac{118}{2475}$

SOL. From the given decimal ($\cdot 0476$), considered as an integer, subtract the finite part (04) for the numerator, below which, for the denominator, place as many *nines* as there are figures in the circulating part (2), with as many *ciphers* annexed to them as there are figures in the finite part (2); then reduce the fraction ($\frac{472}{9900}$) to its lowest terms ($\frac{118}{2475}$).

Reduce to vulgar fractions,

1. $\cdot 4\dot{7}\dot{2}$, $\cdot 58\dot{3}$, $\cdot 1\dot{6}$, $\cdot 0\dot{2}\dot{7}$, $\cdot 01\dot{1}\dot{3}$, $\cdot 48\dot{9}\dot{1}$, $\cdot 638\dot{1}$, $\cdot 729\dot{6}9\dot{3}$

2. $\cdot 14\dot{6}$, $\cdot 235\dot{9}$, $\cdot 002\dot{6}$, $\cdot 056\dot{6}\dot{3}$, $\cdot 1\dot{1}81\dot{8}$, $\cdot 458\dot{5}$, $\cdot 68472\dot{1}$

CASE III. To make circulates similar.

EX. Make $\cdot 0\dot{3}$, $\cdot 7\dot{7}\dot{5}$, and $\cdot 760\dot{3}\dot{4}$ similar.

SOL. Extend each decimal as many places beyond the longest finite part (2), as is indicated by the L. C. M. of the number of places in the several circles (6).

$\cdot 03\dot{3}333\dot{3}\dot{3}$
$\cdot 77\dot{5}75757$
$\cdot 760\dot{3}4\dot{0}\dot{3}\dot{4}$

Make the following circulates similar.

1. $\cdot 14\dot{3}$, $\cdot 0\dot{3}\dot{7}$, $\cdot\dot{0}1\dot{4}$
2. $\cdot 37\dot{4}\dot{2}$, $\cdot 0\dot{0}8\dot{9}$, $\cdot 47\dot{6}$
3. $\cdot 17\dot{6}\dot{9}$, $\cdot 245\dot{6}$, $\cdot 1\dot{1}8\dot{9}$
4. $\cdot 40\dot{2}$, $\cdot 17\dot{9}$, $\cdot\dot{0}42\dot{3}$
5. $\cdot\dot{1}1\dot{7}$, $\cdot 114\dot{6}$, $\cdot 089\dot{4}$
6. $\cdot\dot{2}48\dot{6}$, $\cdot 1175$, $\cdot 06\dot{2}\dot{4}$
7. $1\cdot 7\dot{2}\dot{9}$, $\cdot\dot{2}6\dot{8}\dot{4}$, $\cdot\dot{0}0\dot{4}\dot{6}$, $2\cdot 47\dot{8}$
8. $4\cdot\dot{3}$, $8\cdot 7\dot{2}\dot{9}$, $\cdot\dot{4}67\dot{3}$, $\cdot 0\dot{0}\dot{1}$
9. $\cdot 00\dot{1}0\dot{1}$, $\cdot 26\dot{7}7\dot{0}$, $\cdot\dot{1}42\dot{1}$, $3\cdot 4\dot{2}\dot{8}$

ADDITION AND SUBTRACTION OF INTERMINATE DECIMALS.

Ex. 1. Find the sum and difference of $37{\cdot}14\dot{3}$ and $29{\cdot}873\dot{6}$

Sol. Since there are only repeaters given, extend them one place beyond the longest finite part, and carry or borrow at 9 on the right hand; the right-hand figure of the result is a repeater or 0.

	$37{\cdot}143\dot{3}$
	$29{\cdot}873\dot{6}$
Sum	$67{\cdot}0170$
Diff.	$7{\cdot}269\dot{6}$

Ex. 2. Find the sum and difference of $71{\cdot}85\dot{7}$ and $43{\cdot}976\dot{4}2$.

Sol. Make the circulates similar, and add the carriage (if any) from the left-hand column of the circles to the right-hand figure of the under circle, before adding or subtracting.

	$71{\cdot}85757575$
	$43{\cdot}97642642$
Sum	$115{\cdot}83400218$
Diff.	$27{\cdot}88114933$

After the right-hand figure of the result has been obtained, proceed as in Finite decimals.

Find the sum of,

1. $1{\cdot}6$, $23{\cdot}052$, $\cdot583$, $6{\cdot}3$, $\cdot051$
2. $7{\cdot}8$, $8{\cdot}964$, $\cdot7291$, $14{\cdot}056$
3. $\cdot7$, $\cdot245$, $\cdot006$, $\cdot043$, $\cdot1$
4. $\cdot72$, $\cdot345$, $\cdot854$, $\cdot00625$
5. $9{\cdot}76$, $8{\cdot}427$, $\cdot0864$, $\cdot75$, $8{\cdot}4572$
6. $\cdot1341$, $\cdot672$, $\cdot1487$, $\cdot05$, $6{\cdot}4576$
7. $11{\cdot}1$, $1{\cdot}63$, $\cdot9625$, $\cdot03$, $7{\cdot}1167$
8. $\frac{2}{3}$, $\frac{5}{9}$, $\frac{3}{11}$, $\frac{4}{7}$, $\frac{6}{13}$, and $\frac{3}{4}$
9. £12, 14s. 5d., £27, 16s. $7\frac{1}{4}$d., £33, 16s. $6\frac{1}{4}$d., £17, 11s. 8d., and $10\frac{3}{4}$d.
10. $29{\cdot}146$—$13{\cdot}17$, $16{\cdot}72$—$4{\cdot}6583$, $57{\cdot}6854$—$14{\cdot}976851$
11. $17{\cdot}36$—$3{\cdot}143$, $21{\cdot}867$—$7{\cdot}863$, $41{\cdot}6872$—$19{\cdot}478623$
12. 17 ml. 3 f. 4 yds.—6 ml. 39 po. 5 yds., 18 cwt. 3 qr. 16 lb.—7 cwt. 18 lb.

MULTIPLICATION OF INTERMINATE DECIMALS.

Ex. Multiply $42{\cdot}375$ by $\cdot037$.

Sol. When the multiplicand is a repeater, and the multiplier a finite decimal, multiply as in integers, but add 1 to the right-hand figure of the product for every 9 in it; then extend the several products the same length and add them.

$42{\cdot}375$
$\cdot037$
296628
1271266
$1{\cdot}567895$

Ex. 2. Multiply $7{\cdot}14\dot{6}7\dot{2}$ by $\cdot 69$.

Sol. When the multiplicand is a circulate and the multiplier a finite decimal, multiply as in integers, and add the carriage from the left of the circle to the right-hand figure of the circle; then extend the several products the same length and add them.

$$\begin{array}{r} 7{\cdot}14\dot{6}7\dot{2} \\ \cdot 69 \\ \hline 6432\dot{0}5\dot{4} \\ 4288\dot{0}3\dot{6}\dot{0} \\ \hline 4{\cdot}9312\dot{4}1\dot{4} \end{array}$$

When the multiplier is interminate, or when both are interminate, reduce the multiplier to a vulgar fraction, then multiply by its numerator and divide by its denominator. In dividing, instead of ciphers, the repeating or circulating figures must be annexed in their order to carry on the division: thus,

$$5{\cdot}28571\dot{4} \times \cdot\dot{3} = 5{\cdot}2857142 \times \tfrac{1}{3} = 1{\cdot}76190\dot{4}.$$

1. $5{\cdot}796\dot{3} \times 4{\cdot}8$, $5{\cdot}76$, $8{\cdot}942$, $7{\cdot}63$, $11{\cdot}5$, $\cdot 0042$, $\cdot 176$, $\cdot 0087$
2. $8{\cdot}142\dot{6} \times 7{\cdot}3$, $6{\cdot}84$, $9{\cdot}428$, $3{\cdot}76$, $1{\cdot}51$, $\cdot 43$, $\cdot 0074$, $\cdot 4875$
3. $6{\cdot}872\dot{6} \times \cdot\dot{4}$, $6{\cdot}\dot{6}$, $7{\cdot}\dot{2}$, $\cdot 04\dot{3}$, $\cdot 0\dot{6}\dot{9}$, $\cdot 042\dot{8}$, $\cdot 00\dot{7}\dot{2}$, $\cdot 145\dot{6}$
4. $7{\cdot}876\dot{3} \times \cdot\dot{6}$, $\cdot\dot{6}\dot{3}$, $\cdot\dot{1}7\dot{1}$, $\cdot 0\dot{6}\dot{9}$, $\cdot 48\dot{7}$, $3{\cdot}\dot{1}4\dot{8}$, $6{\cdot}70\dot{9}$, $8{\cdot}47\dot{2}$

DIVISION OF INTERMINATE DECIMALS.

Ex. 1. Divide $26{\cdot}8058\dot{3}$ and $21{\cdot}1872\dot{9}$ by 8.

Sol. When the dividend only is interminate, divide as in finite decimals, and in carrying on the quotient, instead of ciphers, annex the repeating or circulating figures in their order, until a repeater or circulate is obtained in the quotient.

$$\begin{array}{r} 8)26{\cdot}805833333 \\ \hline 3{\cdot}35072916\dot{6} \\ 8)21{\cdot}1872\dot{9}729 \\ \hline 1{\cdot}648412\dot{1}6 \end{array}$$

Ex. 2. Divide $6{\cdot}72\dot{8}\dot{3}$ by $6{\cdot}\dot{6}$. Here $6{\cdot}\dot{6} = 6\frac{2}{3} = \frac{20}{3}$.

Sol. When the divisor or both are interminate, reduce the divisor ($6{\cdot}\dot{6}$) to a vulgar fraction ($6\frac{2}{3}$), then multiply by its denominator (3), and divide by its numerator (20) for the quotient, which may be carried on as in Ex. 1.

$$\begin{array}{r} 6{\cdot}72\dot{8}\dot{3} \\ 3 \\ \hline 20)20{\cdot}184\dot{9}\dot{8} \\ 1{\cdot}00\dot{9}249 \end{array}$$

1. $7{\cdot}41\dot{6} \div \cdot 125$, $187{\cdot}5$, $43{\cdot}75$, $\cdot 52$, $\cdot 42\dot{7}$, $\cdot 7\dot{2}\dot{9}$
2. $\cdot 230769\dot{2} \div \cdot 65$, $4{\cdot}16$, $\cdot 975$, $\cdot 0208$, $4{\cdot}\dot{6}\dot{3}$, $7{\cdot}8\dot{3}$
3. $14{\cdot}\dot{1}42857 \div \cdot 84$, $\cdot 58\dot{3}$, $68{\cdot}\dot{4}$, $7{\cdot}2\dot{3}$, $81{\cdot}\dot{6}$, $9{\cdot}\dot{6}\dot{3}$

MISCELLANEOUS EXERCISES ON DECIMAL FRACTIONS.

1. Find the values of £·31416; ·142857 ton; ·12645 ml.; ·846283 lb. troy; ·1728 yd.; and ·78646 day.

2. From the sum of 7·6, 8·24, 9·1583, subtract 4·72, and multiply the remainder by 21·24.

3. Find the value ·875 of 17s. 6d. + ·143 guinea — ·725 of 8s. 6d.

4. Express 1456·725 cub. ft. in French stères, each 35·31658 cubic feet.

5. Find by decimals the value of 14 cwt. 3 qrs. 14 lbs. of coffee at £9, 6s. 8d. per cwt.

6. The ratio of the diameter of a circle to its circumference is 1 : 3·14159; required the mean equatorial circumference of the earth, the diameter being 7925·626 mls.

7. Find the diameter of the planet Jupiter, its circumerence being 273318·33 miles.

8. Reduce £4, 13s. 4d. to the dec. of £5, 12s. 6d.

9. The gold eagle of the United States weighs 270 grains, 21·875 carats fine; what is its value in sterling money, 46·725 sovereigns weighing a lb. troy, 22 carats fine?

10. A and B can do a piece of work in 4·8 days, A and C the same in 4·4 days, and B and C in 5·45 days; find by decimals in what time the three together could do it, and also separately.

11. Find the value of ·1875 ton + ·375 qr. + ·875 lb., and reduce the result to the decimal of 3 cwt. 3 qrs.

12. The whole area of France is 131017513·33242 acres; find the area in hectares, each 2·473614 acres.

13. Multiply ·06723 by ·00401, and divide 301·5 by ·00045.

14. A French metre is 3·2808992 imperial feet; how many imperial feet are there in a quadrant of the meridian, or in 100000565·268 metres?

15. What is the hourly motion of the earth, whose distance from the sun is 95 millions of miles and period of revolution 365 days?

16. An ounce of tea costs 2·8125d.; what should be paid for 6·583 lbs. of the same?

17. Find the value of $14{\cdot}87\dot{4}\dot{5}$ ml.—$3{\cdot}4\dot{2}\dot{7}$ mile.

18. £4, 6·625s. × 27·45 and $993{\cdot}7\dot{1}4285\dot{7} \div 234{\cdot}2$.

19. Reduce $\cdot0\dot{2}\dot{5}$ of 4 ml. 3 fu. 19·264 pole to the dec. of 2 ml. 5 fu.

20. Reduce 2·275 of $4\frac{1}{2}$ gu. to the dec. of £20, 9s. 6d.

21. Find the values of $\cdot07\dot{3}$ of 8s. 6d. and $\cdot78\dot{5}$ of 15s. 9d.

22. Reduce ·2 of $\frac{2}{3}$ of 4 cwt. 3 qrs. 23 lbs. to the dec. of 31 cwt. 2 qrs. 24 lbs.

23. Divide £1050, $3\frac{3}{4}$d. among 5 men, 8 women, and 16 boys, giving each woman ·5 of $\frac{4}{5}$ of a man's share, and each boy ·5 of 1·25 of a woman's share.

24. Divide £1125 among A, B, and C, giving A $\frac{1}{7}$ of 2·625 of the whole—£45; B 1·025 of what A receives + £75, and C the remainder.

COMMERCIAL ALLOWANCES.

THE *Gross weight* of goods is their whole weight, including the weight of the cask, barrel, &c., which contains them.

Tare is the weight of the cask, barrel, &c., which contains the goods, or it is an allowance made for it.

That which remains after deducting the tare is called the *Tare Suttle.*

Tret is an allowance of $\frac{1}{2}\frac{1}{6}$, or 4 lbs. on every 104 lbs. of the Tare Suttle for waste.—*Draft* is also an allowance sometimes made, and is deducted before the Tare.

The *Net weight* is what remains after all the allowances have been deducted.

Questions under this head may be solved by Practice.

Ex. Find the net weight of 5 hhds. sugar, each 10 cwt. 3 qrs. 4 lbs., allowing tare 14 lbs. per cwt., tret 4 lbs. per 104 lbs., and draft 4 lbs. per hhd.

			10 cwt. 3 qr. 4 lb.	gross weight of each hhd.
			4	draft on 1 hhd.
	10	3	0 × 5	
14 lb. = $\frac{1}{8}$ cwt.)	53	3	0	
	6	2	$24\frac{1}{2}$	tare.
4 lb. p. 104 lb. = $\frac{1}{2}\frac{1}{6}$)	47	0	$3\frac{1}{2}$	tare suttle.
	1	3	$6\frac{3}{2}\frac{1}{6}$	tret.
	45	0	$24\frac{7}{2}\frac{1}{6}$	net weight.

Find the net weight of,

1. 48 cwt. 3 qr. 14 lb., tare 16 lb. per cwt. & tret as usual.
2. 79 cwt. 2 qr. 21 lb., tare 7 lb. " " "
3. 147 cwt. 1 qr. 7 lb., tare 8 lb. " " "
4. 984 cwt. 3 qr. 16 lb., tare 14 lb. " " "
5. 748 cwt. 2 qr. 12 lb., tare 12 lb. " " "
6. 896 cwt. 1 qr. 24 lb., tare 18 lb. " " "

7. 4 chests of tea, each 12 cwt. 3 qrs. 14 lbs., allowing tare 15 lbs. per cwt., tret as usual, and draft 3 lbs. per chest.

8. 7 casks of sugar, each 14 cwt. 2 qrs. 18 lbs., allowing tare 14 lbs. per cwt., tret as usual, and draft 4 lbs. per cask, and the value of the net weight at 6½d. per lb.

9. 3 hhds. tobacco; the first, 8 cwt. 3 qrs. 14 lbs., tare 3 qrs. 7 lbs.; the second, 9 cwt. 2 qrs. 7 lbs., tare 2 qrs. 19 lbs.; and the third, 10 cwt. 1 qr. 16 lbs., tare 3 qrs. 7 lbs., allowing draft 7 lbs. per hhd., and tret as usual.

10. Bought 2709 lbs. of coffee, and was allowed 1 lb. gratis to the score; what did I pay for it at 16¼d. per lb.?

11. How much pure silver in a mass weighing 42 lbs., allowing 15 dwt. of alloy in each lb. of the mass?

12. Purchased 4 bags of rice, each 265 lbs., and was allowed 3 lbs. gratis to every 50 lbs.; what did it cost at 3¼d. per lb.?

COMMISSION AND BROKERAGE.

COMMISSION is an allowance of so much per cent. paid to one person for transacting the business of another.

Brokerage is a smaller allowance of the same nature.

Ex. 1. Find the commission on £475, 12s. 6d., at £1½ per cent. Ans. £7, 2s. 8¼d.

SOL. Multiply the sum (£475,12s.6d.) by the rate per cent. (1½), and divide the product (£713, 8s. 9d.) by 100.

	£475	12	6
			1½
100)	713	8	9
Com.	£7	2	8¼

When the rate is guineas, add $\frac{1}{20}$ of the sum to itself, then multiply by the rate as £'s, and divide by 100 when the rate is shillings, &c., take aliquot parts of £1, and divide by 100.

Ex. 2. Find the commission on £322, 10s., at $2\frac{1}{2}$ gu. and 8s. 9d. per cent.

Sol. 1.	$\frac{1}{20}$)	£322	10	0	Sol. 2. 5s.=$\frac{1}{4}$)	£322	10	0
		16	2	6		80	12	6
		338	12	6	2s.6d.=$\frac{1}{2}$ of 5s.=	40	6	3
				$2\frac{1}{2}$	1s.3d.=$\frac{1}{2}$ of 2s.6d.=	20	3	$1\frac{1}{2}$
	1,00)	8,46	11	3	100)	141	1	$10\frac{1}{2}$
Com. at $2\frac{1}{2}$ p. c.,		£8	9	$3\frac{3}{4}$	Com. at 8s.9d. p.c.,	£1	8	$2\frac{1}{2}$ $\frac{1}{2}$

1. Find the com. on £148, 2s. 6d., at $2\frac{1}{2}$, 3, $3\frac{1}{3}$, and $3\frac{1}{2}$ per cent.

2. Find the brok. on £152, 10s., at $\frac{1}{8}$, $\frac{3}{4}$, $\frac{5}{16}$, and $1\frac{1}{3}$ p. cent.

3. Find the com. on £500, at 2s. 3d., 3s. 9d., 4s. 3d., and 16s. 9d. per cent.

4. Find the brok. on £4216, 5s., at 3s., 2s. 6d., 3s. 4d., and 4s. per cent.

5. Find the com. on £2850, at $1\frac{1}{2}$ gu., $1\frac{3}{4}$ gu., $1\frac{3}{8}$ gu., and $2\frac{1}{3}$ gu. per cent.

