ARITHMETIC

NOTATION

Integers : Vulgar : Decimals

0 9 8 7 6 5 4 3 2 1 : ½ : 1 2 3 4 5 6 7 8 9 0

and — from × into ÷ by = is :: so is

NUMERATION

Trillions	*Millions*	*Thous:* CXI
123,456.	789,987.	654,321.

ADDITION & DEDUCTION

1	2	3	4	5	6	7	8	9	12
2	4	5	6	7	8	9	10	11	14
3	5	6	7	8	9	10	11	12	15
4	6	7	8	9	10	11	12	13	16
5	7	8	9	10	11	12	13	14	17
6	8	9	10	11	12	13	14	15	18
7	9	10	11	12	13	14	15	16	19
8	10	11	12	13	14	15	16	17	20
9	11	12	13	14	15	16	17	18	21

MULTIPLICATION & DIVISION

1	2	3	4	5	6	7	8	9	12
2	4	6	8	10	12	14	16	18	24
3	6	9	12	15	18	21	24	27	36
4	8	12	16	20	24	28	32	36	48
5	10	15	20	25	30	35	40	45	60
6	12	18	24	30	36	42	48	54	72
7	14	21	28	35	42	49	56	63	84
8	16	24	32	40	48	56	64	72	96
9	18	27	36	45	54	63	72	81	108

FIGURES by LETTERS

Fract:ns	a	e	i	o	u	au	oi	ei	ou	y	g..100
[illegible]....ri	1	2	3	4	5	6	7	8	9	0	th.1000
[illegible]....eri	b	d	t	f	l	s	p	k	n	z	m..illion

MNEMONICS

...d only for I. Hodges, at London Bridge, according to Act of Par...

ARITHMETIC

IN TWO PARTS:

Containing

I. *A System of the Art*, in Memorial Verses, and Dictionary-wise; for the readier Learning, Consulting, and Recollecting of the several articles: The whole more Commodious than any, and more Comprehensive than all, that have yet been calculated for the Use of SCHOOLS.

II. *A Collection of Exercises*, accommodated to the various Occasions of Business, and contrivd for the Ease of Teachers: being disposd, partly (under each rule) Alphabetically, for the readier recourse; partly (under all) Promiscuously, for the severer TRIAL.

By SOLOMON LOWE,
Schoolmaster, at Hammersmith.

Numbers are so much the measure of every thing that is valuable; that it is not possible to demonstrate the success of any action, or the prudence of any undertaking, without them. ADDISON, Spectat. n. 174.

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PREFACE.

IF the reader shall find *the title* of this piece *verified by the work* (which it was designd he should) there will be no need of an *Apology* for adding this system to the multitudes of arithmetics, that have been already publisht.——I have, therefore, only to add, in order to give the reader a more precise idea of what I have aimd-at, that 1

The Directions, which I have given for the performance of the operations, and the application of the rules; are contrivd to begin with the name of each of them; the better to start the train of ideas, that will naturally arise after the sound of the leading word.——How easily, above all things, the doctrin of numbers slips out of the mind; every body, that is not in constant practise of it, must be very sensible. The best security against this uncertainty seems to be a set of rules, quite detacht from all examples, and observations thereupon; which are apt to embarrass the mind, and leave it at a loss (for want of due distinction) how much the memory ought to be charg'd with. I have therefore (hereby) provided against this inconvenience: and not only given the rules distinct, and full enough for fixing the idea of what they are designd to teach: (V. paragraph 9) but have thrown them into verse: that they may be the more easily learnt, the more firmly retaind, and the more readily recollected, on any occasion.——Thus advantageous will this peculiarity be to the learner; and, consequently, to the teacher: beside that it will save him the fruitless drudgery of writing fair, in every copy-book, some imperfect sketches of tables, and directions under every head of rules and operations; which is now the common method: though, for ought I can see, it answers no other purpose than that of making a show of their dexterity in writing, striking, and flourishing; which has nothing to do with the art it self; and can be of no value but to amuse and dazzle the illiterate. 2

In the Verses (which have the cadence of latin hexameters) the accent, which is added to ascertain the right reading of them, denotes the first syllable of a dactyl; or that the two following syllables are to be pronounc'd short. 3

As to the Notes (which are chiefly exemplifications of the text) they are so layd-out as to strike the eye, for the readier reference, and easier application. 4

For Particulars (beside several things *new* in the most considerable articles) care has been taken, from a great number of the best systems, to *select* the readiest ways, and cleverest compendiums. 5

The Compass of the whole is in 134 verses, including 23 for the account of *coins*, *weights*, *and measures*; which (beside the advantage of being easily got by heart, and certainly rememberd) do completely answer all the purposes of the largest tables; and may more safely be depended-on than the best. And I will venture to add that they contain a great deal more than is to be met-with in any, or (indeed) all the systems, that have been hitherto publisht.——But *the Whole of what is commonly taught in schools, and All that the generality of people, in business, have occasion for* (to-wit, the four operations, with the rules of Reduction, Proportion, and Practise) are fully taught in about 50 verses; which it will be very convenient, as it is very

easy,

easy, to get-by-heart———For *the Rest*, which there is much less occasion for in ordinary affairs, the reader (as he shall like best) may . . either charge his memory with the rules . . or familiarize the practise by dint of application, in the same manner as in other systems, according to the common usage. 6

As to the Plan of the work, it is drawn-up in the mnemonic form; a method not yet generally receivd: but, whatever prejudices may arise in people's minds against it, on account of its novelty; it will be found, upon trial, both easy, and useful.———By the key to the art, as exhibited in the frontispiece, it is evident that a child may be made master of it, in less than half an hour's time; and I can assure the reader, from certain experience, that, how difficult and forbiding-soever the jargon of it may appear; nothing will stick more effectually in the memory, when once familiarizd by frequent repetition, so as to flow into the mind without reflexion.—Besides, that, without the least encumbrance to the mind, or prejudice to other acquisitions, even children (by the mere dint of sound) may hereby be enabled to lay-up a large treasure of useful notices; so as to be furnisht (betimes) with a satisfactory certainty, readiness, and exactness, in things, of which masters themselves, and men of reading have generally but an imperfect and confus'd remembrance. It is a very easy matter, however impracticable it may seem, for a boy of but indifferent parts to be perfectly acquainted-with, and readily to tell any body, the distances of the most considerable places on the face of the earth; the diameters, magnitudes, revolutions, and velocities of the heavenly bodies; all the epochas in chronology; the remarkables in history, &c. in short to be possest of a fine variety of principles in the several sciences; for the greatest part of which even professors are under a necessity, from time to time (on any occasion, in controversy, or conversation) to have recourse to books, or (when

 those

thoſe are not at hand) to be diſappointed; how much ſoever it may be to their diſcredit, or prejudice. 7