6. Find the brok. on £375, 17s. 6d., at 3s. 9d., 5s. 3d., 11s. 3d., and 13s. 4d. per cent.

7. An agent sells for his employer goods to the amount of £1260, 17s. 6d.; the expenses attending the sale amount to £14, 2s. 6d.: what is his commission at $3\frac{3}{4}$ per cent.?

8. A banker discounts bills to the amount of £1252, 10s.; what is his commission at $\frac{1}{2}$ per cent.?

9. An agent charges $3\frac{3}{4}$ per cent. for commission and risk of bad debts; his sales during the year amount to £9275, 15s., and his losses to £150: required his net income.

10. A broker is authorized to purchase £1120, 10s. of 3 per cent. stock; what is his brokerage at $\frac{1}{8}$ per cent.?

11. An agent's annual sales amount to £12783, 13s. 4d.; his bad debts, valued at 12s. 6d. per £1, amount to £360, and his losses to £150: what is his income, if he is allowed 5 per cent. for commission and guarantee?

12. A factor collects the half-yearly rents of 3 farms; the annual rent of the 1st is £1250; of the 2d, £775; and of the 3d, £840; the charge for repairs on each is $\frac{3}{4}$, $1\frac{1}{2}$, and 2 per cent.: what sum will he remit to the landlord, his factorage being $3\frac{1}{2}$ per cent. upon the rental?

INTEREST.

INTEREST is the money paid for the loan of money.

The money lent is called the *principal*, and the sum of the principal and its interest is called the *amount*.

Interest is divided into *simple* and *compound*.

SIMPLE INTEREST.

CASE I. To find the interest for any number of years.

Ex. Required the interest of £375, 2s. 6d. for 4 years, at $3\frac{1}{3}$ per cent. Ans. £50, 0s. 4d.

SOL. Multiply the principal by the rate per cent. ($3\frac{1}{3}$), and by the number of years (4); and divide the product (£5001, 13s. 4d.) by 100.

	£375	2	6
			$3\frac{1}{3}$
	£1250	8	4
			4
100)	£50,01	13	4
Int.	£50	0	4

NOTE. For months take parts of a year, or multiply by them and divide by 12.

1. Find the interest of £1345, 10s. for 1 year, at 5, $5\frac{1}{8}$, $5\frac{1}{2}$, $4\frac{1}{5}$, $4\frac{1}{4}$, and $3\frac{3}{4}$ per cent.
2. Find the amount of £575, 13s. 4d. for 1 year, at $2\frac{1}{4}$, 3, $3\frac{1}{2}$, $4\frac{1}{5}$, 5, and $5\frac{5}{8}$ per cent.
3. Find the interest of £1200, 13s. 4d. for 5 years and 6 years, at $2\frac{1}{2}$, $3\frac{1}{4}$, and $4\frac{1}{4}$ per cent.
4. Find the amount of £150, 17s. 6d. for $6\frac{2}{3}$ yrs. and $7\frac{1}{2}$ yrs., at $2\frac{1}{3}$, 3, and 5 per cent.
5. Required the interest of £1244, 15s. for 5 ye. 7 mo. and 4 ye. 5 mo., at $3\frac{1}{2}$, 4, and $5\frac{3}{4}$ per cent.
6. Borrowed £750, at $2\frac{1}{2}$ per cent.; what sum will be required to discharge the loan at the end of 5 ye. 8 mo.?

CASE II. To find the interest for any number of days.

Ex. Find the interest of £675, 10s. for 195 days, at 4 per cent. Ans. £14, 8s. $8\frac{1}{4}$d. $\frac{39}{365}$

SOL. Multiply the principal by twice the rate per cent. (8), and by the number of days (195); and divide the product by 73000 (*i. e.* $2 \times 365 \times 100$).

	£675	10	0
			8
	5404	0	0
		195	
73,000)	£1053780	0	0
	£14	8	$8\frac{1}{4}$ $\frac{39}{365}$

7. Required the interest of £677, 10s. 7½d. for 198 days and 364 days, at 2½, 3½, and 4½ per cent.

8. Find the amount of £1436, 14s. 7½d. for 1 ye. 95 da. and 2 ye. 5 da., at 2½, 3½, and 4½ per cent.

To divide by 73000.

Taking Ex. 2—To the pounds of the dividend add ⅛ of itself, $\frac{1}{10}$ of this third, and $\frac{1}{10}$ of the last; then point off 5 figures of a decimal from the right hand of the sum. This gives the interest too much, by about ¼d., for every £10 of interest.

⅛)	£1053780
$\frac{1}{10}$)	351260
$\frac{1}{10}$)	35126
	3513
£14, 8s. 8½d. =	£14·43679

9. Required the interest of £483, 12s. 6d. from Midsummer to Christmas, and from Christmas to Midsummer, at 2½, 4, and 5 per cent.

10. Lodged in the bank £748, 5s. on March 1st, find the amount of this on Dec. 31st, interest at 2½ per cent.

11. Borrowed £1051, 4s. on April 4th; ½ at 3½, and the rest at 3⅓ per cent.; what sum should be returned on Nov. 11th?

12. Find the interest of £210, 12s. 8½d. for 275 days, at 4½ and 4⅕ per cent.; and of £445, 18s. 2d. for 252 days, at 2½ and 3½ per cent.

13. Find the amount of £4482, 4s. from Feb. 23d to June 13th, at 3½, 4⅔, and 5¼ per cent.

14. What is the interest of £1005, 17s. 7d. from Jan. 1st to May 16th, and from April 7th to Dec. 15th, at 3½, 3⅓, and 4⅕ per cent.?

15. Borrowed £340, 19s. 5d. on Lammas-day at 4 per cent., and £361, 7s. at 4½ per cent. on Michaelmas-day; what sum will discharge the whole loan on Whitsunday following?

Case III. To find the interest when a debt is discharged by partial payments at short intervals of time.

Ex. Borrowed £750 on Jan. 1st, of which £200 was paid on March 4th, £250 on May 15th, and the balance on August 1st; what was then due, interest at 2½ per cent.?

Ans. £307, 10s.

Obs. From Jan. 1st to March 4th is 62 days, Mar. 4th to May 15th is 72 days, and from May 15th to Aug. 1st is 78 days.

The *balances* are multiplied by the respective days.

Jan.	1.	Borrowed £750 × 62 =	46500
Mar.	4.	Paid 200	
		Balance 550 × 72 =	39600
May	15.	Paid 250	
		Balance 300 × 78 =	23400
			£109500
		(Mult. by $2\frac{1}{2} \times 2 =$)	5
		Divide by 73000)	£547500
			£7, 10s.
		Balance as above	300
Aug.	1.	Amount due	£307, 10s.

16. A bill of £960 was due Jan. 4th, of which £300 was paid on April 9th, £260 on July 11th, £200 on Nov. 11th, and the balance on Dec. 31st; what was then due, interest at 3 per cent.?

17. Lodged in the bank £1500 on May 13th, and drew £300 on July 11th, £400 on Oct. 1st, £350 on Dec. 14th, £200 on March 29th, and the balance, along with the interest, on June 9th; what was then drawn, interest at $2\frac{1}{4}$ per cent.?

18. Borrowed £1050 on March 9th, of which $\frac{1}{3}$ was paid on June 14th, £200 on Sept. 23d, $\frac{2}{5}$ of the remainder on Nov. 29th, and the balance on Feb. 11th; what was then paid, interest at $3\frac{1}{2}$ per cent.?

19. Lent, Jan. 15th, £1320, and received ·25 of it on March 31st, £400 on June 18th, ·5 of the remainder on Aug. 19th, £100 on Dec. 30th, and the balance on March 1st; what was then received, interest at $3\frac{3}{4}$ per cent.?

CASE IV. To calculate interest on Accounts-Current.

An Account-Current is a statement of the mercantile transactions of two persons when immediate payments are not made. It is written on two pages marked Dr. and Cr.; the Dr. or left-hand side containing all sums *paid by* the person furnishing the account; the Cr. or right-hand side those *paid to* him.

Ex. Required the interest on the following Account-Current between March 2d and Nov. 11th, interest at $3\frac{1}{2}$ per cent.

Dr. Wilson & Co. in Account-Current with Murray & Co. *Cr.*

Mar. 2.	To Cash,	£550	0	0	April 14.	By Cash,	£400	0	0
June 30.	" Do. .	320	0	0	May 17.	" Do. .	350	0	0
Sept. 15.	" Do. .	470	0	0	July 31.	" Do. .	425	0	0
Nov. 11.	" Int. .	1	16	$2\frac{3}{4}$	Nov. 11.	" Bal. .	166	16	$2\frac{3}{4}$
		£1341	16	$2\frac{3}{4}$			£1341	16	$2\frac{3}{4}$
Nov. 11.	To Bal.	£166	16	$2\frac{3}{4}$					

Dr.	da.	Prod.	Cr.	da.	Prod.
Mar. 2.	£550 × 254 =	139700	April 14.	£400 × 211 =	84400
June 30.	320 × 134 =	42880	May 17.	350 × 178 =	62300
Sept. 15.	470 × 57 =	26790	July 31.	425 × 103 =	43775
		209370			190475
		190475			
		£18895 × 7			
		73000) £132265			
		Interest = £1, 16s. $2\frac{3}{4}$d.			

Sol. Multiply each sum by the number of days between the date opposite to it and the last date (Nov. 11). Add the Dr. and Cr. products separately, and multiply the sum of each by twice its respective rate per cent.; subtract their products, and divide by 73000 for the interest which is entered on the Dr. or Cr. side of the Account, "To or By Interest;" as the Dr. or Cr. products, after multiplying by twice the rates, is the greater. Then add each side of the Account, and write the difference on the less side, with the words "To or By Balance."

20. Find the interest, at 3 per cent., on the following Account-Current from March 2d to Oct. 28th, 1871.

Dr. J. Brown in Account-Current with A. Anderson, *Cr.*

Mar. 2.	To Cash, . .	£750	April 17.	By Cash, . .	£640
June 3.	" Do.	240	May 30.	" Do. . . .	550
Aug. 30.	" Do.	560	July 18.	" Do. . . .	310

21. Required the interest on the following Account-Current, at 4 per cent., to April 8th, 1871

Dr. R. Scott in Account-Current with Thos. Younger, *Cr.*

April 14.	To Goods, . .	£650	June 11.	By Goods, . .	£740
Aug. 12.	" Cash, . . .	400	Oct. 19.	" Cash, ...	625
Dec. 15.	" Do.	700	Feb. 14.	" Do.	300

22. Required the interest on the following Account-Current to Oct. 15th, allowing Smith 3½ per cent., and Weddell 3¼ per cent.

Dr. Jas. Smith in Account-Current with Henry Weddell, *Cr.*

June 3.	To Cash, . .	£700	Aug. 1.	By Cash, . .	£1050
Oct. 7.	" Do.	500	Dec. 12.	" Do.	600
Jan. 9.	" Do.	650	Mar. 15.	" Do.	450
May 29.	" Do.	420	July 30.	" Do.	160

23. Required the principal and interest on the following Account-Current to Nov. 29th, allowing Harrison 4 per cent., and Cochrane 4¼ per cent.

Dr. H. Harrison in Account-Current with John Cochrane, *Cr.*

July 4.	To Cash, . .	£600	Sept. 11.	By Cash, . .	£750
Nov. 11.	" Do.	240	Jan. 1.	" Do.	360
Mar. 2.	" Do.	400	May 9.	" Do.	250
July 12.	" Do.	300	Sept. 20.	" Do.	540

24. Required the principal and interest on the following Account-Current to Jan. 12th, allowing Henderson 2¼ per cent., and Clark 2½ per cent.

Dr. Henderson & Son in Account-Current with Jn. Clark, *Cr.*

Aug. 2.	To Cash, . .	£840	Oct. 17.	By Cash, . . .	£960
Dec. 11.	" Goods, . .	800	Feb. 3.	" Do.	750
April 9.	" Cash, . . .	700	June 9.	" Do.	900
Aug. 14.	" Goods, . .	840	Nov. 1.	" Goods, . . .	600

The following examples are solved by Simple and Compound Proportion:

25. In what time will the interest of £725, 16s. 8d. at 2½ per cent. pay a debt of £81, 13s. 1½d.?

26. How long must £532, 5s. 10d. be lent to amount to £548, 4s. 4d. at 3 per cent. per annum?

27. What sum will amount to £476, 9s. 5¾d. in 224 days, at 3¾ per cent. per annum?

28. In what time will £1825 amount to £1840, 18s. 6d. at 3¼ per cent.?

29. In what time will any sum of money double itself at 2½, 2¾, 3, 3½, 3¾, and 4 per cent.? and in what time would any sum of money treble itself at each of these rates?

30. At what rates per cent. will any sum of money double itself in 7½, 10, 11¼, 12½ 15, 16, 20, and 25 years?

31. How long must £1125 be lent to amount to £1188, 15s. at 4 per cent.?

DISCOUNT.

DISCOUNT is an allowance granted for discharging a debt before the period allowed for payment has expired.

The *present value* of a debt due at the end of a certain time is that sum the amount of which for the given time is equal to the sum due at the end of that time: Thus, the present value of £105, due 2 years hence, at $2\frac{1}{2}$ per cent., is £100; for the amount of £100, for 2 years, at $2\frac{1}{2}$ per cent., is £105; and the discount allowed for present payment is £105 — £100 = £5.

Ex. Find the present value of £913, 10s., due 6 months hence, at 3 per cent., and also the discount.

Ans. £900 and £13, 10s.

SOL. The interest on £100 for 6 months, at 3 per cent., is $3 \times \frac{6}{12} = £1\frac{1}{2}$, and the amount of £100 for that time is $£101\frac{1}{2}$. Then, by Proportion, $101\frac{1}{2} : 100 : : £913, 10s. : £900$ present value, and £913, 10s. — £900 = £13, 10s. is the discount, or by Proportion $£101\frac{1}{2} : £1\frac{1}{2} : : £913, 10s. : £13, 10s.$, discount as before.

1. What is the present value of £1158, 11s. 6d., due 4 months hence, at $2\frac{1}{2}$ per cent.?

2. What is the discount upon £345, 1s. $10\frac{1}{2}$d., due in 9 months, at 3 per cent.?

3. What sum will amount to £285, 4s. 4d. in 3 years, at 3 per cent.?

4. A debt of £188, 12s. $5\frac{1}{2}$d. is to be paid; £47, 16s. 4d. in 2 months, £89, 8s. $6\frac{1}{2}$d. in 3 months, and the rest in 4 months; what discount should be allowed for present payment of the whole, interest at 4 per cent.?

5. Required the present value of £527, 10s. 4d., due 219 days hence, at $3\frac{1}{2}$ per cent.

6. What is the difference between the interest of £608, 10s. 6d. for 146 days, and the discount upon it due in 146 days, interest at $2\frac{1}{2}$ per cent.?

7. Bought goods to the amount of £2400; $\frac{1}{3}$ due 1 month hence, $\frac{1}{8}$ due 2 months hence, $\frac{1}{4}$ due 4 months hence, and the rest due 6 months hence; what sum will be sufficient to pay the whole now, interest at 3 per cent.?

8. Required the discount on £373, 16s. $1\frac{1}{4}$d., due 3, 4, and 6 months hence, at 4 per cent.

9. I am offered a discount of £40 for present payment of £640 worth of goods to be paid 3 months hence; at what rate per cent. is the offer made?

10. The present value of £436, 5s. $4\frac{1}{2}$d. due a certain time hence, is £420, 10s.; required the time, interest at $2\frac{1}{2}$ per cent.

In discounting Bills, bankers find the interest on the amount for the time which the bill has to run for the discount; the difference between this discount and the amount is called the *net proceeds*.

In this country *three* days, called *Days of Grace*, more than the term of the bill are allowed.

Ex. Find the net proceeds of a bill of £572, 10s., dated April 8th, at 3 months, and discounted June 3d, at $3\frac{1}{2}$ per cent.

Here, 3 months from April 8th is July 8th, and adding 3 days of grace, the bill is due on July 11th; again from June 3d to July 11th is 38 days. Then the interest on the amount (£572, 10s.) for 38 days, at $3\frac{1}{2}$ per cent., viz. £2, 1s. 9d., is the discount, and the net proceeds is found by subtracting £2, 1s. 9d. from £572, 10s.

£572, 10s.
38
21755, 0s.
7
73,000)£152285, 0s.

Discount = £2, 1s. 9d
Amount = £572, 10s. 0d.
Net proceeds = £570, 8s. 3d.

The interest is calculated to the nearest penny.

Find the net proceeds of the following bills:

	Amount.	Date.	Term.	Discounted.	Rate.
11.	£672, 12s.	Jan. 4.	4 mo.	Mar. 5.	$2\frac{1}{2}$ per cent.
12.	743, 11s.	Feb. 9.	6 "	May 11.	3 " "
13.	897, 15s.	Mar. 11.	5 "	June 14.	$3\frac{1}{2}$ " "
14.	983, 4s.	May 12.	7 "	Aug. 17.	$3\frac{1}{4}$ " "
15.	1260, 14s.	June 15.	3 "	July 26.	4 " "
16.	1340, 17s.	Oct. 14.	5 "	Dec. 26.	$4\frac{1}{2}$ " "
17.	1572, 8s.	Apr. 10.	8 "	Sept. 30.	$4\frac{3}{4}$ " "
18.	2183, 16s.	Dec. 30.	7 "	Mar. 1.	$2\frac{3}{4}$ " "

Discounts on merchants' bills are generally calculated the same way as in Commission.

INSURANCE

Is a contract by which an individual or company, in consideration of a certain allowance called *premium*, agrees to repay the owners of the goods, or other property insured, any loss or damage which they may have sustained to the amount stated in the written agreement or *Policy* of *Insurance*.

The policy of insurance in this country must be written on Stamped Paper, the amount of which is called *Policy-duty*, and is always charged upon exact hundreds; thus, if the sum insured be £510 or £570, the duty is charged on £600.

The calculations are made the same way as in Commission and Brokerage.

Ex. 1. Find the insurance on £310 at 3s. 6d. per cent., and policy-duty 2s. 6d. per cent.

3s. 6d. per cent. on £310	=	£0, 10s. $10\frac{1}{8}$d.
2s. 6d. " " on 400	=	10
Sum required for insuring £310	=	£1, 0s. $10\frac{1}{8}$d.

1. What must be paid for insuring £920 at 3s. 6d., 4s., 5s. 6d., 6s. 3d., 12s. 3d., and 13s. 4d. per cent.?

2. What is the premium for insuring property to the amount of £3530 at $2\frac{1}{2}$, $3\frac{1}{4}$, $4\frac{1}{5}$, $5\frac{1}{10}$, $3\frac{1}{2}$ gu. and $3\frac{1}{3}$ gu. per cent.?

3. What must be paid for insuring £4350 at £$4\frac{1}{2}$, £2, 2s. 10d., £3, 1s. 6d., $2\frac{1}{2}$ gu., $3\frac{1}{4}$ gu., $3\frac{2}{3}$ gu. per cent., and policy 3s. per cent.?

4. What is the expense of insuring £12500 on the ship Isabella from Leith to Calcutta, at $2\frac{1}{2}$ gu. per cent., policy 2s. 6d. per cent., and commission $\frac{1}{2}$ per cent.?

5. Insured £12520 on a ship at 5 gu. per cent., and policy 3s. per cent.; she received damage to the extent of £3250; what sum will be recovered, allowing $1\frac{3}{4}$ per cent. discount on the loss?*

6. Insured £14350 on the ship Ohio from Leith to New Orleans at $4\frac{1}{2}$ gu. per cent., policy-duty 2s. 6d. per cent., and commission $\frac{1}{2}$ per cent.; she received damage to

* To find the sum recovered, from the amount of the damage, subtract the premium and other charges.

the amount of £2580; how much will be recovered, allowing $2\frac{1}{2}$ per cent. discount on the damage?

7. Insured £6750 on a ship at $7\frac{1}{2}$ gu. per cent., £10050 on the cargo at $3\frac{3}{4}$ gu. per cent. and £500, the net freight at 5 gu. per cent.; the policy-duty was $\frac{1}{8}$ per cent. and commission $\frac{1}{4}$ per cent.; required the whole expense of insurance.

Ex. 2. What sum must be insured to recover £7700 at $2\frac{1}{2}$ gu. per cent., policy 5s. per cent., and commission 17s. 6d. per cent., in case of total loss?

Sol. From £100 subtract | £100—(£2, 12s. 6d.+5s.+17s. 6d.)=£96, 5s. and £96, 5s. : £100 : : £7700 : : £8000 sum. the rate and other charges; then state, as the remainder (£96, 5s.) is to £100, so is the given sum (£7700) to the sum to be insured (£8000).

How much must be insured to recover in case of total loss,

8. £2365 at 5 gu. per cent., and policy 3s. per cent.?

9. £4459 at $1\frac{3}{4}$ gu. per cent., and policy 5s. per cent.?

10. £1384, 10s. on a single voyage at $6\frac{1}{2}$ gu. per cent., policy 5s. per cent., and commission $\frac{5}{8}$ per cent.?

11. What must be insured on a ship worth £6750, and the value of the cargo £15954, to cover the whole value; premium 8 gu. per cent., policy 5s. per cent., and commission $\frac{1}{4}$ per cent.; $3\frac{1}{2}$ per cent. to be returned if the ship sailed with convoy, which she did?

Ex. 3. How much must be insured on a voyage out and home to cover £9120, 5s. at $3\frac{3}{4}$ gu. per cent., policy 5s. per cent., and commission $\frac{5}{16}$ per cent.?

Here £100—(£3, 18s. 9d.+5s.+6s. 3d.)=£95, 10s.; hence by Comp. Proportion { £95$\frac{1}{2}$: £100 : : £9120, 5s. : £10000 sum. { 95$\frac{1}{2}$: 100

How much must be insured on a voyage out and home to cover,

12. £223729 at $4\frac{1}{2}$ gu. p. c., pol. 5s. p. c., & com. 8s. 6d. p. c.?

13. £145924 " $3\frac{2}{3}$ gu. " " 3s. " " 10s. "

14. £580326 " $5\frac{1}{8}$ gu. " " 5s. " " 13s. 6d. "

15. £157323 " $7\frac{1}{2}$ gu. " " 5s. " " 5s. 6d. "

16. Insured 250 hhds. sugar, at £24 per hhd., from Jamaica to Leith, at 10 gu. per cent.; policy-duty 5s. per cent., and commission $\frac{3}{4}$ per cent.; to return 5 per cent. if the ship sailed with convoy and arrived, which she did. on her arrival, however, it was found that 200 hhds. only were shipped: required the sum due to the insurers.

NOTE. The insurers charge $\frac{1}{2}$ per cent. on the value of the goods not shipped, in returning the premium upon them.

17. Insured 350 chests of tea, at £12, 10s. per chest, from Canton to Leith, at $9\frac{1}{2}$ gu. per cent.; policy-duty 5s. per cent., and commission 5s. 10d. per cent.; to return 4 per cent. if the ship sailed with convoy and arrived, which she did: on her arrival it was found that only 300 chests were shipped, and these were so much damaged that they sold only for £11, 10s. per chest; whereas, had they been undamaged, they would have brought £13, 16s.: how much is due by the underwriters?

STOCKS.

STOCK is the name given to the money borrowed by government to defray the expenses of the nation; it is also the term applied to the capital of any bank, railway, or trading company.

When £100 of stock is sold for £100 sterling, the price of stock is said to be at par; the price of stock, however, is continually fluctuating. When we see the 3 per cents. quoted at 93, it signifies that £93 sterling is the selling price of £100 stock, and that £3 is the annual dividend on £100 stock, or £93 sterling.

Stock is bought and sold through the agency of brokers, who charge usually $\frac{1}{8}$ per cent. on the amount of the *stock* for their trouble.

The following examples illustrate the several cases which are met with in stocks:

Ex. 1. How much 3 per cent. stock at 93 can be purchased for £3131, 7s. 9d.?

Here £93 : £3131, 7s. 9d. : : £100 : £3367, 1s. 8d. stock.

Ex. 2. How much will be received by selling £2150 Bank stock (7 per cent.) at £220$\frac{1}{8}$, and brokerage $\frac{1}{8}$ per cent.?

Here £220$\frac{1}{8}$ — $\frac{1}{8}$ = £220 sum received for £100 stock.
Hence £100 : £2150 : : £220 : £4730 sum received.

Ex. 3. What rate per cent. is derived from the 3 per cents. at £96? £96 : £100 sterling : : £3 : £3$\frac{1}{8}$ per cent.

Ex. 4. How much must be invested in Russian 5 per cents. at 104$\frac{1}{4}$ to produce an annual income of £300, allowing $\frac{1}{8}$ per cent. for brokerage? Here $104\frac{1}{4} + \frac{1}{8} = 104\frac{3}{8}$. Hence

£5 : £300 : : £104$\frac{3}{8}$: £6262, 10s. sum to be invested.

Ex. 5. At what rate should money be invested in the 4 per cents. to yield 3$\frac{1}{2}$ per cent. interest?

SOL. 3$\frac{1}{2}$: 4 : : £100 : £114$\frac{2}{7}$ per cent.

1. How much stock can be purchased for £68728, 0s. 0$\frac{1}{4}$d. in the 3 per cents. at 91$\frac{1}{2}$, 91$\frac{1}{4}$, 92, 92$\frac{1}{4}$, 93, 93$\frac{1}{3}$, 93$\frac{1}{2}$, and 93$\frac{1}{4}$ per cent.?

2. How much sterling money will be required to purchase £5750, 3 per cent. stock at 92$\frac{3}{4}$, 92$\frac{1}{4}$, 92$\frac{1}{2}$, 93, 93$\frac{1}{3}$, and 93$\frac{1}{4}$ per cent., including brokerage $\frac{1}{8}$ per cent.? (Here £100 stock will cost $\frac{1}{8}$ more than the prices given.)

3. Find the yearly income derived from investing £6012, 7s. 0$\frac{1}{4}$d. in the 4 per cents. at 84, 84$\frac{1}{2}$, 85, 85$\frac{3}{4}$, 88, and 92$\frac{1}{4}$.

4. What rate per cent. is derived from the Russian 4$\frac{1}{2}$ per cents. at 95, 95$\frac{1}{4}$, 95$\frac{1}{2}$, 96, 96$\frac{3}{4}$, and 99?

5. How much sterling must be invested in the 4 per cents. at 83$\frac{1}{4}$ to produce an annual income of £252, 10s.?

6. At what rate should money be invested in Bank stock to produce 3$\frac{1}{2}$, 3$\frac{3}{4}$, 4, 4$\frac{1}{4}$, 4$\frac{1}{2}$, and 5 per cent.?

7. What is the price of India stock (10$\frac{1}{2}$ per cent.), when £4752 can purchase £1728 stock?

8. What is the price of the 3 per cents., when £3412, 10s. invested in them produces £105 per annum?

9. If £8932 be invested in the 3$\frac{1}{4}$ per cents. at 101$\frac{1}{2}$, and sold out at 102$\frac{3}{4}$; what difference will it make in my income to reinvest the proceeds in Bank stock at 220?

10. When the 3 per cents. are at 93, India stock at 230, and Bank stock at 208; which is the preferable investment, including brokerage $\frac{1}{8}$ per cent.?

11. Invested £3196 in the 3 per cents. at 94, and was obliged to sell at 92$\frac{3}{4}$; what was the whole loss?

12. Invested £5194 in Danish 3 per cents. at 53, and sold out so as to gain £294; at what price was it sold?

13. Invested £3570 in Bank stock at 212$\frac{3}{8}$, and sold out at 228$\frac{1}{8}$; what is gained, allowing $\frac{1}{8}$ per cent. for brokerage?

14. How much is derived annually by investing £5590 in India stock at 215 per cent.?

15. A has £2400 in 3 per cents.; how much must he invest in $3\frac{1}{2}$ per cents. at 84 to have an income of £350?

16. At what rate must money be invested in Russian $4\frac{1}{2}$ per cents. to yield $3\frac{3}{4}$ per cent.?

17. If £2261 be invested in 3 per cents. at 84, and sold out at $85\frac{1}{4}$; what difference will it make in my income to reinvest the proceeds in Dutch 4 per cents. at 95?

18. How much 3 per cents. at $99\frac{3}{4}$ must be sold out to pay a debt of £931?

19. A father leaves his son $\frac{1}{3}$ of his fortune in 3 per cent. stock, $\frac{1}{5}$ in the $3\frac{1}{2}$ per cents., and the remainder £2100, in 4 per cent. stock; what is his annual income?

20. Invested £3683 in Russian $4\frac{1}{2}$ per cents. at $95\frac{1}{4}$, and sold out so as to gain £43·5; at what price was it sold?

EQUATION OF PAYMENTS

Is the method of finding the time when two or more debts due at different periods may be discharged at one payment without loss to either party.

Ex. Find the time for discharging at one payment £300 due in 3 mo., £200 in $4\frac{1}{2}$ mo., and £400 due in 6 mo.

Sol. Multiply each sum by its respective time (3×300, &c.); then divide the sum of the products (4200) by the sum of the debts (900).

$3 \times 300 = 900$
$4\frac{1}{2} \times 200 = 900$
$6 \times 400 = 2400$
$900 \overline{)4200}$
Ans. $4\frac{2}{3}$ mo.

Find the time for discharging at one payment,

1. £40 due in 3 mo., £45 in 4 mo., and £55 in 6 mo.

2. £110 due in 72 da., £140 in 84 da., £200 in 96 da., and £240 in 108 days.

3. £300 due in 210 da., £420 in 340, £500 in 365 da.

4. A debt, $\frac{1}{6}$ of which is due in 6 mo., $\frac{1}{5}$ in 7 mo., $\frac{1}{3}$ in 9 mo., and the remainder in 10 months.

5. A debt, $\frac{1}{2}$ of which is due on Christmas-day, $\frac{1}{4}$ on Whitsunday, $\frac{1}{3}$ on Nov. 11, and the rest on Jan. 1.

6. A debt, $\frac{1}{5}$ of which is due on March 14th, and $\frac{1}{3}$ on the 14th of each succeeding month.

The following exercises may be solved in a similar manner:

What is the average price per qr. of,

7. 40 qrs. wheat at 60s. 6d. per quarter, 20 qrs. at 65s., 30 qrs. at 75s. 6d., and 60 qrs. at 80s.?

8. 12 qrs. barley at 42s. per qr., 18 at 45s., 20 at 39s., 24 at 36s. 6d., 30 at 45s., and 36 qrs. at 43s. 4d.?

9. 10 qrs. oats at 25s. per qr., 20 qrs. at 23s. 6d., 25 qrs. at 26s., 30 qrs. at 26s. 6d., and 45 qrs. at 27s.?

10. A wine-merchant mixes 5 gals. sherry at 28s. per gal., with 8 gals. at 30s. 9d., 10 at 36s., 12 at 42s. 8d., and 16 at 42s. 6d.; what is the average price per gal.?

11. A grocer mixes 12 lbs. tea at 3s. 4d. with 42 lbs. at 3s. 8d., 25 lbs. at 4s., 28 lbs. at 4s. 3d., and 30 lbs. at 4s. 6d.; what should the selling price per lb. of the mixture be to gain £4, 11s. 4d. upon the whole?

12. 8 oz. of gold, 24 carats fine, are melted with 16 oz. 23 carats fine, 18 oz. 21$\frac{2}{3}$ carats fine, and 20 oz. 18 carats fine; what is the average fineness of the mixture per oz.?

DISTRIBUTIVE PROPORTION

Is the method of dividing a number into parts proportional to as many given numbers. This rule is employed to divide the gain or loss of a company in proportion to the shares or stocks of each partner, and is then termed *Fellowship* or *Partnership*, which is either *Simple* or *Compound:* Simple Fellowship, when each partner's gain is proportional to his stock only; Compound Fellowship, when each partner's gain is proportional to his stock and the time of its being employed.

SIMPLE FELLOWSHIP.

Ex. Three merchants, A, B, and C, in company, gain £420; A's stock is £500, B's £400, and C's £300: required each man's share of the gain.

Sol. Add the stocks; then state as the sum (£1200) is to each partner's stock, so is the gain (£420) to each partner's gain.

£500 + £400 + £300 = £1200

£1200 : £500 :: £420 : £175 A's share.
1200 : 400 :: 420 : 140 B's "
1200 : 300 :: 420 : 105 C's "

Whole gain, £420

1. Divide 7020 into 3 parts proportional (1) to the numbers 55, 65, and 75, and (2) to the numbers 3, 4, and 5.

2. Three merchants, X, Y, and Z, gain by trade £225: X's stock is £425, Y's £350, and Z's £225: find each man's share of the gain.

3. A bankrupt owes £1470; A's claim is £350, 17s. 6d., B's £415, 8s. 9d., C's £420, 16s. 3d., and D's the rest; his effects amount to £980: what will each receive?

4. Divide 4428 into 3 parts proportional (1) to the numbers 2, 3, and 7, and (2) to the fractions $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{7}$.

5. A tax of £2997 is to be raised from 4 towns; the number of inhabitants in each is respectively 2100, 2400, 3000, and 3600: how much should each town pay?

6. Three graziers, L, M, and N, rent a park for £104, 7s. 6d.; L puts in 12 oxen and 8 horses, M 8 oxen and 12 horses, and N 10 oxen and 10 horses; how much ought each to pay, if 2 oxen eat as much as 3 horses?

7. Gunpowder consists of 74·8 parts of nitre, 13·3 of charcoal, and 11·9 of sulphur; how much of each will be required to make 214 cwt. 32 lbs. of gunpowder?

8. Gun-metal consists of 100 parts of copper and 11 of tin; how much of each of these is there in a brass-gun which weighs 19 cwt. 3 qrs. 8 lbs.?

9. Divide £1620, 15s. among D, F, and E, giving D 6 as often as F 5, and E 4 as often as F 5.

10. A pound troy of sterling silver consists of 37 parts of pure silver and 3 parts of alloy, and is coined into 66s.; how much of each is in 231s.?

11. A pound troy of sterling gold consists of 22 carats of pure gold and 2 carats of alloy, and is coined into £46·725: what quantity of each is there in £700, 17s. 6d.?

12. 37 ac. 3 ro. 2 per. of ground is to be divided among three persons, A, B, and C, in proportion to their estates; A's being worth £560 a-year, B's £640, and C's £700: what part should each receive?

13. Four companies of 60, 56, 52, and 36 men, require to furnish 51 men daily for a particular duty, in proportion to their strength; how many must each furnish?

14. A gentleman hired a carriage for 40 miles for £5, 5s.; at the 10th milestone he admits 3 others, and at the 15th milestone other two: what should each pay?

COMPOUND FELLOWSHIP.

Ex. A and B enter into partnership; A contributes £500 for 5 months, and B £630 for 10 months; they gained £572: what share of the gain should each receive?

Sol. Mult. each partner's stock by the time it continues, then state as the sum of the products (8800) is to each particular product (2500 and 6300), so is the whole gain (572) to each partner's gain.

$500 \times 5 = 2500$
$630 \times 10 = 6300$
Sum of prod. $= 8800$
8800 : 2500 : : £572 : £162, 10s. = A.
8800 : 6300 : : 572 : 409, 10s. = B.
Whole gain, £572

15. L and M enter into partnership; L advances £525 for 6 months, and M £375 for 8 months; they gain £221, 8s.: what is the share of each?

16. A, B, and C, engage in trade; A's stock of £1200 continues for 8 months, B's of £1575 for 10 months, and C's of £1455 for 12 months; they gain £998, 18s.: what is each man's share?

17. X, Y, and Z, rent a grass-park for £39, 19s.; X puts in 12 oxen for 4 months, Y 15 for 6 months, and Z 18 for 8 months: what part of the rent should each pay?

18. E, F, and G, enter into company; E advances £1200 at the first, after 3 mo. F advances £1400, and after 5 mo. G advances £1600; the whole gain during 12 mo. was £573: required each man's share.

19. A and B engage in trade for 12 months; A advances at first £1200, and after 7 mo. withdraws £500; and B advances at first £800, and after 5 mo. £400 more; they gain £2004, 15s.: how much of it belongs to each?

20. The wages of A and B for 4 weeks amount to £12, 19s.; A works 9 hours a-day for $\frac{2}{3}$ of the time, and $10\frac{1}{2}$ ho. a-day for the rest of the time; while B is idle one day a-week, and works 11 ho. a-day the rest of the week: how much of the wages should each receive?

21. A, B, and C, rent a grass-park for 14 months at a rent of £97; A put in 20 oxen, and paid £30; B put in 25 oxen, and paid £40; and C put in 36 oxen, and paid the remainder: how long should each hold the park?

NOTE. Each party's proportional is here found by dividing the sum which he paid by the number of oxen he put into the park; thus, A's propor. is here $30 \div 20 = 1\frac{1}{2}$, &c.

22. Four graziers rented a field for 9 mo. at a rent of £80; A put in 120 sheep, and paid £14; B 30 oxen, and paid £24; C 180 sheep, and paid £18; and D 36 oxen, and paid the remainder: how long should each man retain the field, if 5 sheep eat as much as an ox?

23. A common, consisting of 506 ac. 23 per., is to be divided among 4 persons, A, B, C, and D, whose estates on which their claims are founded are respectively £8000, £7500, £6400, and £6000 yearly, while the value of the land allotted to each is 64s., 60s., 50s., and 48s. per acre: what quantity of the land should each receive?

24. The gain of three merchants was £802, 10s., of which A's share was £360, B's £262, 10s., and C's the remainder; now A's stock of £4000 continued 6 mo., B's 5 mo., and C's 4 mo.: what was the stock of each?

PROFIT AND LOSS

Is that branch of Arithmetic which treats of the gains and losses of merchants, and which enables them to fix the prices of their goods so as to gain or lose so much per cent. upon them.