The Diſpoſition of the parts is dictionary-wiſe, for the readier reference to any particular: an advantage of more conſequence to ſave trouble than (perhaps) is generally imagind. I am the more ſenſible of it, as (in the proſecution of this work) I had frequent occaſion to peruſe a great variety of the beſt ſyſtems: in none of which (though the order of the heads is different in moſt of them) was there ſo much as an alphabetical index, which is the readieſt means (next to the dictionary-form) of turning to what one wants. Many of them, indeed, have tables of contents: but, then, it is a little diſpleaſing, on any occaſion, to hunt, firſt at the begining, or end of a book, or (it may be) after the preface, for the table; and (then) through the table, for the particular that is wanted; and from thence to go to the page, when that is indicated: for, in ſome (as in Fiſher, &c.) there are no references at all. Some, in lieu of ſuch tables, give us the contents in the runing titles: where Mr Weſton wiſely advertiſes us, at the head of every page, that the treatiſe we are peruſing is 'Of arithmetic;' Mr Dilworth, that his is 'The ſchool-maſter's aſſiſtant,' &c: But, then (in this caſe) it is ſtill more tedious to turn-over the leaves from begining to end to come-at any head you would conſult; eſpecially as your labor is not without danger of a diſappointment, after all; ſince moſt of the writers (which further encreaſes the trouble) are deficient, not only in reſpect to many particulars under moſt heads; but even in the heads themſelves. Mr Fisher (whom I mention as one of the lateſt writers) in his conciſe arithmetic (of 312 pages) has nothing at all under the heads of Alligation, Annuities, Combination, Equation, Evolution, Falſe; and Mr Weston (from whom more might have been expected, conſidering, at leaſt, the bulk of his book) has omited the doctrin of Annuities, Barter,

Combi-

Combination, Gain, Exchange, Intereſt, Rebate, and Tare.—But it is, it ſeems, a general perſuaſion among philoſophers, that the dictionary-way is improper for ſuch a purpoſe. 'When an art, or ſcience, (ſay they) 'is to be explaind: to break it into parcels; and re- 'fer to diſtant articles; is (by no means) tolerable. 'It gives a great deal of trouble, and perplexity; if 'not deſtroys that connexion and dependance, which 'ought to appear in all the parts of a ſcience.' Nor is this ſayd without a ſhow of probability; ſince, by being traind-up in the ſyſtem-way (which has always univerſally prevaild) we are naturally drawn into ſtrong prejudices againſt any other; and very eaſily ſlide into this way of thinking. But, I am apt to believe, it will be found, on due examination, that the dictionary-form (if rightly conducted) does not at all differ from that of the ſyſtem, except that it has the advantage of a readier recourſe. For, ſuppoſe a perſon, unacquainted with arithmetic, going-about to learn it: The ſkeleton of the ſcience (whether in ſyſtem, or dictionary) will be the ſame [a]. Now, What will be the difference, to the learner, whether he begin with the firſt page in the ſyſtem, or the leading article in the dictionary? where he has the compaſs of his work, and the courſe of his procedure [b]. Why (1) in the Syſtem

[a] *For inſtance:* ARITHMETIC——*its Parts:* Notation, Numeration, Operations, Rules.——*its Operations:* Addition, Subtraction, Multiplication, Diviſion.——*its Rules:* Reduction, Proportion, Practiſe, &c.

[b] *The order*, in which every article is to be learnt, is (here) ſpecified in two verſes (line 7, 8) of the firſt page: though few of thoſe, that proceed in the ſyſtematic way, can hardly point-out the order of all, even after they have learnt them.——It may not, however, be amiſs, in this place, to obſerve, with reſpect to the doctrin of *fractions* and *evolution*; that, though, in the natural gradation of the branches of the art, they are to be learnt, as operations after

Syſtem (which muſt be divided into chapters, or ſections, or ſomething equivalent) he muſt turn to a table of contents, or an index (and, from thence to the page) for whatever particular he has a mind to inform himſelf about: Whereas (2) in the Dictionary (which is divided into ſo many ſeparate articles) half his trouble will be ſavd, by going directly to it. 8

The Conciſeneſs, with which the whole is drawn-up, will (I doubt not) be an objection with many; who will be apt to ſurmiſe, that, being ſo ſhort (if complete) it muſt be obſcure. But, I flatter myſelf, if they will but have patience to peruſe it with proper attention, they will find in it the double benefit of brevity, and perſpicuity [c].—I ſhould be *loth* .. to oppreſs and

after the 4 fundamental ones, to which they are referable (V. p. 4, note [f]) yet it will, perhaps, be better to let them alone, till, in the courſe of proceeding through the rules, they ſhall be found neceſſary for the ſolution of any queſtion in any of them: the rather, as the much greateſt part of ſuch calculations, as occur in the ordinary occaſions of buſineſs, may very well be managd without the knowlege of them.

[c] The more ſo, as *the rules are detacht from the exemplifications, and diſtinguiſht by a larger letter*. Hereby the learner will know what he is to commit to memory, in order to have a clear conception of the whole ſcience. And, by this means, his practiſe being always directed by the theory he has treaſurd-up in his mind, he will be leſs liable to forget; and may more eaſily recover what may have ſlipt, through diſuſe; than can poſſibly be expected from other ſyſtems: in all which there is ſuch a huddle of inſtructions (always undiſtinguiſht, and oftentimes verboſe) that both the eye and the mind are at a loſs what to pitch-upon for the fixing of thoſe ideas, which are found, of all others, to be the moſt fleeting. Beſide that, a multiplicity of words, where a few would anſwer the purpoſe, is apt to confound the mind, as well as to check the ſpirit in the purſuit of knowlege.—Dr WELLS (in his Young gentleman's arithmetic

and confound a learner with 34 pages of tedious instructions, to acquaint him with a couple of troublesom methods of Division; as Mr FISHER has done (arithmetic, in the most concise method, p. 89—123) and thinks he has done bravely too (pref. p. 3) when a much fightlier, shorter, and easier way (with the several compendiums of it) might be taught him, in 7 hexameter verses (readily applicable, and hardly to be forgoten) with about 2 pages of exemplifications, &c.. or to swell the doctrin of Practise into a great many long rules, through 37 pages, which he thinks (preface, and contents) he has done with greater variety and brevity than has been done in any one book extant: when a full account of it may be given within the compass of 3 lines of rules, and about 2 pages of exemplification; and that, too, with greater evidence to the understanding, and far greater security to the memory.——I should be *asham'd* also to offer a compendium

metic) thought it necessary to spend above 8 pages in octavo, to make plain the doctrin of numeration; when the whole of what he has sayd thereon may be pictur'd-out, and made perfectly intelligible even to a child, within the compass of 2 verses explicatory of a table of half a line. To what purpose, then, such a profusion and cumber of words; that do so little honor to a note of his (p. 9) wherein he is pleasd to declare, notwithstanding the length of his instructions, that, It can be experimentally sayd, that several young gentlemen have (by the method there explaind) been taught, in a very few minutes time, to read sums of 20, 40, 60, figures.'——The ANALYST (in his Introduction to the mathematics, 1746) with a grand apparatus of definitions, illustrations, corollaries, problems, theories, scholiums, &c. has spun-out his doctrin of fractions to 85 pages: whereas, without all that pomp and parade, a fuller account of them, and with much greater evidence, is (here) exhibited, in one view, in 26 verses; with an illustration thereof, by a great variety of examples, in 4 pages.

pendium of arithmetic (both practical, and theoretical) as Mr. Dilworth has done; without particular directions, for working the operations; the omiſſion of which he gives (ſchool-maſter's aſſiſtant, preface, p. 2) as a reaſon for his book's being reduc'd to the narrow compaſs (of 168 pages) it appears in. In effect, the only value of his performance is (what the general title imports,) that it may ſerve to take-off the heavy burthen of writing-out queſtions, which teachers have long labord-under: inaſmuch as he has given us a larger liſt of queſtions than we generally meet-with in books of this nature. With the ſame view, therefore, I have drawn-up an Appendix to my ſyſtem (and which may equally ſerve as a ſupplement to any other) in which there will be found ſeveral peculiarities of great uſe to the eaſing of the maſter's trouble: beſide a ſeries of exerciſes (without the interruption of other matters) that will open the mind of the learner to all the varieties of views, that either buſineſs, or curioſity may require.

The Title, how paradoxical and preſumptuous ſoever it may appear, will (I hope) be excus'd; if the work ſhall be found anſwerable to the high pretenſes. I ſhould, indeed, have been better pleasd with the plain title of a New ſyſtem of arithmetic: but, that I conſiderd, with the accurate Mr. Malcolm (arithm. pref. p. 5) that ' When a ſubject has gone through ſo ' many hands as arithmetic has done, a new book ' cannot want many prejudices againſt it: and, there- ' fore, that to ſend it into the world without ſome in- ' troductory account of it, is no better than laying it ' down at random, or (more properly) expoſing it. ' 'Tis an unreaſonable neglect of ſomething that ' equally concerns the author, and the world. For, if ' an author has endeavord to do ſomething more uſe- ' ful and complete on any ſubject than has been al- ' ready done, and thinks he has (in ſome meaſure)

' ſuc-

'succeeded: as the telling the world so, may be done without any breach of modesty; so it appears equally just and necessary to explain particularly wherein the improvements and advantages of the work lie: that every one may see how far it answers their purpose, and deserves their encouragement. It is true, it must stand upon its own basis: yet nothing seems more honest and reasonable than this kind of invitation to look into it. It may be objected, I know, that Here is only the author's word for this account; which is a partial testimony: but, if it be considerd that he ventures his credit, as well as the success of his work upon a fair representation: this, it may reasonably be hop'd, will incline the more candid and charitable to believe that it is so.' 10

As to the Freedoms I have usd in finding fault with others, I take the liberty to declare—in the first place, that I shall be so far from taking-amiss the like usage from others; that I shall look-upon it as a kindness done to my-self as well as to the public, to be convicted of any mistakes I may have been guilty-of, or to be shown wherein I have fallen-short of what I profess to have aimd-at—and, in the next place (1) I think I have the same apology (and a good one too) for what I have done here, as I thought necessary to make on another occasion (in a critique on Lilye's, and the Westminster grammars) viz. that, in an attempt at any thing extraordinary, it is impossible, however necessary it may be to attain the end, either to point-out the excellencies one aims-at, without an air of vanity; or to show another his faults, without the appearance of ill-natur'd rudeness, or insolent civility. (2) Not to insist on the authority of the best of writers on this subject, Mr. Malcolm; who has criticizd two fam'd arithmeticians; and that, as he tells us, (arithm. pref. p. 7) in his own vindication; to-wit, that he might not seem to offer to the world a work,

that

that must have been deemd impertinent, or superfluous; if Mr. Hatton's book had answerd the title; or Mr. Hill's, the recommendation given it by so good a judge as Mr. Ditton. (3) And I will venture to add (without offense, I hope, to that excellent arithmetician) that I have renderd the whole of the science much fiter for the use of schools than his system was design-for; and, in many things, made considerable improvements, and additions; which (I dare believe) he will be pleasd-with: at the same time that I have omited nothing that he has given us, except demonstrations, and such particulars as (more properly) belong to algebra: which, though within the compass of his design, were foreign to my purpose and proposals. 11

The Frontispiece, which was designd more for use than ornament, is all (I think) that remains to be considerd. In order to the explication of it, the reader will be pleasd to observe that it *contains the rudiments* of the art; with which if the learner be perfectly well acquainted [d] (so as to say them without study,

[d] *To be perfectly well acquainted with these rudiments*, the only means, is (1) First, to form, and fix a sensible idea of the powers and combinations of numbers, by the use of counters *, or some such palpable objects; which a child will tell-out with pleasure, according to the several dispositions of them, to which he shall be directed; for the better answering the various purposes of the fundamental notices. (2) And, then, to imprint them on the mind by frequent repetition.——It may not be improper, therefore, to accustom children to them very early; that the sounds may grow familiar, before they begin to reflect on the reasons of them. For, if they offer to cast-about in their thoughts to find-out, what they ought to know by rote and without reflexion; they cannot be said to be perfect enough in the use of the rudimental tables, to be able to proceed to the rules with pleasure.———This is, indeed, the reverse of what I advise