The price at which goods are bought is called the *prime cost*, that at which they are sold the *selling price*; when the selling price is greater than the prime cost, the difference is called *gain*, otherwise it is called *loss*.

The calculations are made by means of the Compound Rules, Practice and Simple & Compound Proportion.

Ex. 1. Bought tea at £21 per cwt., and sold it at 4s. 10½d. per lb.; what was the gain or loss per cwt. and per lb.?

Obs. The S. P. being greater than the P. C. per cwt., the difference (£6, 6s.) is the gain per cwt., from which the gain per lb. is found by dividing by 112.

S. P. of 112 lbs. at 4/10½ = £27,6s.
Prime cost of do. = 21
Gain per cwt. = £6, 6s.
£6, 6s. ÷ 112 = 1/1½ gain per lb.

Ex. 2. Bought tea at 3/9 per lb.; at what price should it be sold per lb. to gain 10 per cent.? Obs. £100 worth is sold for £110; hence £100 : £110 : : 3/9 : 4/1½ S. P. per lb.

Ex. 3. Bought tea at 3/9 per lb., and sold it at 4/1½; what was the gain per cent.? Obs. 4/1½—3/9=4½d. is the gain on 3/9; hence 3/9 : 4½d. : : £100 : £10 the gain per cent.

Ex. 4. Gained 10 per cent. by selling tea at 4/1½ per lb.; what was the P. C. per lb.? Sol. £110 : £100 : : 4/1½ : 3/9 P. C. per lb.

Ex. 5. Bought sugar at 37/6 per cwt.; at what price should it be sold to lose 8 per cent.? Obs. £100 worth is sold for £92; hence £100 : £92 : : 37/6 : 34/6 S. P. per cwt.

Ex. 6. Gained 7½ per cent. by selling coffee at 1/9½ per lb.; what is gained or lost per cent. by selling it at 1/10 per lb.? Sol. 1/9½ : 1/10 : : 107½ : 110, & 110—100=£10 per cent. gain.

Ex. 7. Bought goods at 15/3 and 4 months' credit, interest at 5 per cent.; at what rate should they be sold to gain 6 per cent., and allow a discount of 4 per cent.?

For the 4 months' cred. 101⅔ : 100 : : 183d. : 16/6¾ S. P.
" the gain . . . 100 : 106
" the discount . . 96 : 100

1. Bought 3 cwt. 3 qrs. 14 lbs. of tea at 3s. 9d. per lb. and sold it at £23, 11s. 4d. per cwt.; what was the gain per lb., per cwt., and on the whole?

2. Bought 4 casks sugar, each 3 cwt. 2 qrs. 21 lbs., at 5d. per lb.; what should the whole be sold for to gain 14s. per cwt?

3. Sold 143 yds. at 10s. 3d. per yd. and gained £13, 8s. 1½d.; what was the P. C. of 1 yd. and of the whole?

4. Bought muslin at 1s. 4½d. per yd.; how should it be sold to gain 7½ per cent.?

5. Bought soap at 4½d. per lb., and sold it at 5¾d.; how many lbs. must be sold to gain 13s. 9d.?

6. Sold 326 dozen wine at 31s. 6d. per doz. and gained £24, 9s.; what was the P. C. of 1 doz. and of the whole?

7. How much per cent. is gained by selling 1s. worth of goods for 1s. 1½d.?

8. Bought goods at £3, 6s. 8d.; how should they be rated to gain 4 p. cent., and allow the purchaser a discount of 5 p. cent.?

9. Bought sago at 70s. per cwt., and sold it at 73s. 6d.; what was the gain per cent.?

10. Gained 3⅓ per cent. by selling 126 yds. of cambric for £48, 16s. 6d.; what was the P. C. per yd. and of the whole?

11. Bought linen at 3s. 2d. per English ell, and sold it at the same per yd.; what was the gain or loss per cent.?

12. At what price should a yard of gingham which cost 1s. 5d. a-yard, be sold to gain 15s. 8¾d. on 151 yds.?

13. Lost 4⅘ per cent. by selling goods at £72, 11s. 3d.; what was their prime cost?

14. Gained 10 per cent. by selling coffee at £10, 10s. 10d. per cwt.; what was the prime cost per cwt. and per ton?

15. Bought 4 cwt. 3 qrs. 21 lbs. of raisins at 98s. per cwt.; how much per cent. was gained by selling the whole for £28, 2s. 10½d., the expenses of the sale being 16s. 5½d.?

16. Gained 3¼ per cent. by selling tea at 5s. 3d. per lb.; what was gained or lost per cent. by selling it at 5s. per lb.?

17. The prime cost of a book is 6s. 8d., the expense of selling is 3 per cent., and the gain is 12 per cent.; what is the selling price of 40 copies of the book?

18. Lost 3⅓ per cent. by selling butter at 16s. 3¾d. per stone; what was gained or lost per cent. by selling it at 1s. 4d. per lb.?

19. By selling 5 apples for 2d., 3 per cent. is gained; what is gained or lost per cent. by selling 18 for 6d.?

20. How much per cent. is 2s. 6d. profit per £1?

21. Bought 50 reams of paper at 18s. 6d. per ream; 3 per cent. was lost in selling: what was the whole loss?

22. A merchant bought 252 gallons of wine at 35s. 6d., but ⅛ of it being damaged, he sells it at a loss of 2½ per cent.; how must he rate the remainder per dozen to gain 5 per cent. on the whole?

23. Bought 4 casks of brandy, each 126 gallons, at 5s. 3d. a-bottle: now each cask leaked a gallon; how should the remainder be rated per gallon to gain 10 per cent. and allow a discount of 4 per cent.?

24. Bought a horse for £40, and sold it for £45, and 3 mo. credit, interest at 5 per cent.; required the gain.

25. Purchased 108 yds. of cloth at 18s. 9d. a-yd., but being damaged, I am willing to lose 5 per cent. in selling it; for how much must a yard and also the whole be sold?

26. A buys goods to the amount of £2025, and sells them to B for £2250, who in turn disposes of them to C at a profit of 4 per cent.; how much per cent. above their prime cost did C pay for them?

27. Bought 350 qrs. of wheat at £2, 12s. 6d. per qr., and sold ⅘ of them at a profit of 7½ per cent., and the rest at a loss of 2½ per cent.; what was gained upon the whole?

28. Purchased 4350 yds. of linen at 2s. 7½d. per yd., and sold ½ of the whole at 2s. 8½d., ⅖ at 2s. 9d., and the remainder at 10 per cent. profit; required the price of the remainder per yd., and the gain upon the whole.

29. By selling an article for £43, 10s. I lost 3⅓ per cent., and recovered the loss by selling another for £19, 10s.; what was the gain per cent. on the second article?

30. Bought sugar at 70s. per cwt.; how must I sell it per cwt. to gain 5 per cent., and allow the purchaser a discount of 4 per cent. and 4 months' credit, interest at 6 per cent.?

EXCHANGE

Is the method of valuing the money of one country in that of another, according to a certain rate.

The intrinsic value of the money of one country compared with that of another is called the Par of Exchange, and is determined by the weight and fineness of their coins.

The Course of Exchange at any time is the value of a fixed sum of the money of one country estimated in that of another: from various circumstances this is continually fluctuating. In some countries, money is distinguished into Banco and Currency, or into Specie and Paper money,—the former being more valuable than the latter by a certain rate per cent., which is called agio, discount or premium.

TABLES OF FOREIGN MONEYS.

France.—100 centimes=10 decimes=1 franc=9½d. ster. nearly. Par of exch. with London in gold, 25 francs 22 cents for £1 ster.; in silver, 25 francs 57 cents for £1 ster.

Holland and Belgium.—100 cents=20 stivers=1 florin = 1s. 8d. Par of exch. with London, 12 fl. 9 cents for £1.

Hamburg. — 192 pfennings = 16 schillings = 1 mark.
3 marks or 48 schillings = 1 rixdollar of exchange.
Par of exch. with London, 13 marks 10½ sch. for £1 ster. Money is here divided into banco and currency; the agio fluctuates between 20 and 25 per cent. Accounts are kept in currency, and exchanges are made in banco.

Portugal.—1000 reas=1 milrea=57½d. ster.; 400 reas = 1 crusado, and 1000000 reas = 1 conto = £239, 11s. 8d. ster. The discount on paper money is about 24 per cent.; exchange money is ½ in paper.

Russia.—100 copecs = 1 silver ruble = 37½d. ster
1 paper ruble = 10¾ ster. nearly.

Turkey.—40 paras = 1 piastre = 2⅜d. ster. Par of exch. with London, 100 piastres for £1 ster.

North America and West Indies.—£100 ster. at par = £111⅑ currency, or £100 currency = £90 ster. In Jamaica, £166⅔ currency = £100 ster.

United States.—100 cents=10 dimes=1 dol.=4s. 6d. ster. The par of exch. with London was originally 4⅔ dol. for £1 ster.; this value being now too small, a variable premium of 9 or 10 per cent. is added to the par value.

EAST INDIES.—192 pice = 16 annas = 1 sicca rupee = 2s. ster. nearly. 116 current rupees = 100 sicca rupees; 100000 rupees = a lac, and 10 million rupees = a crore.

The Calculations of Exchange are made by means of Proportion or Practice.

Ex. How much sterling money is equal to 750 copecs, exchange at 3s. 2¼d. per ruble?

SOL. 100 copecs : 750 copecs : : 3s. 2¼d : £1, 4s. 0¾d. ster.

1. How much sterling money in 11619 francs 30 cents, and in 21126 fr., exch. at 25 fr. 20 cents, and at 25 fr. 15 cents per £1 ster.?

2. In £420, 17s. 6d. and £580, 13s. 4d., how much French money, exch. at 25 fr. 20 cts., and 25 fr. 16 cts. per £1 ster.?

3. How much sterling money in 2145 marcs 15 sch. and in 5845 marcs 2 sch., exch. at 13 marcs 10 sch. and 13 marcs 8 sch. per £1 ster.?

4. In 456325 reas, and in 874625 reas, how much sterling, exch. at 56d. and at 57½d. per milrea?

5. In £212, 17s. 6d. and in £318, 2s. 6d., how much money of Holland, exch. at 12 fl. 8 cts. and at 12 fl. 9 cts. per £1 ster.?

6. How much Turkish money in £124, 5s. and in £340, 7s. 6d., exch. at 100 piastres, and at 103⅓ piastres per £1 ster.?

7. How much sterling money in 100 rubles 50 copecs, and in 1825 rubles 25 copecs, exch. at 10d. and 10½d. per ruble?

8. How much Hamburg currency in £360, and in £756, 13s. 4d., exch. at 13 marcs 8 sch. banco per £1 ster., agio 20 per cent., and at 13 mar. 10 sch. banco per £1 ster., agio 25 p. cent.?

9. How much sterling in 435 rupees 9 annas, and in 750 rup. 5 an. 8 pice, exch. at 2s. and 2s. 4d. per rupee?

10. How much United States currency in £250, 12s. 6d., and in £742, 17s. 6d., exch. at 4⅘ dollars per £1 ster., premium 8 and 10 per cent.?

11. How much sterling in £364, and in £1008 Canadian currency, exch. at 112 and 112½ per cent.?

12. How many current rupees in £376, 5s. and in £980, exch. at 2s. and 2s. 0½d. per sicca rupee?

13. How many rupees in 3452 dollars 80 cents, and in 5179 dol. 20 cents, exch. at ·415 dol. and ·416 dol. per rupee?

14. How much Hamburg currency in 706 francs 70 cents, and in 869 francs 50 cents, exch. at 100 marcs banco for 185 francs, agio 20 and 25 per cent.?

15. In 11880 milreas current, and in 10560 milreas current, how much ster. at 56d. per milrea, agio on paper money 20 per cent., and at 57¾d. per mil., agio on paper money 24 p. cent.?

DUODECIMALS

Is a method employed for multiplying feet and inches, &c. by feet and inches, &c.

A foot is divided into 12 inches, an inch into 12 parts or primes, and a prime into 12 seconds.

Ex. Multiply 6 ft. 3 in. 4 pts. by 7 ft. 2 in. 5 pts.

Sol. Arrange the numbers so that ft. may be below ft., in. below in., &c. Multiply by the ft. (7) in the multiplier as in Compound Multiplication; in the same way, multiply by the inches (2), but write the product one place nearer to the right hand; again, multiply by the parts (5), and write the product one place nearer to the right hand than the last; then add the separate products, carrying at 12.

6 ft.	3 in.	4 pts.		
7	2	5		
43	11	4		
	12	6	8	
		31	4	8
45	2	6	0	8

The answer is 45 s. ft., 2 twelfths of a s. ft., six 144ths of a s. ft. (*i. e.* 6 s. in.), and eight 144ths of a s. in.; now 2 twelfths = twenty-four 144ths; hence the answer may be written 45 s. ft. $(24+6\ {}^{8}_{144})$ s. in. = 45 s. f. 30 ${}^{8}_{144}$ s. in.

	ft.	in.	pt.		ft.	in.	pt.	ft.	in.	pt.	ft.	in.	pt.
1.	7	4	6	×	4	6	0	5	7	0	6	4	0
2.	10	5	3	×	3	5	0	4	3	0	10	5	0
3.	11	6	9	×	2	2	4	3	4	8	6	11	9
4.	12	8	4	×	3	6	9	7	3	6	9	10	3
5.	15	9	10	×	2	6	3	3	9	6	8	9	4
6.	16	11	2	×	3	9	6	6	8	9	10	11	3
7.	18	9	8	×	4	7	6	7	9	3	12	11	9
8.	21	10	7	×	6	3	5	9	5	4	11	3	6
9.	48	4	9	×	7	10	11	10	10	5	11	8	9
10.	56	3	6	×	14	6	4	15	9	2	17	6	6
11.	78	6	4	×	21	4	6	25	7	9	32	8	4
12.	99	11	8	×	36	10	3	49	11	9	54	7	6

Note. The area of a board is found by multiplying the length by the breadth, and the cubic content by multiplying the length, breadth, and thickness together.

13. Find the area of a board 4 feet 7 in. broad and 18 feet 9 in. long.

14. Find the area of a floor 12 ft. 6 in. 4 pts. by 18 ft. 6 in. 3 pts.

15. Find the area of a wall 17 ft. 4 in. 6 pts. long and 10 ft. 6 in. high.

16. Find the content of a cistern 7 ft. 4 in. long, 6 ft. 6 in.

deep, and 3 ft. 9 in. wide, and the number of gallons it would contain, each 277¼ c. in.

17. Find the cubic content of a block of marble 3 ft. 4 in. long, 2 ft. 10 in. wide, and 1 ft. 8 in. thick.

18. What is the length of a floor containing 44 s. yd. 96 s. in., whose breadth is 17 ft. 6 in.?

19. What length of carpet ¾ wide will cover a floor 22 ft. 6 in. long and 18 ft. 4 in. broad?

20. How much paper will be required to cover the walls of a room 27 ft. 8 in. long, 20 ft. 3 in. broad, and 12 ft. 6 in. high?

21. How many gallons of water must be run off from a cistern 8 ft. 6 in. long, 4 ft. 3 in. broad, and 6 ft. 8 in. deep, to make the surface sink a foot?

22. The paving of a court-yard cost £13, 4s. at 5s. 6d. per sq. yard; how broad is it, its length being 36 ft.?

INVOLUTION.

When a number is multiplied by itself any number of times, the process is called Involution, or the raising of Powers.

The original number is called the *root*, and the products *powers of the root*. Powers are often indicated by writing the number *once*, and a small figure (called the *index* or exponent of the power) a little to the right above the number, denoting how many times the number is to be taken as a factor. Thus,

$5^2 = 5 \times 5 = 25$, is the second power or square of 5.
$5^3 = 5 \times 5 \times 5 = 125$, is the third power or cube of 5.
$5^7 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 78125$, is the 7th power of 5.
$(\frac{3}{11})^5 = \frac{3 \times 3 \times 3 \times 3 \times 3}{11 \times 11 \times 11 \times 11 \times 11} = \frac{243}{161051}$ = the fifth power of $\frac{3}{11}$.

It may be noticed that $5^7 = 5^3 \times 5^4 = 125 \times 625 = 78125$ as above, *i. e.* the sum of the indices of powers of the same number, is the index of their product.

1. Find the cubes of 21, 33, 44, 67, 89, 11·9, 1·25, & 1·075.
2. Raise 24^6, 75^7, $1{\cdot}05^8$, $2{\cdot}15^5$, $\cdot 025^4$, and $1{\cdot}025^4$.
3. Raise $(\frac{3}{4})^3$, $(\frac{2}{5})^6$, $(\frac{2}{11})^7$, $(\frac{5}{13})^5$, $(\frac{7}{22})^4$, and $(\frac{4}{6})^8$.
4. The side of a square is 11 feet; find its area. (11^2 = area in s. feet.)
5. The side of a cube is 8 feet; find its content. (8^3 = content in c. feet.)

6. The side of a square court-yard is 22 ft. 6 in.; what is its area?

7. The side of a cubic cistern is 6 ft. 3 in.; what is its content?

8. A cubic foot of quartz weighs 2640 oz.; required the weight of a piece $4\frac{1}{2}$ in. in the side.

9. A cub. ft. of chalk weighs 2784 oz.; find the weight of a column 4 ft. 6 in. in the side.

10. A cub. ft. of water weighs 1000 oz.; what weight of water does a cubic cistern contain, whose side is 4 ft.?

11. How many dice, $\frac{1}{4}$ in. in the side, can be cut from a cubic piece of ivory 6 in. in the side?

12. How many squares, 3 in. in the side, can be cut from a square piece of pasteboard, whose side is 1 ft. 6 in.?

EVOLUTION

Is the method of extracting the root of a given power.

The *square root* is the method of extracting the second root of a given number, or of finding a number which, when raised to the second power, produces the given number; thus, the square root of $169 = 13$, for $13^2 = 169$; $\sqrt{\frac{9}{16}} = \frac{3}{4}$, for $\frac{3 \times 3}{4 \times 4} = \frac{9}{16}$.

The *cube root* is the method of extracting the third root of a given number, or of finding a number which, when raised to the third power, produces the given number; thus, the cube root of 1331 is 11, for $11^3 = 1331$; $\sqrt[3]{\frac{8}{27}} = \frac{2}{3}$, for $(\frac{2}{3})^3 = \frac{8}{27}$.

The sign $\sqrt{\ }$ placed before a number indicates that the square root of the number is to be taken; $\sqrt[3]{\ }$ placed before a number indicates that the cube root of the number is to be taken.

EXTRACTION OF THE SQUARE ROOT.

Ex. 1. Extract the square root of 9177·64. Ans. 95·8.

Sol. 1. Divide the given number into periods of two figures each, beginning at the *units'* figure.

2. Find the greatest square number in the first period (81), place its root (9) on the right of the given number, and subtract its square (81) from the

	91,77,·64(95·8 root.
	81
185	1077
5	925
1908	15264
	15264

first period (91); then to the remainder (10) annex the next period (77) for a resolvend (1077).