ſtudy, doubt, or heſitation) the whole buſineſs of operation will be eaſy, and expeditious.—The *firſt* table gives the figures of the arabic characters, in the three forms of integers, decimals, and vulgar fractions, with the arithmetical ſymbols or ſigns of the operations, &c. the explanation whereof may be ſeen in the ſyſtem, line 9: being here preſented, only to ſtrike the imagination with the form and power of each.—The *ſecond* table is alſo deſignd as a picture, to ſhow the manner of reading any ſeries of thoſe figures, according to the explanation given thereof, line 4, 5, 6.—The *third* table exhibits the firſt principles of addition and ſubtraction. In learning it (I) To Add, ſay (1) either 6 (to the left) and 3 (at the top) is 9, where the rows meet (2) or, reverſely, 3+6=9; and ſo on [e]. (I) To Subtract, ſay (1) ei-

A ther

advise on all other occaſions; not even approving a child's geting ſo much as his catechiſm, without firſt giving him (by familiar explications, queſtions, and canvaſings) ſo much underſtanding of it as his tender years will admit, and the nature of the thing will allow. But, here, the caſe ſeems to be quite different: becauſe nothing more is deſignd, hereby, than the fixing in the memory a concatenation of ſounds, without any regard had to their uſe or application. If therefore a perſon, in multiplying (for inſtance) 7 into 6, muſt fall a-reaſoning that 3 times 7 is 21, and that twice 21 is 42, &c. he will find himſelf ſadly perplext, and ſlow in his operation: but if 6 times 7 draws-in the ſound of 42 (and ſo of the reſt) as readily as twice 2 does that of 4; every thing will be eaſy, without any effort, or embaraſment of the mind.

* *Dr Record* (arithm. p. 179—216) has been very particular in his inſtructions for accounting by counters: 'which 'feat, ſays he, doth not only ſerve for them, that cannot 'write and read; but alſo for them, that can do both; but 'have not, at ſome time, their pen, or tables ready with them.

[e] NB. The digits being known, Every thing beyond will be eaſy. For——The *decads* (10, 20, &c.) with any

ther 3 (to the left) from [f] 9 (where the rows meet) and there remains 6 (at the top) (2) or, reversely, 6—9=3; and so on [g].—The *fourth* table carries the doctrin of multiplication and division as far as is necessary to prepare for the performance of the operations in all cases [h]. In learning it (I) To Multiply, say (1) either 3- (to the left) -times 6 (at the top) is 18, where the rows meet; (2) or, reversely,

git, are known by the name: Thus, 10 and 8 is 18; 20+8=28; &c.—Any *beyond the decads* (as 13, 23, &c.) are known by reflecting on the digits. Thus, 13 and 9 (by thinking that 9 and 3 is 12) appears to be 22; and 23+9 (by the same consideration) = 32, &c.

[f] NB. Though I (here) direct the performance of subtraction according to the customary way; I am apt to think that the doing it, addition-wise, is, on many accounts, the most easy, and the most commodious. V. Subtraction, note [b]. Division, note [d]. See, also, the next Note [g].

[g] From this explication of this table it appears that *Subtraction is the reverse of addition*: and, indeed, if we study to find-out an answer to a question in the former, it is (chiefly) by attention to the latter, that we come-at-it. Thus, to take 3 from 9, we consider how many more than 3 make 9; and so hit-upon 6. In like manner to take 6 from 19 we think that 6 and 3 make 9; and consequently 6 and 13 is 19. So, we say 6 from 19, and there remains 13. V. note [f].

[h] From this explication of this table it appears that *Division is the reverse of multiplication*: and, accordingly, to find How-oft one number is containd in another, we multiply it (in our minds) from some lower step, till we come so near, as that the next would carry us beyond it. Thus, suppose I enquire how oft 9 in 71. I begin (by guessing) at 4 times 9, which is 36; and go-on 5x9=45; 6x9=54; 7x9=63; 8x9=72: by which I find that the answer will be 7 times, and 8 over. V. Division.

verſely, $6\times3=18$ [i]; and ſo on [k]. (II) To Divide, ſay (1) either, How oft 3 (to the left) in 18 (where the rows meet) anſwer, 6 at the top; (2) or, reverſely, $6\div18=3$; and ſo on.——The *fifth* table, which *is a key to the mnemonic art* (and may be got-by-heart in a few minutes) needs no explanation: only, ... For the readier geting, and remembering the numeral force of the letters, it may be obſervd that (I) the Cipher is denoted by the laſt vowel, and conſonant. (II) The Digits (1) in the Upper line (1 2 3 4 5) by the vowels in their order: 6 7 9, by the diphthongs, according to the value of the vowels added together: 8, by the initial letters. (2) In the Under line: 1, by the firſt conſonant; 3 4 6 9, by the initials; 2 7 8, by their alluſion to Duo, ſePtem, οKτω: 5 to L; which (in roman notation) ſtands for 50. (NB) To diſtinguiſh the ſound of *y* from *i*, it may be pronounc'd *wee* ſhort. 12

The Liſt of Authors, at the end of the work, though of little uſe to many, is a curioſity, that ſome will not be diſpleasd with. I have (always) been of opinion, that, Before a man undertakes to write a ſyſtem of any ſcience, he ought to conſider what has already been done: leſt he ſhould loſe his labor, and expoſe himſelf too, by offering to the world what (for ought he knows) may have been done much better: not to mention the advantages he might make both of the errors

[i] Though, poſſibly, it may ſuffice to get the table in the ſhort way, by begining each digit to the left with the ſame at the top, e. g. 6×6, 7×7, &c.——Leſs perplexity will ariſe hence: and, after this way is well known, a child will eaſily be apprizd of the reverſe way.

[k] NB.——10 is (here) *omited:* becauſe the anſwer is imported by the name: 2 tens is twenty; 3×10, thirty, &c. ——11 is *omited:* becauſe it is only puting the multiplier before itſelf. Thus 4 times 11 is 44, $5\times11=55$, &c.—— 12 is *added*; becauſe the ready knowlege of it is very convenient as a pence-table; and for ſundry particulars in reduction.

errors and excellencies he may diſcover in the performances of thoſe, whom he endeavors to excel. I cannot indeed ſay that I have peruſd all the authors in this liſt: but preſume I have reaſon to believe there will nothing of moment be found in any of them, which I have not here given with ſome improvements; inaſmuch as I have carefully conſulted the moſt conſiderable of the ancients, and thoroughly ſtudied almoſt all the moderns. If I am miſtaken in any particular, I reckon I have given provocation enough, by my pretenſes, to be told of it; and ſhall think my-ſelf oblig'd to any one that will be ſo good as to do it. I ſhould be glad, alſo, if the curious would be pleaſd to communicate the names of ſuch authors as I have not been able to recollect; or that never came under my obſervation; and (for that reaſon) are not to be found in this catalogue. 13

ARITHMETIC
THE
DOCTRIN of NUMBER.

Parts of Arithmetic:

1 NOTATION, NUMERATION, RULES, OPERATIONS.

2 NOTATION: Doctrin of *Signs* [a]; and of *Figures* [b]: *digits* (nine) and a *cipher* [b].

3 NUMER: Expression of *Numbers*: *fractions*, Parts; *integers*, Wholes note [c].

4 *Ten* of the Row-to-the-Right make *One* of the Row-to-the-Left [d]·— And

5 *Period*, six Figures: By *threes* write, and read; to-wit, Units (I) Tens (x) Hundreds (c).

6 *Commas*, note Thousands; *Dots*, Periods: 2d, Millions; 3d, Trillions; and so on [e].

7 OPER: Addition, Substraction, Multiplication, Division [f]. - - - - - - - - - 4

8 RULES: Re. Pro. Prác. In. Reb. Ex. Tare: Fél. Ba. Gain: Cómb. Al. Equ. Ev. False [g]. - - - - - - - - - - - 15

in handling of which, regard is to be had to

9 *Signs:* Add, *and* (+) Sub, *from* (—) Múlt, *into* (x) Div, *by* (÷) E'qual-to (=) So is (::) [h].

10 *Denominations* (different) of Coins, Measures, Weights: Vide *Tables.*

A Abbreviatures *Explaind:* Alligation. Barter. Combination. Equation. Evolution. Exchange. Fellowship. Interest. Practise. Proportion. Rebate. Reduction.

E Equivalents *Referd:* Alternations = *combination.* Arbitration, *exchange.* Commutation, *barter.* Company, *fellowship.* Composition, *combination.* Discount, *rebate.* Elections, *combination.* Extraction, *evolution.* Factorship, *fellowship.* Loss, *gain.* Partnership, *fellowship.* Permutation, *combination.* Position, *false.* Profit, *gain.* Supposition, *false.* Trucking, *barter.*

a For the *Signs,* or Characters, expressive of the several operations, &c. V. line 9.

b The *Figures,* or Arabic characters, are—nine *digits,* (1 one, 2 two, 3 three, 4 four, 5 five, 6 six, 7 seven, 8 eight, 9 nine) and — a *cipher,* or Nought, or Ought (as it is vulgarly calld) to-wit 0: for the Use of which, See note [d], and [c] †. See also Notation-Table, in the Frontispiece.

c *Fractions* (importing the Parts, or Subdivisions of an Integer) are either Vulgar, or Decimal——To give an Idea of both: *Four, and three fourths* are exprest (1) in *vulgar* Fractions, thus: $4\frac{3}{4}$ * (2) in *decimal* Fractions (a Dot, or Comma, being the Separatrix; which, in Mixt numbers, distinguishes the Integer from the Fraction) thus: 4.75, or 4,75 †.

* $4\frac{3}{4}$ is calld a *Mixt* Number, as consisting of——4, an *integer;* signifying so many Wholes, for instance, Shillings: & ——$\frac{3}{4}$, a *fraction* (of which, 3, the Upper, is calld the Numerator; and 4, the Under, the Denominator) importing 3 Parts of a Whole divided into 4; that is, Three-Fourths, or Three-Quarters. Accordingly, $4\frac{3}{4}s$ is 4*s* 9*d*; 1 fourth of a shilling being 3*d*; and, consequently, 3 fourths, 9*d*.

† 4.75 is equivalent to $4\frac{3}{4}$: the denominator of .75 being conceivd to be 100; which bears the same proportion to 75, as 4 does to 3: for, 4 : 3 :: 100 : 75.—— In like manner, .5 is $\frac{5}{10}$ (that is, 5 Tenths, or 1 Half) .25 is $\frac{25}{100}$ (that is, 25 Hundredths, or 1 Quarter) and, so, in all cases; taking the figures exprest for a numerator; and supposing 1 under the separatrix, and ciphers under the figures, for a denominator——So that a decimal is a fraction, whose denominator (not exprest) is to be understood to be 10, or some power of 10; viz. 100, 1000,

1000, &c.——And hence it appears that ciphers, at the end of a decimal fraction, have no value: .5 being equal to .50, or .500; since 5 bears the same proportion to 10, as 50 to 100, or 500 to 5000. V. note [d] *.

d Thus (in the Numeration-table, in the frontispiece) ten of the 1st row (to the right) make one of the 2d; to-wit one ten (exprest by 1 before a cipher, thus: 10): and ten of the 2d row make one of the 3d; that is, ten tens make 1 hundred; to express which 2 ciphers are to be plac'd after the 1, thus: 100; and so of the rest——And hence appears the use of the *cipher*; viz. to raise the value (by altering the place) of the figures to the left of them *: Thus 9, by one cipher added, is removed to the place of tens; and becomes 90 (that is, 9 tens, or ninety) by two, 900 (nine-hundred) &c.——And, from this consideration, we find that a precise idea may be formed of any number, be it ever so great, and by what name soever calld; so we do but know its distance from Unity. V. note [e].

* Before figures (to the right of them) they have no value [05, 005, are but 5] except in decimals, where they diminish [.5 is $\frac{5}{10}$ or $\frac{1}{2}$, .05 is $\frac{5}{100}$, .005 is $\frac{5}{1000}$ &c.] And it is to be observd that the diminution encreases in proportion to the rising of the numbers: Thus the denominative value 'Hundreth' is lesser than that of 'Tenth'; forasmuch as the Hundreth part of a thing is ten times less than the Tenth of it. V. note [c] †.

e To initiate a child in *reading* by means of the Numeration-table in the frontispiece——Let him begin to practise on the three figures of the semiperiod to the right; and fix an idea of the value of their places by the terms of units, tens, hundreds. So 21 will appear to be 2 tens (or twenty) and 1 unit; to be read twenty-one: and 321 (to-wit, 3 hundreds, and 2 tens, and 1) will be three hundred and twenty-one.——Then, regard had to the names of the periods, he may (in the same manner, and with the same ease) *read* the longest series of figures. Thus the example, in the frontispiece, will be a hundred twenty three thousand (viz. trillions; but not to be exprest till you come to the end of the period) 456 Trillions *: 789 thousand, 987 Millions: 654 thousand, 321.——And, in this manner, any sum, how long soever, being commad and dotted, is (as it were) spelt; and becomes as legible as a syllable of three letters——And, which adds greatly to the conveniency, the longest sum may be *writ* forward, without the least hesitation, or retrospection from the last figures: so that there is no need of saying, through a long train of figures (as is usual) 'units, tens, hundreds, thousands, tens of thousands, hundreds of thousands, millions, &c.' †——A tyro may, indeed, be puzzled by a different way of expression; but may easily be led into a right conception. For example, To write-down 11 thousand, 11 hundred, and 11; he may be apt to set-out wrong: but, give him the hint that 11 hundred (by virtue of the comma) is 1,100 [that is, 1 thousand, 1 hundred] and he will add that thousand to 11,000; which will make the number (in plain numeration) 12,111; as will appear more expresly by addition, as in the margin. By like considerations he will find that six score and 10, is 130; three dozen and 4, is 40; &c. V. Frontisp. & pref. 11.