3. Write the double of the figure in the root for a partial divisor (18), and find how often it is contained in the resolvend (1077), omitting its right-hand figure (7); place the number of times (5) after the last figure of the root, and after the partial divisor (18), for a complete divisor (185); then multiply the complete divisor (185) by the figure last placed in the root (5), and subtract the product (925) from the resolvend (1077): to the remainder (152) annex the next period (64) for a new resolvend (15264).

4. To the last complete divisor (185) add its right-hand figure (5) for a new partial divisor, and so proceed until all the periods are brought down.

NOTE. When there is a remainder, after bringing down the last period, the root may be carried on decimally, by annexing periods of two ciphers each to the remainder.

The square root of a fraction is found by taking the square roots of its terms, if they are exact squares; if not, the fraction must be reduced to its equivalent decimal and its square root taken.

Extract the square roots of,

1. 5184, 6889, 9801, 14884, 17161, 22201, 297025, & 958441
2. 1100401, 1279161, 3786916, 4008004, 14356521, 60481729
3. 9862·4761, 99·980001, 56·725, 597·184, 674·85, & 948·625
4. $127\cdot\dot{3}$, $2479\cdot\dot{6}$, $118\cdot6\dot{3}$, $2459\cdot1\dot{4}7$, $4\cdot\dot{8}$, $5\cdot4\dot{2}4\dot{5}$, & $121\cdot4\dot{5}$

NOTE. The repeating figures of the decimals must be annexed in their order, in periods of two figures each.

5. 2, 3, 5, 7, 11, 12, 13, 17, and 19, each to 6 places of dec.
6. $\frac{49}{121}$, $\frac{64}{169}$, $2\frac{14}{25}$, $3\frac{13}{81}$, $1\frac{165}{196}$, $11\frac{1}{4}$, $14\frac{1}{9}$, $17\frac{6}{11}$, and $24\frac{5}{7}$.
7. 102030201, 10020210201, and 9018027018009.

Ex. 2. Find a mean proportional between 9 and 25. Ans. 15.

SOL. $\sqrt{9 \times 25} = \sqrt{225} = 15$, for 9 : 15 : : 15 : 25.

8. Find a mean proportional between 7 and 28, 15 and 135, 24 and 96, 18 and 288, 44 and 396, 19 and 46.

NOTE 1. The side of a square equal to any given area is the square root of that area.

2. Circles are to each other as the squares of their diameters.

3. In a right-angled triangle, the square of the hypothenuse, or side opposite the right angle, is equal to the sum of the squares of the other two sides.

9. Find the side of a square to contain 756 s. yds.

10. A gentleman's estate contains 4851 ac. 1 per., and he wishes another of equal area in the form of a square; required its side.

11. An army of 58564 men is to be formed into a square; how many men will the front contain?

12. The diameter of a circular pond is 540 ft.; what is the diameter of another 5 times as large?

13. Two ships sail from the same port, the one due east 180 mls., and the other due south 230 mls.; what is the distance between them?

14. A wall is 83 ft. high; what length of line will reach from the top to a point 67 feet from its base?

15. The wages of a certain number of men amounted to £561, 2s. 6d. at 2s. 6d. per day; they wrought as many days as there were men employed; what was the number of men?

16. A ladder 84 ft. long reaches from the edge of a ditch, 40 ft. wide, to the top of a wall on the opposite side of the ditch; what is the height of the wall?

17. A room is 48 ft. long, 36 ft. broad, and 16 ft. high; what is the length of each of the diagonals, and also the diagonal of the contained space?

18. What is the length and breadth of a parallelogram 4 times as long as it is broad, whose area is 3 ac.?

19. 79524 trees 16 ft. distant are planted in a square plantation; what is the length of the side?

20. A room as broad as it is high, and 32 ft. 6 in. long, contains 8937 c. ft. 1254 c. in.; find the height.

21. Arrange 24964 soldiers so that the number of men in rank may be 4 times the number in file.

22. The paving of a square enclosure cost £36, 9d. at 9d. per square yard; find the length of its side.

EXTRACTION OF THE CUBE ROOT.

Ex. Extract the cube root of 12·812904. Ans. 2·34.

Sol. 1. Divide the given number into periods of 3 figures each, beginning at the *units'* figure.

2. Find the greatest cube number in the first period (8), place its root (2) towards the right of the given number, and subtract its cube (8) from the first period (12); then to

$2^2 \times 300$	12·812,904 (2·34
1200	8 4
189 }	4812 63×3
1389 }	4167 6
9 }	645904 694×4
158700	645904
2776	
161476	

the remainder (4) annex the next period (812) for a resolvend (4812).

3. Write 300 times the square (4) of the figure in the root for a partial divisor (1200), and find how often it is contained in the resolvend (4812), then place the number of times (3) to the right of the figure in the root. Again to the former part of the root (2) add its double (4), to the sum (6) annex the trial figure (3), and multiply this number (63) by it (3); then add the product (189) to the partial divisor (1200) for a complete divisor (1389). Multiply this number (1389) by the figure last placed in the root (3), subtract the product (4167) from the resolvend (4812), and to the remainder (645) annex the next period (904) for a new resolvend (645904).

4. Place the square of the last figure in the root (9) below the last complete divisor (1389), add it (9) and the two lines above it (189 and 1389) together, and to the sum (1587) annex two ciphers for a new partial divisor (158700).

5. With this partial divisor find another figure (4), and place it in the root. To the number on the right (63), which was multiplied by the last figure of the root (3), add the double of that figure (6), annex to the sum (69) the new trial figure (4), then multiply the number thus found (694) by the trial figure (4), and add the product (2776) to the partial divisor (158700) for a complete divisor (161476), and so proceed till all the periods are brought down.

NOTE. When there is a remainder, after bringing down the last period, the root may be carried on decimally by annexing periods of three ciphers each to the remainder.

The cube root of a fraction is found by taking the cube roots of its terms when they are exact cubes; if not, the fraction must be reduced to its equivalent decimal and its cube root taken.

Extract the cube roots of,

1. 76765625, 143877824, 260917119, 485587656.
2. 997002999, 25128·011089, 143795466·919, 865·250742889.
3. 14·75, 118·62, 1·47825, $7\cdot\dot{6}$, $8\cdot\dot{3}\dot{6}$, $94\cdot\dot{8}$, to 6 places of dec.
4. 2, 4, 6, 7, 9, 12, 13, 16, to 6 places of decimals.
5. 1030607060301, 27054306369020601.
6. $\frac{125}{216}$, $\frac{1331}{1728}$, $3\frac{587}{729}$, $4\frac{3}{4}$, $5\frac{1}{2}$, ·000000405224.

NOTE. Similar solids are to each other as the cubes of their like dimensions.

7. The side of a cubic vessel is 10 in.; what should be the side of another to contain $\frac{1}{2}$ as much?

8. A block of granite is 6 ft. long, 5 ft. broad, and 4 ft. thick; what are the dimensions of another 3 times as heavy?

9. A stone is $8\frac{1}{2}$ ft. long, 7 ft. broad, and 5 ft. thick; what are the dimensions of another 9 times as large, and the side of a cube equal to both?

10. A cubic block of marble is 8 ft. in the side; what are the length and breadth of another 3 times the weight, whose thickness is 3 ft., and length twice the breadth?

11. The solid content of a cube is 407 ft. 1673 in.; how many square ft. are in its surface?

12. A vessel contains 411540 c. in., and has its sides in proportion to the numbers 3, 4, and 5; what are its sides?

COMPOUND INTEREST.

When a sum of money is put out to interest, and its amount at the end of a fixed period is considered the principal for the same period and at the same rate, the original sum is said to be improved at Compound Interest.

Case I. Given the principal, rate, and time; to find the amount and the interest.

Ex. 1. Find the compound interest of £100 for 3 years at 2 per cent. per annum, the interest payable yearly. Here 2 per cent. $= \frac{2}{100} = \frac{1}{50}$.

$\frac{1}{50}$)	£100	Principal for 1st year.
	2	Interest for 1st year.
$\frac{1}{50}$)	102	Principal for 2d year.
	2·04	Interest for 2d year.
$\frac{1}{50}$)	104·04	Principal for 3d year.
	2·0808	Interest for 3d year.
	106·1208	Amount at end of 3 years.
	100	Principal for 1st year.
£6, 2s. 5d. =	£6·1208	Interest for 3 years.

1. Find the compound interest of £875 for 5 years at 2, $2\frac{1}{2}$, 4, 5, $7\frac{1}{2}$, and 10 per cent., the interest payable yearly.

2. Required the amount of £450, 10s. for 6 years at 2, $2\frac{1}{2}$, 4, 5, $7\frac{1}{2}$, and 10 per cent. per annum, compound interest.

When the number of payments of interest is small, and the rate an aliquot part of 100, this method answers very well. The following method is suitable for all cases:

The amount of £1 for 4 years at 3 per cent., when the interest is payable yearly, is that power of the amount of £1 for 1 year (1·03) which corresponds with the number of years (4), *i.e.* $(1{\cdot}03)^4$; when the interest is payable half-yearly, the amount of £1 for half-a-year is 1·015, and for 4 years or 8 half-years it is $(1{\cdot}015)^8$; in the same way when the interest is payable quarterly the amount of £1 for 4 years is $(1{\cdot}0075)^{16}$.

Ex. 2. Find the compound interest of £375 for 5 years at 5 per cent., the int. payable (1) yearly, (2) half-yearly.

Sol. 1. Amt. of £1 for 5 ye. at 5 p. cent. $=(1{\cdot}05)^5=1{\cdot}276282$
Multiply by 375
Amt. of £375 for 5 ye. at 5 per cent. = £478·605750
Subtract 375
Compound interest of £375=£103,12s.1¼d.

Sol. 2.
Amt. of £1 for 5 ye., *i.e.* 10 h.-ye. at 5 p.c. $=(1{\cdot}025)^{10}=£1{\cdot}28008$
Multiply by 375
Amt. of £375 for 10 h.-ye. at 5 p. cent. per an. =£480·03000
Subtract 375
Compound interest of £375=£105,0s.7½d.

3. What is the compound interest of £750 for 5 years at 3 per cent., 8 years at 4 per cent., and 7 years at 3½ per cent., the interest payable yearly?

4. What is the amount of £350 for 6 years at 2 p. c., 8 ye. at 2½ p. c., and 10 ye. at 3¼ p. c. compound interest, the interest payable yearly?

5. What is the compound interest of £120, 10s. for 4 ye. at 2 p. c., 5 ye. at 4 p. c., and 6 ye. at 5 p. c., interest payable half-yearly?

6. What is the amount of £240, 12s. 6d. for 2 years at 3 p. c., 3 ye. at 4 p. c., and 2¾ ye. at 5 p. c. compound interest, the interest payable quarterly?

7. What is the compound interest of £375, 14s. for 3⅓ ye. at 3 p. c., 4 ye. at 2½ p. c., and 4⅓ ye. at 6 p. c., the interest payable three times yearly?

8. A merchant began business with £1000, which he increases every half-year by ⅛; what will his capital be at the end of 5½ years?

Case II. To find the interest on bonds when the intervals between the payments are great.

Ex. Lent on bond £1050 at 4 per cent., Aug. 12th, 1855; and received on Sept. 15th, 1856, £300; on Oct.

20th, 1869, £350: what was the balance due, including the interest on Dec. 15th, 1870? Ans. £502, 19s. 8¼d.

Aug. 12, 1867.	Lent at 4 per cent., . . .	£1050
	Interest on ditto for 399 days,	45·9123
	Amount,	1095·9123
Sept. 15, 1868.	Received in part, ...	300
	Balance,	795·9123
	Interest on ditto for 400 days,	34·8893
	Amount,	830·8016
Oct. 20, 1869.	Received in part, ...	350
	Balance,	480·8016
	Interest on ditto for 421 days,	22·1827
	Amount,	502·9843
Dec. 15, 1870.	Received in full, ...	502·9843

9. A bond of £975 became due on January 15th, 1866, of which was paid April 21st, 1867, £250; July 29th, 1868, £200; Oct. 16th, 1869, £300; and the balance on Dec. 17th, 1870: what was then paid, including interest at 4½ per cent.?

10. Lent on bond £1225, at 2½ per cent., on March 4th, 1864, and received £320 on June 17th, 1865; £250 on Aug. 7th, 1866, £300 on Nov. 12th, 1867; £200 on Jan. 13th, 1869; and the balance on April 19th, 1870: what was then due, including the interest?

11. Borrowed on bond, at 3 per cent., £875 on Jan. 4th, 1865, and paid £200 on March 7th, 1866; £150 on June 13th, 1867; £200 on Sept. 11th, 1868; £150 on Nov. 17th, 1869; and the balance on Jan. 4th, 1871: what was then paid, including the interest?

12. Borrowed, at 3½ per cent., £1500 on June 4th, 1865, of which was paid, Aug. 1st, 1866, £350; Oct. 9th, 1867, £250; Nov. 21st, 1868, £400; and the balance on Dec. 31st, 1869: what was then paid, including the interest?

MISCELLANEOUS QUESTIONS.

1. How many francs, each 9½d., are equal in value to 209 half-crowns?

2. If whisky at 14s. 6d., 15s. 6d., 16s., and 17s. a-gallon, be mixed in equal quantities; what should a gallon of the mixture be sold for to gain 5 per cent. and allow a discount of 6⅔ per cent.?

3. A cubic foot of water weighs 1000 oz.; how many tons of water will a cistern 16 ft. 6 in. long, 15 ft. 4 in. broad, and 5 ft. 6 in. deep contain?

4. Find the value of $\frac{5}{8}$ gui.; reduce 5s. 7½d. to the frac. of 9 gui., and 3 ml. 2 fur. to the frac. of 1 ml. 6 fur. 12 poles.

5. A ladder, 45 ft. long, reaches to a window 27 ft. from the ground on one side of a street, and, without moving the foot, it reaches to a window 36 ft. high on the other side; find the breadth of the street.

6. 248 trees are planted in the breadth of a plantation at a distance of 5 ft. 4 in. from each other; what is the breadth of the plantation, allowing the same distance between the trees and the fence on both sides?

7. If £435 gains £58, 14s. 6d. in 4½ years; what is the rate per cent.?

8. The side of a cubic piece of marble is 32 ft.; find the side of a piece 7½ times as large.

9. Find the value of a rectangular piece of ground 48 ft. 4 in. by 34 ft. 6 in., at 24s. per s. ft.

10. Exchanged 19 cwt. 2 qr. 12 lb. of coffee at £9, 6s. 8d. p. cwt. for sugar at 7½d. and tea at 4s. 6d. per lb.; there was 5 times as much sugar as tea: how much was there of each?

11. If 7 lb. sugar be equal to 3 of coffee, and 6 of coffee to 2½ of tea; how many lbs. tea are equal to 168 lbs. sugar?

12. A cask is $\frac{3}{4}$ full, and after 40 gals. were run off, it was $\frac{5}{12}$ full; how many gals. could the cask contain?

13. If a globe 9 in. diameter weighs 27 lbs.; what will a globe weigh whose diameter is 25 in.?

14. Purchased 1260 lbs. tea at 4s. per lb., but ⅛ of it being damaged, 25 per cent. was lost in selling it; the remainder was sold at 4s. 6d. per lb.: how much per cent. was gained at the latter price and on the whole?

15. In 1854, the number of births registered in England was 324069 males and 310336 females; how many males were born for 100 females?

16. What fraction multiplied by the square of 1½, and the product divided by the cube root of $\frac{1}{4}\frac{6}{3}$, produces 3?

17. Invested £10710 in new 2½ per cents at 74⅜; how much must I invest in 3 per cents at 90½ to produce an income of £500 yearly?

18. In 1801 the population of Scotland was 1608420, and in 1851 it was 2888742; what was the increase per cent. during that time?

19. What is the thickness of a solid foot of stone that is 9 ft. 4 in. long and 2 ft. 6 in. broad?

20. A certain number of persons were fined 5s. 6d. each, but 3 of them having no money, each of the others had to pay 1s. 10d. more than their fine; how many persons were there?

21. Reduce 14s. 11½d. to the dec. of £5, 19s. 6d., and $\frac{6}{11}$ of 2¾d. to the dec. of half-a-crown.

22. In 1855 the number of births registered in Scotland was 93498, of which 47872 were males, and 45626 females; what decimal of the whole were males and females?

23. Find the present value of £475, 15s. due 4 years hence, at 2½ per cent. simple interest.

24. A grocer buys sugar at 5d. and 7d. per lb. and mixes them in the proportion of 3 : 5; what will he gain per cent. by selling it at 7½d. per lb.?

25. A square contains exactly 2½ ac.; find its side.

26. In the Centigrade thermometer the freezing-point is zero, and the boiling-point 100°; in Fahrenheit's the freezing-point is 32° and the boiling-point 212°: what degree C. corresponds to 68° F., and what degree F. corresponds to 45° C.?

27. What is the shortest piece of cloth that shall at the same time be an exact number of yards, English ells, Flemish ells, and French ells?

28. A person spends £10, 4s. 2d. in 35 days, and he saves £93, 10s. 10d. yearly; what is his income?

29. $\frac{1}{8}$ of an army was killed in battle, $\frac{1}{20}$ was taken prisoners, $\frac{1}{10}$ died from sickness, $\frac{3}{16}$ was in hospital, and 31375 effective men remained; how many were there at first?

30. A person being asked his age, answered, if to my age you add $\frac{1}{5}$ and $\frac{1}{3}$ of it, the sum will be 59; what was his age?

31. The corn produced by a field was found to be 200 qrs. or $\frac{1}{4}$ more than what was sown; how much was sown?

32. Bought £126 worth of tea at 4s. 6d. per lb., some of which being damaged, I sold the remainder at 4s. 9d. per lb., which produced £106, 17s. 6d.; what quantity was damaged?

33. A gentleman gave to three persons £78, 6s. 6d.; the second received $\frac{2}{3}$ of the first, and the third $\frac{3}{4}$ of the second: what did each receive?

34. A person bought a horse, gig, and harness for £60; the horse cost 7 times as much as the harness, and the gig was $\frac{1}{2}$ the price of the horse and harness; what was the price of each?

35. What must be the depth of a cistern which is 6 ft. 3 in. long and 4 ft. 6 in. broad, to contain 481·665 gals. of water?

36. Light travels at the rate of 192000 miles per sec.; how long does it take to travel from the sun to the earth, a distance of 95 millions of miles?

DECIMAL COINAGE.

THE pupil, having worked the Elementary Exercises in Decimal Coinage, at the end of the "Lessons in Arithmetic," and also those given under Decimal Fractions (page 30), may now solve the following questions.

TABLE OF DECIMAL MONEY.

1 mil (m.)			$= £\frac{1}{1000} =$	$\frac{2}{5}$f.
10 mils =	1 cent (c.)		$= £\frac{1}{100} =$	$2\frac{2}{5}$d.
100 mils =	10 cents =	1 florin (fl.)	$= £\frac{1}{10} =$	2s.
1000 mils =	100 cents =	10 florins	$= £1 =$	20s.

Ex. 1. Reduce £12, 17s. 9d. from the present to the proposed system. Ans. £12·8875 = £12, 8 fl. 8 c. $7\frac{1}{2}$ m.