11,000
1,100
11
12,111

This period, by custom time-out-of-mind, is calld, even to this day, *millions of millions*; the 4th, of course, millions of millions of millions; and so on: but the terms are too vague and embarassing, to deserve regard.——By the modern reformers it is commonly calld *billions*: but may, I think, be more instructively calld *Trillions*, from tres three; as being the third, in order. And, agreeably hereto, the rising periods may be denominated, from their relation to the first, Quatrillions, Quinquillions, &c.

Thus, To write *forty millions, two hundred thousand and eight*: attending only to the names and powers of the periods, I set-down 40. (with a dot, to import the period; to-wit, millions) Then 200, (with a comma, to denote the semiperiod of thousands) And, with regard to the last semiperiod, having neither hundreds, nor tens; I fill-up the places with ciphers, and write 008. So, it is 40.200,008.

The Operations of arithmetic consist in the managing and working of figures, in order to the solving of questions.———They are, properly speaking, only the four mentiond in the text; the doctrin of *evolution*, & *fractions* being referable to them.——For the *proof* of them, or the means of being satisfied that they are rightly performd; V. Proof.

The Rules of arithmetic, as they are commonly calld, give

give particular directions how to apply the operations for the solution of questions——*For the order in which they are to be learnt*; that, in which they are here recited, may (perhaps) be the most commodious. However, since, as Mr Dilworth (pref. p. 7.) observes, there are hardly two masters, that follow the order of the rules alike; some liking best to teach that rule first, which another thinks convenient to teach afterward; while another looks upon it as a matter quite indifferent, among some rules, which he teaches first: it is to be hop'd, no objection will be made, either to the order I here propose; or to that of the book, which is dispos'd alphabeticaly; for, notwithstanding this difference in the disposition of them, every body may here (most readily) turn to that rule first, which he likes should be taught first. V. Pref. paragra. 7.

h *The Signs*, or characters, made-use-of by arithmeticians, more concisely and commodiously to denote the several operations, &c. are as in the text, and frontispiece. —*For example* (1) $2 + 4 = 6$ (2) $9 - 6 = 3$ (3) $3 + 6 = 18$ (4) $12 \div 3 = 4$ (5) $3 : 6 :: 4 : 8$. ——*Read thus:* (1) 2 and 4 is 6 * (2) 6 from 9 is 3 † (3) 3 into 6 is 18 ‡ (4) 12 by 3 is 4 § (5), as 3 is to 6, so is 4 to 8 ‖. V. Frontisp. & pref. 11.

* Or, 2 plus [more] 4 is equal to 6.

† Or, 9 minus [less] 6, there remains [rests] 3.

‡ Or, 3 times 6 makes 18.

§ Or, 12, by 3, gives [quotes] 4. Or, the threes in 12, 4. §

‖ Or, If 3 gives 6, 4 will give 8 ‖.

Division is also exprest (1) by reverse Parentheses: 3) 12 (4, (2) by numbers plac'd Fraction-wise: $\frac{12}{3}$; the lower number being the divisor; the upper the dividend.

ADDITION.

1 ADD. Place the figures in rows: units under units; to tens, tens; &c.

2 (of different names, same to same; in each, less than th' amounts to the next name)

3 Cast-up the last, and the total set-down: Then, go backwards [a]——In *Deep* rows

I) Dot the Amounts-to-the-next-name *: thither carry 'em, having writ the Remainder [b].

II) Or, by Division, the amounts find † (1) when Easy (2) or book to be kept Fair [c].

Shillings as Integers: half even-tens carry; set down the odd one [d].

When it is Fitest to Dot [e];

Clear-up the tens with the units; though added asunder, in summing [f].

When

The Amounts-to-the-next-name are Fractions;

Bring the sum to the least name: Divide by what the amount makes [g].

For example: To add 24 20 and 3——Having plac'd them in rows, units under units, tens under tens, as in the margin——Cast-up the last row, that of units; Saying * 3 + 4 = 7: which set-down directly under the row——Then, going-backwards to the row of tens, Say 2 + 2 = 4: which set down likewise; and the sum, or total (or, as some call it, the sum-total) is 47. V. Front. & Pref. 11.

24
20
3
47

Or, rather (after a little practise, at least) *adding* the particulars, *without naming* them: which is the easiest and speediest way; so many sounds as there are figures being spar'd, and the mind (unembarrast with din) more free to think.

For example: To add-up the sum in the margin:—Having plac'd, in rows, denomination under denomination †, units under units, &c. Begin at the last row, that of farthings ‡; and say: 2 + 3 = 5; that is 1 penny (the amount to 1 of the next row) and 1q: say, therefore, Dot, and go 1.

Denomin.	*l.*	*s.*	*d.*	*q.*
Particulars.	4	18.	11.	3
	9	16	9.	2.
	*--	—	5	3.
	7	19.	10.	2
Total —	22	16	1	2

——Then,

——Then, that 1 (carried-on) + 2 = 3 + 3 = 6 q: that is 1 d (the 2d amount to one of the next name) and 2 q: which q set-down (having no more to add in that row) and carry the 2 dots, or 2 d, to the next row—And say: 2 (that I carry) + 10 = 12 (the first amount to 1 of the next row) Dot, therefore, and go-on, as in the farthing-row, with the pence and shillings.

NB. The First row (in all cases) is considerd as consisting of *integers*; and is, therefore, in regard to the decuple proportion of the rows (mentiond under the article Arithmetic, line 4) to be cast-up, without doting, by carrying the tens (that each row amounts-to) to the next; and seting-down the overplus. V. note [d].

* *A dash*, instead of a cipher, is more readily made; and leaves the sum opener to the eye, and easier to be cast-up.——*Formerly*, two ciphers were usd (under a notion of uniformity) to set-down nothing.——And, *even Now*, it is a very common practise to make two slope-dashes between every denomination; which is taking pains, to ill purpose.

† *The particular denominations being reduc'd to the usual ones, if exprest otherwise.* For example, Six and thirty shillings = 1 l 16 s: Nineteen pence = 1 s 7 d: Three half-pence = 1 d. 2 q.——And, thus, in receiving mony of several coins; each species being estimated asunder, the total will arise more easily. Thus, suppose I were paid a sum in 3 moidores, 2 portugal pieces, 5 guineas: I say (for the moidores) 3 × 27 s = 81 s; and set-down 4 l 1 s: Then (for the portugal pieces) 2 × 3 l = 6 l; and 2 × 12 s = 24 s; in all 7 l 4 s. Then (for the guineas) 5 × 21 s. = 105 s; that is 5 l 5 s. Then 4 l 1 s + 7 l 4 s + 5 l 5 s = £ 16 10: To which may be added whatever silver, &c. is paid with the aforesaid pieces. V. Reduction, note [b].

‡ *Farthings* are commonly set-down fractionwise ($\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$) which Mr Fisher (p. 14) will have to be the best way: though it is hard to say on what account; there being three strokes of the pen instead of one; beside the unsightliness to the eye, and embarasment in the operation, without any one advantage.

c *For example*: In the above-sum (note [b])——Casting-up the whole row, say 2 + 3 = 5 + 2 = 7 + 3 = 10 q: or rather, looking on the figures (without pronouncinnouncing them) ſay 5 7 10; according to the hint, given note [a].——Then, the number of farthings in a penny (the next name) being 4; ſay, the fours in ten: Anſw. twice; which is 2 d (to be carried to the next row) and 2 q over; to be ſet-down: And ſo on.——*NB.* Thus (in lieu of pence-tables, &c. *) (I) *A diviſor* (1) when ſmall enough for the head, gives the amounts to-the-next-row (2) and when too-large, may be workt on a ſlate. (II) Or (till diviſion is learnt) the amounts, as they ariſe may be noted (1) by clenching the fingers ſucceſſively, (2) or by doting on a bit of paper applied to the edge of the row; in order to keep the account fair, and unblur'd. V. note [c].

Pence-tables [20d is 1s 8d: 30d is 2s 6d, &c.] are (however generaly recommended) not only unneceſſary, but embarraſſing. Setting-aſide the charging of the memory with ſuch tables (the uſe of which extends no farther than to pence) it is eaſier, if I would know the value of 87d, to ſay 12 in 87: anſwer 7, and 3 over, (to-wit, 7s 3d) than, firſt to conſider that 80d is 6s 8d; and then add 7d: which, a ſudden thought does not ſo readily hit-upon to be 7s 3d as in the aforeſaid manner, wherein is requird no more attention than to the multiplication-table, which muſt be known.

Shillings are moſt commodiouſly caſt-up as integers (V. note [b]) in which you carry the tens of the preceding row to the next; and ſet-down the overplus——Thus, in the ſhilling-row (note [b]) 3 (that you carry) + 9 + 6 + 8 = 26: ſet-down the 6 (the overplus of the tens) and carry the 2 tens to the next row; where 2 (that you carry) + 1 + 1 + 1 = 5. Then, having ſet-down the odd-one, carry to the next row (that of pounds) the half of the even tens, to-wit, 4: that is, 4 ten ſhillings; or 2 pounds.

That is, I think, when the amount-to-the-next-name is too great to divide-by with the head only: though Mr Malcolm (arithm. p. 81) is of opinion that there is leſs trouble in doting; and, even, that it is more convenient than to do the work by diviſion (when one can do it ſo) becauſe more ſimple. V. note [c].

For

f *For example*: In casting-up the sum in the margin: say——First, 41 + 7 = 48 + 30 = 78: dot (at 60, the number of minutes that make an hour) and carry 18——Then, 18 + 9 = 27 + 40 = 67: dot, and go 7.——Then, 7 + 6 = 13 + 50 = 63: dot, and set-down (the overplus) 3.——Then, carrying the dots to the next name, proceed as in integers. V. note [b].

hrs	min.
23	56.
22	49.
16	37.
19	41
83	3

g *For example:* In casting-up the sum in the margin, Say —— For the *runlets* (1) First 1 + 1 + 1 + 1 = 4 runlets (2) Then (there being $1\frac{3}{4}$ of them in a barrel) bring them to the least name, *viz.* quarters; saying 4 × 4 = 16. (3) Then, 16 ÷ 7 (the number of quarters, that make the amount-to-the-next-name; to-wit, barrels) = 2 barrels (to be carried) and 2 quarters, or half a runlet to be set-down)——For the *barrels* (1) First 2 (that you carry) + 1 + 1 + 1 + 1 = 6 (2) Then (there being $1\frac{1}{3}$ of them in a tierce) bring them to the least name, to-wit thirds; saying 3 × 6 = 18. (3) Then 18 ÷ 4 (the number of thirds, that make the amount-to-the-next-name; to-wit, tierce) = 4 tierce (to be carried) and $\frac{2}{3}$ (to be set-down).—— For the *tierce*, proceeding in the same manner; and——For the *hogsheads*, casting-them-up as integers (V. note [b]) The total will be as in the margin.

hogsh.	tierc.	barr.	runl.
24	1	1	1
32	1	1	1
59	1	1	1
19	1	1	1
138	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{2}$

ALLIGATION.

1 AL. for propórtioning ŏf míxtures * is Médial (l. 2.) or Alternate (l. 3.)

2 M'EAN *rate of mixtures to find:* As the Things to their Rátes; so a Part is [a].

3 M'IXTURES *to mâke for a Ráte* [b]: (1) Counterplace the dífferences ŏ'th' extremes; [c].

linking

4 línking a gréat and a léſs [d]; and an ódd-
one to éach of the others, [e].
5 (2) *Pártial:* As dìfference of gíven to gíven;
ſo ŏf ſoúght unto ſought is [f].
6 (3) *Tótal:* As dìfferences ŏf quántities; ſó to
its quántity each difference [g].

Hither may be Referd the Doctrin of
ALLOY.