Here, by Case V. p. 32, £12, 17s. 9d. = £12·8875 = £12, 8fl. 8c. $7\frac{1}{2}$m.

Ex. 2. Reduce £7, 8 fl. 2 c. 5 m. from the proposed to the present system. Ans. £7, 16s. 6d.

Here, by Case VI. p. 32, £7, 8fl. 2c. 5m. = £7·825 = £7, 16s. 6d.

Reduce from the present to the proposed system,

1.	6s.	6d.	5.	14s.	$2\frac{1}{4}$d.	9.	£2,	8s.	9d.	13.	£12,	13s.	4d.
2.	7	3	6.	13	$7\frac{1}{2}$	10.	4	15	8	14.	15	16	8
3.	18	4	7.	15	$8\frac{1}{4}$	11.	7	6	8	15.	17	14	7
4.	19	7	8.	17	5	12.	9	10	10	16.	21	12	8

Reduce from the proposed to the present system,

17.	£·425	21.	£·763	25.	£4·6375	29.	£10·7750
18.	·675	22.	·574	26.	6·8125	30.	12·6666
19.	·850	23.	·235	27.	7·4025	31.	15·3333
20.	·925	24.	·075	28.	9·7875	32.	17·8166

33. A man earns £58, 7fl. 7c. 5m. per annum, his expenses are £49, 8fl. 9c. 7m.; how much does he save?

34. What is the value of 27oz. of silver at 2fl. 7c. 5m. per oz.?

35. A man's wages are £1, 2fl. 7c. 5m. weekly; how much do they amount to in a year?

36. What is the weekly rent of a house, when the yearly rent is £65, 1fl. 4m.?

37. If 35 quarters of oats cost £53, 3fl. 7c. 5m.; what is the rate per quarter?

38. A bankrupt who owed £3595, paid his creditors £2786, 1fl. 2c. 5m.; how much did he pay per £1?

39. If 15 gallons of whisky cost £13, 1fl. 2c. 5m.; what should be paid for a cask containing 125 gals.?

40. Find by practice the value of 17 cwt. 2 qrs. 14 lbs. of sugar at £2, 4fl. 5c. per cwt.

41. A man's wages are £50, 2fl. 2c. 5m. for 146 days; how much is this per annum?

42. What is the commission on £575, 2c. 5m. at 2 and $3\frac{1}{2}$ per cent.?

43. What is the brokerage on £796, 2fl. 5c. 6m. at $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{3}{8}$ per cent.?

44. How much should be paid for insuring £5750, 2fl. 5c. at 3 per cent., and policy 1fl. 2c. 5m. per cent.?

45. What is the interest on £487, 7fl. 5c. for 4 years, at $2\frac{1}{2}$ and 4 per cent.?

46. Find the amt. of £896, 5fl. for 3 years, at 2 and 5 p. c.

47. Find the interest on £228, 1fl. 2c. 5m. for 198 days, at 4 and $4\frac{1}{2}$ per cent.

48. What should £2851, 5fl. 6c. $2\frac{1}{2}$m. amount to in 1 year and 99 days, at 4 per cent.?

49. What sum will amount to £251, 8fl. 7c. 5m. in 4 months, at $2\frac{1}{2}$ per cent.?

50. Divide £153, 1fl. 4m. among 4 persons, so that $\frac{1}{2}$ the share of the first, $\frac{1}{3}$ of that of the second, $\frac{1}{4}$ of that of the third, and $\frac{1}{5}$ of that of the second may make up the same sum.

51. What is the rent of a farm of 525 ac. 3 ro. 25 per. at £3, 5fl. 2c. 8m. per acre?

52. A bill of £919, 8fl., dated Feb. 14, at 6 months, was discounted June 13, at $3\frac{1}{2}$ per cent.; what was the net proceeds, deducting commission $\frac{1}{2}$ per cent.?

53. If $7\frac{1}{2}$ per cent is gained by selling tea at £22, 5fl. 7c. 5m. per cwt.; what is gained or lost per cent. by selling it at £22, 8fl. 9c. per cwt.?

54. In what proportions should tea at 1fl. 2c. 5m., and 2fl. per lb. be mixed to reduce the price to 1fl. 7c. 5m. per lb.?

55. What part of £9, 7fl. 5c. is £8, 4c. $3\frac{3}{4}$m.?

56. In what time will the interest of £437, 6fl. 7c. 5m. pay a debt of £52, 5fl. 2c. 1m., at 4 per cent. per annum?

THE END.

EDINBURGH: PRINTED BY OLIVER AND BOYD.

EDUCATIONAL WORKS

PUBLISHED BY

OLIVER AND BOYD, EDINBURGH;

SOLD ALSO BY

SIMPKIN, MARSHALL, AND CO., LONDON.

A Specimen Copy of any work will be sent to Principals of Schools, post free, on receipt of one half the retail price in postage stamps.

OLIVER AND BOYD'S NEW CODE CLASS-BOOKS, page 4.

Writing, Arithmetic, etc.

Gaelic.

Mathematics, etc.

French.

Latin and Greek.

German.

Logic.

School Registers.

Geometrical Drawing.

Messrs Oliver and Boyd were awarded Medals for their Educational Works by Her Majesty's Commissioners of the London International Exhibition, and by the Jurors of the Paris Universal Exhibition.

EDUCATIONAL WORKS.

ENGLISH READING, GRAMMAR, ETC.

In the initiatory department of instruction a valuable series of works has been prepared by Dr M'Culloch, formerly Head Master of the Circus-Place School, Edinburgh, now Minister of the West Church, Greenock.

DR M'CULLOCH'S SERIES OF CLASS-BOOKS.

These Books are intended for the use of Schools where the general mental culture of the pupil, as well as his proficiency in the art of reading, is studiously and systematically aimed at.

They form, collectively, a progressional Series, so constructed and graduated as to conduct the pupil, by regular stages, from the elementary sounds of the language to its highest and most complex forms of speech; and each separate Book is also progressively arranged,—the lessons which are more easily read and understood always taking the lead, and preparing the way for those of greater difficulty.

The subject-matter of the Books is purposely miscellaneous. Yet it is always of a character to excite the interest and enlarge the knowledge of the reader. And with the design of more effectually promoting his mental growth and nurture, the various topics are introduced in an order conformable to that in which the chief faculties of the juvenile mind are usually developed.

That the moral feelings of the pupil may not be without their proper stimulus and nutriment, the lessons are pervaded throughout by the religious and Christian element.

DR M'CULLOCH'S READING-BOOKS FOR SCHOOLS.

FIRST READING-BOOK, ... 1½d.

Do. *Large Type Edition*, in two parts, price 2d. each.

Do. In a Series of Sheets for Hanging on the Wall, 1s.; or on Roller, 1s. 8d.

SECOND READING-BOOK, ... 3d.

THIRD READING-BOOK, containing simple Pieces in Prose and Verse, with Exercises. *Now Printed in Larger Type,* 10d.

FOURTH READING-BOOK, containing only Lessons likely to interest. With Synopsis of Spelling, . . . 1s. 6d.

SERIES OF LESSONS in Prose and Verse, ... 2s.

COURSE OF ELEMENTARY READING in Science and Literature, compiled from popular Writers, 39 Woodcuts, 3s.

MANUAL OF ENGLISH GRAMMAR, Philosophical and Practical; with Exercises; adapted to the Analytical mode of Tuition, ... 1s. 6d.

Oliver & Boyd's New Code Class-Books.

1.

STANDARD READING-BOOKS,

By JAMES COLVILLE, M.A., English Master, Glasgow Academy; late English Master, George Watson's College-Schools, Lauriston, Edinburgh, one of the Educational Institutions of the Merchant Company.

PRIMER: Being Spelling and Reading Lessons Introductory to Standard I. (*Illustrated.*) 36 pages. 1½d.

FIRST STANDARD READING-BOOK; with Easy Lessons in Script. (*Illustrated.*) 95 pages. 4d. in stiff wrapper, or 6d. cloth.

SECOND STANDARD READING-BOOK; with Dictation Exercises, partly in Script. (*Illustrated.*) 108 pages. 4d. in stiff wrapper, or 6d. cloth.

THIRD STANDARD READING-BOOK; with Dictation Exercises, partly in Script. 144 pages, strongly bound. 8d.

*** The **Fourth, Fifth,** and **Sixth Standard Reading-Books,** completing the Series, *will shortly be published.*

2.

ARITHMETIC,

By ALEX. TROTTER, Teacher of Mathematics, etc., Edinburgh; Author of "Arithmetic for Advanced Classes," etc.

PART I., embracing Standards 1 and 2. 36 pages. 2d.—*Answers,* 3d.
„ II., embracing Standards 3 and 4. 36 pages. 2d.—*Answers,* 3d.
„ III., embracing Standards 5 and 6.

3.

STANDARD GEOGRAPHIES,

By W. LAWSON, F.R.G.S., St Mark's College, Chelsea; Author of "Geography of the British Empire," etc.

GEOGRAPHICAL PRIMER, embracing an Outline of the Chief Divisions of the World. Adapted to Standard IV. 36 pages. 2d.

GEOGRAPHY of ENGLAND and WALES; with a Chapter on Railways. Adapted to Standard V. 36 pages. 2d.

GEOGRAPHY of SCOTLAND and IRELAND; with Notes on Railways. 36 pages. 2d.

GEOGRAPHY of EUROPE. Adapted to Standard VI. 48 pp. 3d.

4.

LAWSON'S ELEMENTS OF PHYSICAL GEOGRAPHY.
Adapted to the Requirements of the New Code. 90 pages. 6d.

The following Works, included in the present Catalogue, will also be found adapted to the Requirements of the New Code:—

REID'S RUDIMENTS OF MODERN GEOGRAPHY, with 36 pages of information on Counties and Railways, . *Catalogue, p.* 10
DOUGLAS'S PROGRESSIVE GEOGRAPHY, *a New Work*, . . 10
LENNIE'S GRAMMAR, with Analysis of Sentences, . . . 6
DOUGLAS'S GRAMMAR, with Analysis of Sentences, . . . 5
REID'S GRAMMAR, with Analysis of Sentences, ... 7
HUNTER'S SCHOOL SONGS, with Music, ... 17

THE PRINCIPLES OF ENGLISH GRAMMAR; with a Series of Progressive Exercises, and a Supplementary Treatise on Analysis of Sentences. By Dr JAMES DOUGLAS, lately Teacher of English, Great King Street, Edinburgh. 1s. 6d.

DOUGLAS'S INITIATORY GRAMMAR, for JUNIOR CLASSES. Printed in larger type, and containing a Supplementary Treatise on Analysis of Sentences. 6d.

DOUGLAS'S PROGRESSIVE ENGLISH READER. A New Series of English Reading-Books. *The Earlier Books are illustrated with numerous Engravings.*

FIRST BOOK. 2d.	THIRD BOOK. 1s.	FIFTH BOOK. 2s.
SECOND BOOK. 4d.	FOURTH BOOK. 1s. 6d.	SIXTH BOOK. 2s. 6d.

DOUGLAS'S SELECTIONS FOR RECITATION, with Introductory and Explanatory Notes; for Schools. 1s. 6d.

DOUGLAS'S SPELLING AND DICTATION EXERCISES. 144 pages, price 1s.

Athenæum.—"A good practical book, from which correct spelling and pronunciation may be acquired."

DOUGLAS'S ENGLISH ETYMOLOGY: A Text-Book of Derivatives, with numerous Exercises. 168 pages, price 2s.

Scotsman.—"An especially excellent book of derivatives."

SHAKESPEARE'S KING RICHARD II. With Historical and Critical Introductions; Grammatical, Philological, and other Notes, etc. Adapted for Training Colleges. By Rev. Canon ROBINSON, M.A., late Principal of the Diocesan Training College, York. 2s.

WORDSWORTH'S EXCURSION. THE WANDERER. With Notes to aid in Analysis and Paraphrasing. By Canon ROBINSON. 8d.

LENNIE'S PRINCIPLES OF ENGLISH GRAMMAR. Comprising the Substance of all the most approved English Grammars, briefly defined, and neatly arranged; with Copious Exercises in Parsing and Syntax. *New Edition;* with the author's latest improvements, and an Appendix in which Analysis of Sentences is fully treated. 1s. 6d.

THE AUTHOR'S KEY, containing, besides Additional Exercises in Parsing and Syntax, many useful Critical Remarks, Hints, and Observations, and *explicit and detailed instructions as to the best method of teaching Grammar.* 3s. 6d.

ANALYSIS OF SENTENCES: Being the Appendix to Lennie's Grammar adapted for General Use. Price 3d.—KEY, 6d.

OUTLINES OF ENGLISH GRAMMAR AND ANALYSIS, for ELEMENTARY SCHOOLS, with EXERCISES. By WALTER SCOTT DALGLEISH, M.A. Edin., lately one of the Masters in the London International College. 8d. KEY, 1s.

DALGLEISH'S PROGRESSIVE ENGLISH GRAMMAR, with EXERCISES. 2s. KEY, 2s. 6d.

From Dr JOSEPH BOSWORTH, *Professor of Anglo-Saxon in the University of Oxford; Author of the Anglo-Saxon Dictionary, etc., etc.*

"Quite a practical work, and contains a vast quantity of important information, well arranged, and brought up to the present improved state of philology. I have never seen so much matter brought together in so short a space."

DALGLEISH'S GRAMMATICAL ANALYSIS, with PROGRESSIVE EXERCISES. 9d. KEY, 2s.

DALGLEISH'S OUTLINES OF ENGLISH COMPOSITION, for ELEMENTARY SCHOOLS, with EXERCISES. 6d. KEY, 4d.

DALGLEISH'S INTRODUCTORY TEXT-BOOK OF ENGLISH COMPOSITION, based on GRAMMATICAL SYNTHESIS; containing Sentences, Paragraphs, and Short Essays. 1s.

DALGLEISH'S ADVANCED TEXT-BOOK OF ENGLISH COMPOSITION, treating of Style, Prose Themes, and Versification. 2s. Both Books bound together, 2s. 6d. KEY, 2s. 6d.

ENGLISH GRAMMAR, founded on the Philosophy of Language and the Practice of the best Authors. With Copious Exercises, Constructive and Analytical. By C. W. CONNON, LL.D. 2s. 6d.

Spectator.—"It exhibits great ability, combining practical skill with philosophical views."

CONNON'S FIRST SPELLING-BOOK. 6d.

A DICTIONARY OF THE ENGLISH LANGUAGE, containing the Pronunciation, Etymology, and Explanation of all Words authorized by Eminent Writers. By ALEXANDER REID, LL.D., late Head Master of the Edinburgh Institution. Reduced to 5s.

DR REID'S RUDIMENTS OF ENGLISH GRAMMAR. *Greatly improved.* Copious Exercises have been introduced throughout; together with a new Chapter on the Analysis of Sentences; while the whole work has been revised and printed in a larger type. 6d.

DR REID'S RUDIMENTS OF ENGLISH COMPOSITION, with Copious Exercises. 2s. *Thoroughly Revised and Enlarged.*

The work has been entirely remodelled. It now includes Systematic Exercises in Sentence-making. A distinct division has been devoted to the Structure of Paragraphs. The sections on Descriptive and Narrative Essays have been entirely rewritten.

KEY TO THE IMPROVED EDITION, including Directions for teaching the Work. 2s. 6d.

HISTORY OF ENGLISH LITERATURE; with an OUTLINE of the ORIGIN and GROWTH of the ENGLISH LANGUAGE. Illustrated by EXTRACTS. For Schools and Private STUDENTS. By WILLIAM SPALDING, A.M., Professor of Logic, Rhetoric, and Metaphysics, in the University of St Andrews. *Continued to* 1870. 3s. 6d.

Spectator.—"A compilation and text-book of a very superior kind. . . The volume is the best introduction to the subject we have met with."

POETICAL READING-BOOK; with Aids for Grammatical Analysis, Paraphrase, and Criticism; and an Appendix on English Versification. By J. D. Morell, A.M., LL.D., Author of Grammar of the English Language, etc.; and W. IHNE, Ph.D. 2s. 6d.

STUDIES IN COMPOSITION: A Text-Book for Advanced Classes. By DAVID PRYDE, M.A., Head-Master of the Edinburgh Merchant Company's Educational Institution for Young Ladies. 2s. *Recently published.*

ENGLISH COMPOSITION FOR THE USE OF SCHOOLS. By ROBERT ARMSTRONG, Madras College, St Andrews; and THOMAS ARMSTRONG, Heriot Foundation School, Edinburgh. Part I., 1s. 6d. Part II., 2s. Both Parts bound together, 3s. KEY, 2s.

ARMSTRONG'S ENGLISH ETYMOLOGY. 2s.

ARMSTRONG'S ETYMOLOGY for JUNIOR CLASSES. 4d.

SELECTIONS FROM PARADISE LOST; with NOTES adapted for Elementary Schools, by Rev. ROBERT DEMAUS, M.A., late of the West End Academy, Aberdeen. 1s. 6d.

DEMAUS'S ANALYSIS OF SENTENCES. 3d.

EWING'S PRINCIPLES OF ELOCUTION, improved by F. B. CALVERT, A.M. 3s. 6d.

Consists of numerous rules, observations, and exercises on pronunciation, pauses, inflections, accent, and emphasis, accompanied with copious extracts in prose and poetry.

RHETORICAL READINGS FOR SCHOOLS. By WM. M'DOWALL, late Inspector of the Heriot Schools, Edinburgh. 2s. 6d.

SYSTEM OF ENGLISH GRAMMAR, and the Principles of Composition. With Exercises. By JOHN WHITE, F.E.I.S. 1s. 6d.

MILLEN'S INITIATORY ENGLISH GRAMMAR. 1s.

OBJECT-LESSON CARDS ON THE VEGETABLE KINGDOM. Set of Twenty in a Box. £1, 1s.

HOW TO TRAIN YOUNG EYES AND EARS: Being a MANUAL of OBJECT-LESSONS for PARENTS and TEACHERS. By MARY ANNE ROSS, Mistress of the Church of Scotland Normal Infant School, Edinburgh. 1s. 6d.

HOUSEHOLD ECONOMY: A MANUAL intended for Female Training Colleges, and the Senior Class of Girls' Schools. By MARGARET MARIA GORDON (Miss Brewster), Author of "Work, or Plenty to do and how to do it," etc. 2s.

Athenæum.—"Written in a plain, genial, attractive manner, and constituting, in the best sense of the word, a practical domestic manual."

SESSIONAL SCHOOL BOOKS.

ETYMOLOGICAL GUIDE. 2s. 6d.

This is a collection, alphabetically arranged, of the principal roots, affixes, and prefixes, with their derivatives and compounds.

OLD TESTAMENT BIOGRAPHY, containing notices of the chief persons in Holy Scripture, in the form of Questions, with references to Scripture for the Answers. 6d.

NEW TESTAMENT BIOGRAPHY, on the same Plan, 6d.

FISHER'S ASSEMBLY'S SHORTER CATECHISM EXPLAINED. 2s.

PART I. Of what Man is to believe concerning God.
II. Of what duty God requires of Man.

GEOGRAPHY AND ASTRONOMY.

In compiling the works on these subjects, the utmost possible care has been taken to ensure clearness and accuracy of statement. Each edition is scrupulously revised as it passes through the press, so that the works may be confidently relied on as containing the latest information accessible at the time of publication.

A COMPENDIUM OF MODERN GEOGRAPHY, Political, Physical, and Mathematical: With a Chapter on the Ancient Geography of Palestine, Outlines of Astronomy and of Geology, a Glossary of Geographical Names, Descriptive and Pronouncing Tables, Questions for Examination, etc. By the Rev. Alex. Stewart, LL.D. *Carefully Revised.* With 11 Maps. 3s. 6d.

SCHOOL GEOGRAPHY. By James Clyde M.A., LL.D., one of the Classical Masters of the Edinburgh Academy. With special Chapters on Mathematical and Physical Geography, and Technological Appendix. *Corrected throughout.* 4s.

Athenæum.—"We have been struck with the ability and value of this work, which is a great advance upon previous Geographic Manuals. . . . Almost for the first time, we have here met with a School Geography that is quite a readable book,—one that, being intended for advanced pupils, is well adapted to make them study the subject with a degree of interest they have never yet felt in it. . . . Students preparing for the recently instituted University and Civil Service Examinations will find this their best guide."

DR CLYDE'S ELEMENTARY GEOGRAPHY. *Corrected throughout.* 1s. 6d.

An Appendix on Sacred Geography has now been added, which will be found amply sufficient for ordinary uses. Fresh interest has been given to many old names by the mention of quite modern facts connected with the corresponding places.

AN ABSTRACT OF GENERAL GEOGRAPHY, comprehending a more minute Description of the British Empire, and of Palestine or the Holy Land, etc. With numerous Exercises. For Junior Classes. By John White, F.E.I.S., late Teacher, Edinburgh. *Carefully Revised.* 1s.; or with Four Maps, 1s. 3d.

WHITE'S SYSTEM OF MODERN GEOGRAPHY; with Outlines of Astronomy and Physical Geography; comprehending an Account of the Principal Towns, Climate, Soil, Productions, Religion, Education, Government, and Population of the various Countries. With a Compendium of Sacred Geography, Problems on the Globes, Exercises, etc. *Carefully Revised.* 2s. 6d.; or with Four Maps, 2s. 9d.

RUDIMENTS OF MODERN GEOGRAPHY. By Alex. Reid, LL.D., late Head Master of the Edinburgh Institution. With Plates and Map of the World. *Carefully Revised.* 1s.; or with Five Maps, 1s. 3d. *Enlarged by 36 pages of extra information regarding the Counties and principal Railways of the United Kingdom.*

The names of places are accented, and accompanied with short descriptions, and occasionally with the mention of some remarkable event. To the several countries are appended notices of their physical geography, productions, government, and religion; concluding with an outline of sacred geography, problems on the use of the globes, and directions for the construction of maps.

FIRST BOOK OF GEOGRAPHY: Being an Abridgment of Dr Reid's Rudiments of Modern Geography. With an Outline of the Geography of Palestine. *Carefully Revised.* 6d.

This work has been prepared for the use of young pupils. It is a suitable and useful companion to Dr Reid's Introductory Atlas.

DR REID'S OUTLINES OF SACRED GEOGRAPHY. 6d.

This little work is a manual of Scripture Geography for young persons. It is designed to communicate such a knowledge of the places mentioned in holy writ as will enable children more clearly to understand the sacred narrative. It contains references to the passages of Scripture in which the most remarkable places are mentioned, notes chiefly historical and descriptive, and a Map of the Holy Land in provinces and tribes.

AN INTRODUCTORY GEOGRAPHY, for Junior Pupils. By Dr James Douglas, lately Teacher of English, Great King Street, Edinburgh. *Carefully Revised.* 6d.

DR DOUGLAS'S PROGRESSIVE GEOGRAPHY. *An entirely new work,* showing the recent changes on the Continent and elsewhere, and embracing much Historical and other Information. 160 pages, 1s. *Carefully Revised.*

DR DOUGLAS'S TEXT-BOOK OF GEOGRAPHY, containing the Physical and Political Geography of all the Countries of the Globe. Systematically arranged. 2s. 6d.; or with ten Coloured Maps, 3s. *Carefully Revised.*

GEOGRAPHY OF THE BRITISH EMPIRE. By William Lawson, St Mark's College, Chelsea. *Carefully Revised.* 3s.

Part I. Outlines of Mathematical and Physical Geography. II. Physical, Political, and Commercial Geography of the British Islands. III. Physical, Political, and Commercial Geography of the British Colonies.

LAWSON'S STANDARD AND PHYSICAL GEOGRAPHIES, *adapted to the requirements of the New Code.* See Catalogue, page 4.

EDINBURGH ACADEMY MODERN GEOGRAPHY. *Carefully Revised.* 2s. 6d.

EDINBURGH ACADEMY ANCIENT GEOGRAPHY. 3s.

EWING'S SYSTEM OF GEOGRAPHY. *Carefully Revised.* 4s. 6d.; with 14 Maps, 6s.

Besides a complete treatise on the science of geography, this work contains the elements of astronomy and of physical geography, and a variety of problems to be solved by the terrestrial and celestial globes. At the end is a pronouncing Vocabulary, in the form of a gazetteer, containing the names of all the places in the work.

ELEMENTS OF ASTRONOMY; adapted for Private Instruction and Use of Schools. By Hugo Reid, Member of the College of Preceptors. With 65 Wood Engravings. 3s.

REID'S ELEMENTS OF PHYSICAL GEOGRAPHY; with Outlines of GEOLOGY, MATHEMATICAL GEOGRAPHY, and ASTRONOMY, and Questions for Examination. With numerous Illustrations, and a large coloured Physical Chart of the Globe. 1s.

SCHOOL ATLASES.

A GENERAL ATLAS OF MODERN GEOGRAPHY; 29 Maps, Coloured. By THOMAS EWING. 7s. 6d.

WHITE'S ELEMENTARY ATLAS OF MODERN GEOGRAPHY. 4to, 10 Maps, Coloured. 2s. 6d.

CONTENTS.—1. The World; 2. Europe; 3. Asia; 4. Africa; 5. North America; 6. South America; 7. England; 8. Scotland; 9. Ireland; 10. Palestine.

A SCHOOL ATLAS OF MODERN GEOGRAPHY. 4to, 16 Maps, Coloured. By ALEXANDER REID, LL.D., late Head Master of the Edinburgh Institution, etc. 5s.

REID'S INTRODUCTORY ATLAS OF MODERN GEOGRAPHY. 4to, 10 Maps, Coloured. 2s. 6d.

CONTENTS.—1. The World; 2. Europe; 3. Asia; 4. Africa; 5. North America; 6. South America; 7. England; 8. Scotland; 9. Ireland; 10. Palestine.

MURPHY'S BIBLE ATLAS of 24 MAPS, with Historical Descriptions. 1s. 6d. coloured.

Witness.—"We recommend this Atlas to teachers, parents, and individual Christians, as a comprehensive and cheap auxiliary to the intelligent reading of the Scriptures."

HISTORY.

THE works in this department have been prepared with the greatest care. They will be found to include Class-books for Junior and Senior Classes in all the branches of History generally taught in the best schools. While the utmost attention has been paid to accuracy, the narratives have in every case been rendered as instructive and pleasing as possible, so as to relieve the study from the tediousness of a mere dry detail of facts.

A CONCISE HISTORY OF ENGLAND IN EPOCHS.

By J. F. CORKRAN. With Maps and Genealogical and Chronological Tables, and comprehensive Questions to each Chapter. *New Edition, with the History continued.* 2s. 6d.

The writer has endeavoured to convey a broad and full impression of the great Epochs, and to develop with care, but in subordination to the rest of the narrative, the growth of Law and of the Constitution.

HISTORY OF ENGLAND FOR JUNIOR CLASSES; with

Questions for Examination. Edited by HENRY WHITE, B.A. Trinity College, Cambridge, M.A. and Ph.D. Heidelberg. 1s. 6d.

Athenæum.—"A cheap and excellent history of England, admirably adapted for the use of junior classes. The various changes that have taken place in our constitution are briefly but clearly described. It is surprising how successfully the editor has not merely avoided the obscurity which generally accompanies brevity, but invested his narrative with an interest too often wanting in larger historical works. The information conveyed is thoroughly sound; and the utility of the book is much increased by the addition of examination questions at the end of each chapter."

HISTORY OF GREAT BRITAIN AND IRELAND; with

an Account of the present State and Resources of the United Kingdom and its Colonies. With Questions and a Map. By Dr WHITE. 3s.

Athenæum.—"A carefully compiled history for the use of schools. The writer has consulted the more recent authorities: his opinions are liberal, and on the whole just and impartial: the succession of events is developed with clearness, and with more of that picturesque effect which so delights the young than is common in historical abstracts."

HISTORY OF SCOTLAND FOR JUNIOR CLASSES;

with Questions for Examination. Edited by Dr WHITE. 1s. 6d.

HISTORY OF SCOTLAND FOR SENIOR CLASSES;

with Questions for Examination. Edited by Dr WHITE. 3s. 6d.

HISTORY OF FRANCE; with Questions for Examination,

and a Map. Edited by Dr WHITE. 3s. 6d.

Athenæum.—"Dr White is remarkably happy in combining convenient brevity with sufficiency of information, clearness of exposition, and interest of detail. He shows great judgment in apportioning to each subject its due amount of consideration."

OUTLINES OF UNIVERSAL HISTORY. Edited by Dr

WHITE. 2s.

Spectator.—"Distinct in its arrangement, skilful in its selection of leading features, close and clear in its narrative."

DR WHITE'S ELEMENTS OF UNIVERSAL HISTORY, On a New and Systematic Plan. In THREE PARTS. Part I. Ancient History; Part II. History of the Middle Ages; Part III. Modern History. With a Map of the World. 7s.; or in Parts, 2s. 6d. each.

This work contains numerous synoptical and other tables, to guide the researches of the student, with sketches of literature, antiquities, and manners during each of the great chronological epochs.

OUTLINES OF THE HISTORY OF ROME; with Questions for Examination. Edited by Dr WHITE. 1s. 6d.

London Review.—"This abridgment is admirably adapted for the use of schools,—the best book that a teacher could place in the hand of a youthful student."

SACRED HISTORY, from the Creation of the World to the Destruction of Jerusalem. With Questions for Examination. Edited by Dr WHITE. 1s. 6d.

ELEMENTS OF GENERAL HISTORY, Ancient and Modern. To which are added, a Comparative View of Ancient and Modern Geography, and a Table of Chronology. By ALEX. FRASER TYTLER, Lord Woodhouselee, formerly Professor of History in the University of Edinburgh. *New Edition, with the History continued.* With two large Maps, etc. 3s. 6d.

WATTS' CATECHISM OF SCRIPTURE HISTORY, and of the Condition of the Jews from the Close of the Old Testament to the Time of Christ. With INTRODUCTION by W. K. TWEEDIE, D.D. 2s.

SIMPSON'S HISTORY OF SCOTLAND; with an Outline of the British Constitution, and Questions for Examination at the end of each Section. 3s. 6d.

SIMPSON'S GOLDSMITH'S HISTORY OF ENGLAND; With the Narrative brought down to the Middle of the Nineteenth Century. To which is added an Outline of the British Constitution. With Questions for Examination at the end of each Section. 3s. 6d.

SIMPSON'S GOLDSMITH'S HISTORY OF GREECE. With Questions for Examination at the end of each Section. 3s. 6d.

SIMPSON'S GOLDSMITH'S HISTORY OF ROME. With Questions for Examination at the end of each Section. 3s. 6d.

WRITING, ARITHMETIC, AND BOOK-KEEPING.

THIS section will be found to contain works in extensive use in many of the best schools in the United Kingdom. The successive editions have been carefully revised and amended.

ARITHMETIC ADAPTED TO THE NEW CODE, in

Three Parts. By ALEXANDER TROTTER, Teacher of Mathematics, etc., Edinburgh. *Parts I. and II., embracing the first four Standards, are now Ready.* Each containing 36 pages, 2d., stiff wrapper. Answers to Parts I. and II., price 3d. each. *Part III. in Preparation.*

PRACTICAL ARITHMETIC FOR JUNIOR CLASSES.

By HENRY G. C. SMITH, Teacher of Arithmetic and Mathematics in George Heriot's Hospital. 64 pages, 6d. stiff wrapper. *Answers*, 6d.

From the Rev. PHILIP KELLAND, A.M., F.R.SS. L. & E., *late Fellow of Queens' College, Cambridge, Professor of Mathematics in the University of Edinburgh.*

"I am glad to learn that Mr Smith's Manual for Junior Classes, the MS. of which I have examined, is nearly ready for publication. Trusting that the Illustrative Processes which he has exhibited may prove as efficient in other hands as they have proved in his own, I have great pleasure in recommending the work, being satisfied that a better Arithmetician and a more judicious Teacher than Mr Smith is not to be found."

PRACTICAL ARITHMETIC FOR SENIOR CLASSES;

Being a Continuation of the above. By HENRY G. C. SMITH. 2s. *Answers*, 6d. KEY, 2s. 6d.

*** *The Exercises in both works, which are copious and original, have been constructed so as to combine interest with utility. They are accompanied by illustrative processes.*

LESSONS IN ARITHMETIC FOR JUNIOR CLASSES.

By JAMES TROTTER. 66 pages, 6d. stiff wrapper; or 8d. cloth. *Answers*, 6d.

This book was *carefully revised*, and *enlarged* by the introduction of Simple Examples of the various rules, worked out at length and fully explained, and of Practical Exercises, by the Author's son, Mr Alexander Trotter, Teacher of Mathematics, etc., Edinburgh; and to the present edition Exercises on the proposed Decimal Coinage have been added.

LESSONS IN ARITHMETIC FOR ADVANCED CLASSES;

Being a Continuation of the Lessons in Arithmetic for Junior Classes. Containing Vulgar and Decimal Fractions; Simple and Compound Proportion, with their Applications; Simple and Compound Interest; Involution and Evolution, etc. By ALEXANDER TROTTER. New Edition, with Exercises on the proposed Decimal Coinage. 76 pages, 6d. in stiff wrapper; or 8d. cloth *Answers*, 6d.

Each subject is also accompanied by an example fully worked out and minutely explained. The Exercises are numerous and practical.

A COMPLETE SYSTEM OF ARITHMETIC, Theoretical and Practical; containing the Fundamental Rules, and their Application to Mercantile Computations; Vulgar and Decimal Fractions; Involution and Evolution; Series; Annuities, Certain and Contingent. By Mr TROTTER. 3s. KEY, 4s. 6d.

*** *All the* 3400 *Exercises in this work are new. They are applicable to the business of real life, and are framed in such a way as to lead the pupil to reason on the matter. There are upwards of* 200 *Examples wrought out at length and minutely explained.*

INGRAM'S PRINCIPLES OF ARITHMETIC, and their Application to Business explained in a Popular Manner, and clearly Illustrated by Simple Rules and Numerous Examples. *Remodelled and greatly Enlarged*, with Exercises on the proposed Decimal Coinage. By ALEXANDER TROTTER, Teacher of Mathematics, etc., Edinburgh. 1s. KEY, 2s.

Each rule is followed by an example wrought out at length, and is illustrated by a great variety of practical questions applicable to business.

MELROSE'S CONCISE SYSTEM OF PRACTICAL ARITHMETIC; containing the Fundamental Rules and their Application to Mercantile Calculations; Vulgar and Decimal Fractions; Exchanges; Involution and Evolution; Progressions; Annuities, Certain and Contingent, etc. *Re-arranged, Improved, and Enlarged*, with Exercises on the proposed Decimal Coinage. By ALEXANDER TROTTER, Teacher of Mathematics, etc., in Edinburgh. 1s. 6d. KEY, 2s. 6d.

Each Rule is followed by an example worked out at length, and minutely explained, and by numerous practical Exercises.

HUTTON'S ARITHMETIC AND BOOK-KEEPING. 2s. 6d.

HUTTON'S BOOK-KEEPING, by TROTTER. 2s.

Sets of Ruled Writing Books,—Single Entry, per set, 1s. 6d.; Double Entry, per set, 1s. 6d.

STEWART'S FIRST LESSONS IN ARITHMETIC, for Junior Classes; containing Exercises in Simple and Compound Quantities arranged so as to enable the Pupil to perform the Operations with the greatest facility and correctness. With Exercises on the proposed Decimal Coinage. 6d. stiff wrapper. *Answers*, 6d.

STEWART'S PRACTICAL TREATISE on ARITHMETIC, *Arranged for Pupils in Classes.* With Exercises on the proposed Decimal Coinage. 1s. 6d. This work includes the Answers; with Questions for Examination. KEY, 2s.

GRAY'S INTRODUCTION TO ARITHMETIC; with Exercises on the proposed Decimal Coinage. 10d. bound in leather. KEY, 2s.

LESSONS IN ARITHMETIC FOR JUNIOR CLASSES. By JAMES MACLAREN, Master of the Classical and Mercantile Academy, Hamilton Place, Edinburgh. 6d. stiff wrapper.

The Answers are annexed to the several Exercises.

MACLAREN'S IMPROVED SYSTEM OF PRACTICAL BOOK-KEEPING, arranged according to Single Entry, and adapted to General Business. Exemplified in one set of Books. 1s. 6d.

A Set of Ruled Writing Books, expressly adapted for this work, 1s. 6d.

SCOTT'S FIRST LESSONS IN ARITHMETIC. 6d. stiff wrapper. *Answers,* 6d.

SCOTT'S MENTAL CALCULATION TEXT-BOOK. Pupil's Copy, 6d. Teacher's Copy, 6d.

COPY BOOKS, in a Progressive Series,
By R. SCOTT, late Writing-Master, Edinburgh.

Each containing 24 pages. Price: Medium Paper, 3d.; Post Paper, 4d.

SCOTT'S COPY LINES, in a Progressive Series, 4d. each.

THE PRINCIPLES OF GAELIC GRAMMAR; With the Definitions, Rules, and Examples, clearly expressed in English and Gaelic: containing copious Exercises for Reading the Language, and for Parsing and Correction. By the Rev. JOHN FORBES, late Minister of Sleat. 3s. 6d.

MATHEMATICS, NATURAL PHILOSOPHY, ETC.

INGRAM'S CONCISE SYSTEM OF MATHEMATICS, Theoretical and Practical, for Schools and Private Students. Improved by JAMES TROTTER. With 340 Woodcuts. 4s. 6d. KEY, 3s. 6d.

TROTTER'S MANUAL OF LOGARITHMS AND PRACTICAL MATHEMATICS, for Students, Engineers, Navigators, and Surveyors. 3s.

A COMPLETE SYSTEM OF MENSURATION; For Schools, Private Students, and Practical Men. By ALEX. INGRAM. Improved by JAMES TROTTER. 2s.

INGRAM AND TROTTER'S EUCLID. 1s. 6d.

INGRAM AND TROTTER'S ELEMENTS OF ALGEBRA, Theoretical and Practical, for Schools and Private Students. 3s.

INTRODUCTORY BOOK OF THE SCIENCES. By James Nicol, F.R.S.E., F.G.S., Professor of Natural History in the University of Aberdeen. With 106 Woodcuts. 1s. 6d.

SCHOOL SONGS WITH MUSIC,

By T. M. Hunter, Director to the Association for the Revival of Sacred Music in Scotland.

ELEMENTS OF VOCAL MUSIC: An Introduction to the Art of Reading Music at Sight. Price 6d.

*** *This Work has been prepared with great care, and is the result of long practical experience in teaching. It is adapted to all ages and classes, and will be found considerably to lighten the labour of both teacher and pupil. The exercises are printed in the standard notation, and the notes are named as in the original Sol-fa System.*

Contents.—Music Scales.—Exercises in Time.—Syncopation.—The Chromatic Scale.—Transposition of Scale.—The Minor Scale.—Part Singing.—Explanation of Musical Terms.

HUNTER'S SCHOOL SONGS. With Preface by Rev. James Currie, Training College, Edinburgh.

FOR JUNIOR CLASSES: 60 Songs, principally set for two voices. 4d.—*Second Series:* 63 Songs. 4d.

FOR ADVANCED CLASSES: 44 Songs, principally set for three voices. 6d.—*Second Series:* 46 Songs. 6d.

SCHOOL PSALMODY; containing 58 Pieces arranged for three voices. 4d.

GEOMETRICAL DRAWING.

THE FIRST GRADE PRACTICAL GEOMETRY. Intended chiefly for the use of Drawing Classes in Elementary Schools taught in connexion with the Department of Science and Art. By John Kennedy, Head Master of Dundee School of Art. 6d.

SCHOOL REGISTER. Pupil's Daily Register of Marks. *Improved Edition.* Containing Spaces for 48 Weeks; to which are added, Spaces for a Summary and Order of Merit for each Month, for each Quarter, and for the Year. For Schools in general, and constructed to furnish information required by Government. 2d.

SCHOOL REGISTER OF ATTENDANCE, ABSENCE, AND FEES: adapted to the Provisions of the Revised Code, by Morris F. Myron. Each folio will serve 50 pupils for a Quarter. 1s.

CLASS-BOOKS BY CHAS. HENRI SCHNEIDER, F.E.I.S., M.C.P., Senior French Master in the Edinburgh High School, the Merchant Company's Educational Institution for Young Ladies, the School of Arts and Watt Institution, etc.; French Examiner to the Educational Institute of Scotland, etc.

SCHNEIDER'S FIRST YEAR'S FRENCH COURSE. 1s. 6d.

*** This work forms a Complete Course of French for Beginners, and comprehends Grammatical Exercises, with Rules; Reading Lessons, with Notes; Dictation; Exercises in Conversation; and a Vocabulary of all the Words in the Book.

THE EDINBURGH HIGH SCHOOL FRENCH CONVERSATION-GRAMMAR, arranged on an entirely New Plan, with Questions and Answers. *Dedicated, by permission, to Professor Max Müller.* 3s. 6d. KEY, 2s. 6d.

THE EDINBURGH HIGH SCHOOL NEW PRACTICAL FRENCH READER: Being a Collection of Pieces from the best French Authors. With Questions and Notes, enabling both Master and Pupil to converse in French. 3s. 6d.

THE EDINBURGH HIGH SCHOOL FRENCH MANUAL of CONVERSATION and COMMERCIAL CORRESPONDENCE. 2s. 6d.

In this work, Phrases and Idiomatic Expressions which are used most frequently in the intercourse of every-day life have been carefully collected. Care has been taken to avoid what is trivial and obsolete, and to introduce all the modern terms relative to railways, steamboats, and travelling in general.

ÉCRIN LITTÉRAIRE: Being a Collection of LIVELY ANECDOTES, JEUX DE MOTS, ENIGMAS, CHARADES, POETRY, etc., to serve as Readings, Dictation, and Recitation. 3s. 6d.

Letter from PROFESSOR MAX MÜLLER, *University of Oxford, May* 1867.

"MY DEAR SIR,—I am very happy to find that my anticipations as to the success of your Grammar have been fully realized. Your book does not require any longer a godfather; but if you wish me to act as such, I shall be most happy to have my name connected with your prosperous child.—Yours very truly, MAX MÜLLER.

"To Mons. C. H. Schneider, Edinburgh High School."

THE FRENCH NEW TESTAMENT. The most approved PROTESTANT VERSION, and the one in general use in the FRENCH REFORMED CHURCHES. Pocket Edition, roan, gilt edges, 1s. 6d.

CHAMBAUD'S FABLES CHOISIES. With a Vocabulary containing the meaning of all the Words. By SCOT and WELLS. 2s.

LE PETIT FABLIER. With Vocabulary. For Junior Classes. By G. M. GIBSON, late Rector of the Bathgate Academy. 1s. 6d.

STANDARD PRONOUNCING DICTIONARY OF THE FRENCH AND ENGLISH LANGUAGES. In Two Parts. Part I. *French and English.*—Part II. *English and French.* By Gabriel Surenne, late Professor in the Scottish Naval and Military Academy, etc. The First Part comprehends Words in Common Use, Terms connected with Science and the Fine Arts, Historical, Geographical, and Biographical Names, with the Pronunciation according to the French Academy and the most eminent Lexicographers and Grammarians. The Second Part is an ample Dictionary of English words, with the Pronunciation according to the best Authorities. The whole is preceded by a Practical and Comprehensive System of French Pronunciation. 7s. 6d., strongly bound.

The Pronunciation is shown by a different spelling of the Words.

SURENNE'S FRENCH-ENGLISH and ENGLISH-FRENCH DICTIONARY, without the Pronunciation. 3s. 6d., strongly bound.

SURENNE'S FENELON'S TELEMAQUE. 2 vols, 1s. each, stiff wrapper; or bound together, 2s. 6d.

SURENNE'S VOLTAIRE'S HISTOIRE DE CHARLES XII. 1s. stiff wrapper; or 1s. 6d. bound.

SURENNE'S VOLTAIRE'S HISTOIRE DE RUSSIE SOUS PIERRE LE GRAND. 2 vols, 1s. each, stiff wrapper; or bound together, 2s. 6d.

SURENNE'S VOLTAIRE'S LA HENRIADE. 1s. stiff wrapper; or 1s. 6d. bound.

SURENNE'S NEW FRENCH DIALOGUES; With an Introduction to French Pronunciation, a Copious Vocabulary, and Models of Epistolary Correspondence. *Pronunciation marked throughout.* 2s.

SURENNE'S NEW FRENCH MANUAL AND TRAVELLER'S COMPANION. Containing an Introduction to French Pronunciation; a Copious Vocabulary; a very complete Series of Dialogues on Topics of Every-day Life; Dialogues on the Principal Continental Tours, and on the Objects of Interest in Paris; with Models of Epistolary Correspondence. Intended as a Class-book for the Student and a Guide to the Tourist. Map. *Pronunciation marked throughout.* 3s. 6d.

SURENNE'S PRONOUNCING FRENCH PRIMER. Containing the Principles of French Pronunciation, a Vocabulary of easy and familiar Words, and a selection of Phrases. 1s. 6d. stiff wrapper.

SURENNE'S MOLIERE'S L'AVARE: Comédie. 1s. stiff wrapper; or 1s. 6d. bound.

SURENNE'S MOLIERE'S LE BOURGEOIS GENTILHOMME: Comédie. 1s. stiff wrapper; or 1s. 6d. bound.

SURENNE'S MOLIERE'S LE MISANTHROPE: Comédie. LE MARIAGE FORCE: Comédie. 1s. stiff wrapper; or 1s. 6d. bound.

SURENNE'S FRENCH READING INSTRUCTOR, Reduced to 2s. 6d.

HALLARD'S FRENCH GRAMMAR. 3s. 6d. KEY, 3s. 6d

GRAMMAR OF THE FRENCH LANGUAGE. By AUGUSTE BELJAME, B.A., LL.B., Vice-Principal of the Paris International College. 2s.

BELJAME'S FOUR HUNDRED PRACTICAL EXERCISES. Being a Sequel to Beljame's French Grammar. 2s.

*** *Both Books bound together*, 3s. 6d.

The whole work has been composed with a view to conversation, a great number of the Exercises being in the form of questions and answers.

FIRST FRENCH CLASS-BOOK, or a Practical and Easy Method of learning the FRENCH LANGUAGE, consisting of a Series of FRENCH and ENGLISH EXERCISES, progressively and grammatically arranged. By JULES CARON, F.E.I.S., French Teacher, Edin. 1s. Key, 1s.

This work follows the natural mode in which a child learns to speak its own language, by repeating the same words and phrases in a great variety of forms until the pupil becomes familiar with their use.

CARON'S FIRST FRENCH READING-BOOK: Being Easy and Interesting Lessons, progressively arranged. With a Copious Vocabulary of the Words and Idioms in the text. 1s.

CARON'S PRINCIPLES OF FRENCH GRAMMAR. With numerous Exercises. 2s. Key, 2s.

Spectator.—"May be recommended for clearness of exposition, gradual progression, and a distinct exhibition to the mind through the eye by means of typographical display: the last an important point where the subject admits of it."

AN EASY GRAMMAR OF THE FRENCH LANGUAGE. With EXERCISES AND DIALOGUES. By JOHN CHRISTISON, Teacher of Modern Languages. 1s. 4d. Key, 8d.

CHRISTISON'S RECUEIL DE FABLES ET CONTES CHOISIS, à l'Usage de la Jeunesse. 1s. 4d.

CHRISTISON'S FLEURY'S HISTOIRE DE FRANCE, Racontée à la Jeunesse. With Translations of the difficult Passages. 2s. 6d.

FRENCH EXTRACTS FOR BEGINNERS. With a Vocabulary and an Introduction By F. A. WOLSKI, Master of the Foreign Language Department in the High School of Glasgow. 2s. 6d.

WOLSKI'S NEW FRENCH GRAMMAR. With Exercises. 3s. 6d.

EDINBURGH ACADEMY CLASS-BOOKS.

THE acknowledged merit of these school-books, and the high reputation of the seminary from which they emanate, almost supersede the necessity of any recommendation. The "Latin" and "Greek Rudiments" form an introduction to these languages at once simple, perspicuous, and comprehensive. The "Latin Rudiments" contain an *Appendix*, which renders the use of a separate work on Grammar quite unnecessary; and the *list of anomalous verbs* in the "Greek Rudiments" is believed to be more extensive and complete than any that has yet appeared in School Grammars of the language. In the "Latin Delectus" and "Greek Extracts" the sentences have been arranged strictly on the *progressive principle*, increasing in difficulty with the advancement of the Pupil's knowledge; while the *Vocabularies* contain an explanation not only of every *word*, but also of every *difficult expression* which is found in the works,—thus rendering the acquisition of the Latin and Greek languages both easy and agreeable. The Selections from Cicero embrace the portions of his works which are best adapted for Scholastic tuition.

1. RUDIMENTS OF THE LATIN LANGUAGE. 2s.

*** *This work forms an introduction to the language, at once simple, perspicuous, and comprehensive.*

2. LATIN DELECTUS; with a Vocabulary containing an Explanation of every Word and Difficult Expression which occurs in the Text. 3s. 6d.

3. RUDIMENTS OF THE GREEK LANGUAGE, with the Syntax entirely re-written, and with Accent and Quantity treated of according to their mutual relations. 3s. 6d.

4. GREEK EXTRACTS; with a Vocabulary containing an Explanation of every Word and of the more Difficult Passages in the Text. 3s. 6d.

5. SELECTIONS FROM CICERO. 3s.

6. SELECTA E POETIS LATINIS. 3s.

GREEK SYNTAX; with a Rationale of the Constructions, by JAS. CLYDE, LL.D., one of the Classical Masters of the Edin. Academy. With Prefatory Notice by JOHN S. BLACKIE, Professor of Greek in the University of Edinburgh. *4th Edition*, entirely re-written, and enlarged by a Summary for the use of Learners and a chapter on Accents. 4s. 6d.

GREEK GRAMMAR for the Use of Colleges and Schools. By Professor GEDDES, University of Aberdeen. 4s.

The author has endeavoured to combine the clearness and conciseness of the older Greek Grammars with the accuracy and fulness of more recent ones.

DR HUNTER'S CLASSICS.

1. HUNTER'S RUDDIMAN'S RUDIMENTS. 1s. 6d.
2. HUNTER'S SALLUST; with Footnotes and Translations. 1s. 6d.
3. HUNTER'S VIRGIL, with Notes and other Illustrations. 2s. 6d.
4. HUNTER'S HORACE. 2s.
5. HUNTER'S LIVY. Books XXI. to XXV. With Critical and Explanatory Notes. *Reduced to* 3s.

LATIN PROSE COMPOSITION: The Construction of Clauses, with Illustrations from Cicero and Cæsar; a Vocabulary containing an Explanation of every Word in the Text; and an Index Verborum. By JOHN MASSIE, A.M. 3s. 6d.

DYMOCK'S CÆSAR; with Illustrative Notes, a Historical and Geographical Index, and a Map of Ancient Gaul. 4s.

DYMOCK'S SALLUST; with Explanatory Footnotes and a Historical and Geographical Index. 2s.

CÆSAR; with Vocabulary explaining every Word in the Text, Notes, Map, and Historical Memoir. By WILLIAM M'DOWALL, late Inspector of the Heriot Foundation Schools, Edinburgh. 3s.

M'DOWALL'S VIRGIL; with Memoir, Notes, and Vocabulary explaining every Word in the Text. 3s.

NEILSON'S EUTROPIUS ET AURELIUS VICTOR; with Vocabulary containing the meaning of every Word that occurs in the Text. *Revised* by WM. M'DOWALL. 2s.

LECTIONES SELECTÆ: or, Select Latin Lessons in Morality, History, and Biography: for the use of Beginners. With a Vocabulary explaining every Word in the Text. By C. MELVILLE, late of the Grammar School, Kirkcaldy. 1s. 6d.

MACGOWAN'S LESSONS IN LATIN READING. In Two PARTS. Part I., *Improved* by H. FRASER HALLE, LL.D. 2s. 17th Edition. Part II. 2s. 6d. The two Courses furnish a complete Latin Library of Reading, Grammar, and Composition for Beginners, consisting of Lessons which advance in difficulty by easy gradations, accompanied by Exercises in English to be turned into Latin. Each volume contains a complete Dictionary adapted to itself.

MAIR'S INTRODUCTION TO LATIN SYNTAX: with Illustrations by Rev. ALEX. STEWART, LL.D.; an English and Latin Vocabulary, for the assistance of the Pupil in translating into Latin the English Exercises on each Rule; and an Explanatory Vocabulary of Proper Names. 3s.

STEWART'S CORNELIUS NEPOS; with Notes, Chronological Tables, and a Vocabulary explaining every Word in the Text. 3s.

AINSWORTH'S LATIN DICTIONARY. Edited by WM. DUNCAN, E.C.P. 1070 pages. 9s. strongly bound.

This edition contains a copious index of proper names, a complete list of Latin abbreviations, and other important and useful tables.

DUNCAN'S GREEK TESTAMENT. 3s. 6d.

BEZA'S LATIN TESTAMENT. Revised by the late ADAM DICKINSON, A.M. 3s. 6d.

XENOPHON'S ANABASIS, BOOKS I. AND II.; with Vocabulary giving an Explanation of every Word in the Text, and a Translation of the more difficult Phrases. By JAMES FERGUSSON, M.D., late Rector of the West End Academy, Aberdeen. 2s. 6d.

Athenæum.—"The text of this admirable little work is that of Dindorf, and the punctuation generally that of Poppo. Its principal excellence as an introduction to the study of Greek consists in the copious, correct, and well arranged Vocabulary at the end. This contains good translations of difficult passages, with exact information upon points of antiquities derived from the best and most modern authorities."

GRAMMATICAL EXERCISES ON THE MOODS, TENSES, AND SYNTAX OF ATTIC GREEK. With a Vocabulary containing the meaning of every Word in the Text. On the plan of Professor Ferguson's Latin "Grammatical Exercises." By Dr FERGUSSON. 3s. 6d. KEY, 3s. 6d.

*** *This work is intended to follow the Greek Rudiments.*

HOMER'S ILIAD—GREEK, FROM BEKKER'S TEXT. Edited by the Rev. W. VEITCH, Author of "Greek Verbs, Irregular and Defective," etc. 3s. 6d.

HOMER'S ILIAD, BOOKS I., VI., XX., and XXIV.; with Vocabulary giving an Explanation of every Word in the Text, and a Translation of the more difficult Passages. By Dr FERGUSSON. 3s. 6d.

LATIN ELEMENTARY WORKS AND CLASSICS.

Edited by GEORGE FERGUSON, LL.D., lately Professor of Humanity in King's College and University of Aberdeen, and formerly one of the Masters of the Edinburgh Academy.

1. FERGUSON'S GRAMMATICAL EXERCISES. With Notes, and a Vocabulary explaining every Word in the Text. 2s. KEY, 2s.

2. FERGUSON'S INTRODUCTORY LATIN DELECTUS: Intended to follow the Latin Rudiments; with a Vocabulary containing an Explanation of every Word and of every Difficult Expression. 2s.

3. FERGUSON'S OVID'S METAMORPHOSES. With Explanatory Notes and an Index, containing Mythological, Geographical, and Historical Illustrations. 2s. 6d.

4. FERGUSON'S CICERONIS ORATIONES SELECTAE. Containing pro Lege Manilia, IV. in Catilinam, pro A. L. Archia, pro T. A. Milone. Ex Orellii recensione. 1s. 6d.

5. FERGUSON'S CICERONIS CATO MAJOR sive de Senectute, Laelius sive de Amicitia, Somnium Scipionis, et Epistolae Selectae. Ex Orellii recensione. 1s. 6d.

6. FERGUSON'S CICERONIS DE OFFICIIS. 1s. 6d.

ITALIAN.

THEORETICAL AND PRACTICAL ITALIAN GRAMMAR; with numerous Exercises and Examples, illustrative of every Rule, and a Selection of Phrases and Dialogues. By E. LEMMI, LL.D., Italian Tutor to H. R. H. the Prince of Wales. 5s.—KEY, 5s.

From COUNT SAFFI, *Professor of the Italian Language at Oxford.*—"I have adopted your Grammar for the elementary instruction of students of Italian in the Taylor Institution, and find it admirably adapted to the purpose, as well for the order and clearness of the rules, as for the practical excellence and ability of the exercises with which you have enriched it."

GERMAN.

A NEW GERMAN READER, in PROSE and VERSE; with a Grammatical and Etymological Vocabulary, containing the meaning of all the words in the Text; Forms of Commercial and other Correspondence, and Specimens of German National Handwriting. For the Use of Schools. By CHARLES FISCHER-FISCHART, of the Edinburgh Merchant Company's Educational Institutions, etc. 3s. 6d. *Now ready.*

PUBLISHED BY OLIVER AND BOYD, EDINBURGH;
SOLD ALSO BY SIMPKIN, MARSHALL, AND CO., LONDON, AND ALL BOOKSELLERS.