7 ALLOY: the mixture of copper, that makes
Gold and Silver *ſtandard*, &c. [h].
8 *Gold:* carat ed, copper e [i]. *Silver:* pen-
ny-weight ded, copper aei [k].
9 V'ALUE [l]: *Ounce*; Cópper, u,trŏ farthings [m]:
Sílver, auz pence [n]: Gold, o pounds [o].
10 Therefore, *Grains*; Guinea, ben: Shillin,
oui: Half-penny, *Drams* i:
11 And, the want of *a Grain*, in Gold, 2-pence;
Silver $\frac{1}{2}$-farthing [p].

a *For example:*—I. A *merchant* has 13 gallons of wine at 17s per gallon; 11 gallons, at 15s; and 19 gallons, at 14s. If theſe are mixt, What is the price of 1 gallon of the mixture? (Anſw.) As 43 g to 652s (the value of the gallons, according to the rate *) So 1 gallon to 15s 1 d 3 $\frac{35}{43}$ q. (Note) If we ſuppoſe 6 gallons of water (whoſe value is nothing) mixt with theſe; the proportion is this: If 49 g coſt 652s; what 1 gallon?——II. A *goldſmith* mixes 7 ounces of gold, 23 carats fine, with 13 ounces 19 carats fine: What is the quality of the mixture †? Say, As 20 oz to 408 carats (of pure gold: the value, in quality, of the 20 oz †) So is 1 oz (of the mixture) to $20\frac{2}{5}$ carats.

* For—If 1 g gives 17*s*; 13 g will give 221 *s*.—And, if 1 g gives 15*s*; 11 g will give 165*s*--And, if 1 g gives 14*s*; 19 g will give 266*s*—Then, 221 + 165 + 266 = 652*s*.
For the nature of this mixture, V. Alloy, l. 7.

† For—If 1 oz has 23 carats (of pure gold) 7 oz have

161 carats.—And, If 1 oz. has 19 carats (of fine gold) 13 have 247 carats——Then 161 + 247 = 408.

b *Alternate* Alligation has 3 cases; and may be calld (1) *Simple*, When the mean rate of the mixtures is given; but neither the whole quantity of the ingredients to be mixt, nor any part of them, is limited. (2) *Partial*, When one of the quantities is given, with the mean rate of the whole mixture. (3) *Total*, When the sum of all the quantities is given, with the mean rate of that sum.

c *For example:* How much wheat (at 5s the bushel) and rye (at 3s 6d the bushel) will make a mixture that may be sold at 4s 4d the bushel?——*Answ.* (the prices being brought into one name)

d. 52	60d. Wheat. 10 the differ. of the less extreme	counterplac'd
	42 d. Rye. 8 the differ. of the greater extreme.	

So, the mixture requird will be 10 bushels of wheat, and 8 of rye.—*Proof:* As 18 (the sum of the bushels, 10 + 8) to (600 + 336) 936 (d. the total of the price of 10 bushels, at 60d; and 8 bushels, at 42d.)—So is 1 (bushel of the mixture) to 52 (d. the mean rate.

d *For example:* A *vintner* would make a mixture of malaga (worth 7s 6d a-gallon) with canary (at 6s 9d a-gallon) sherry (at 5s a-gallon) and white wine (at 4s 3d a-gallon) what quantity of each must he take, that the mixture may be sold for 6s, a-gallon?——Answ.

d. 72	90 Malaga	21	or	90 Malaga	12	72 d.
	51 White	18		60 Sherry	18	
	60 Sherry	9		81 Canary	21	
	81 Canary	12		51 White	9	

—Suppose it were requird that the whole mixture should consist of 20 gallons: Say, As 60 (the number of the gallons of all the wines, found by the differences) to 21 (the gallons of malaga found by the differences) So is 20 (the number of the gallons required to be mixt) to 7 (the gallons of malaga, sought). And so of the rest.

e *For example:* A *tobacconist* would mix three sorts of tobacco together: to-wit, one sort of 18*d* a-pound; another, of 22*d*; and a third, of 2*s*. How much of each must he take, that the mixture may be sold for 20*d* a-pound?—*Answ.* (by linking the odd extreme to each of the others; and counterplacing the difference of the rates, twice to the odd-one:

d20

$$20\left\{\begin{matrix}18 & 2+4\\ 22 & -\;-\;2 \\ 24 & -\;-\;2\end{matrix}\right\} i.e. \left\{\begin{matrix}6\\2\\2\end{matrix}\right\} \text{or} \left\{\begin{matrix}\text{any numb.}\\ \text{in the ſame}\\ \text{proport. as}\end{matrix}\right. \left|\begin{matrix}9&12&15\\3&4&5\\3&4&5\end{matrix}\right\} \&c.$$

For 6 : 2 :: 9 : 3, &c. in infinitum.

The rule here is (indeed) limited, in its immediate effect, to the different anſwers found by the various methods of linking the ſimples; which can be done only a certain limited number of ways:—Yet, from this rule we can find an infinit number of other ſolutions. Thus, (1) Take any method of linking the ſimples: then take the quantities ariſing from that method; and, if you increaſe, or diminiſh each of them, in the ſame proportion (i.e. by equal multiplication, or diviſion) theſe new quantities are alſo true anſwers; for that very reaſon that they are proportional to thoſe ariſing immediatly from the linking, and differences: becauſe, if two quantities of two ſimples make a balance of gain or loſs, with reſpect to the mixture-price; ſo muſt double, or triple, or the half, or a third part, or any other proportion of theſe quantities. And, becauſe theſe quantities may be increas'd, or diminiſh'd, in an infinite variety of proportions; therefore it is plain, that we may proceed from an infinit variety of ſolutions. (2) Or if we only encreaſe, or diminiſh, the alternate, or correſpondent differences of any pair of ſimples, that are linkt-together; or of any two, or more pairs, leaving the reſt as they are:- we may thus, alſo, proceed to an infinite number of ſolutions.

For example: How much malaga, at 7*s* 6*d* the gallon; ſherry, at 5*s* the gallon; and white-wine, at 4*s* 3*d* the gallon, muſt be mixt with 18 gallons of canary, at 6*s* 9*d* the gallon; that the whole mixture may be ſold at 6*s* the gallon?—*Anſw.* (the differences being found, as afore, note [c]) As 12 (the quantity of canary, found by the differences of the rates) to 18 (the quantity of canary given) So (1) 21 (the quantity of malaga, found by the differences of the rates) to $31\frac{1}{2}$ (the quantity of the malaga ſought) (2) 18 (as afore) to 27 gallons of white-wine, &c.

For example: Suppoſe it were requird to mix malaga, at 7*s* 6*d* the gallon, with canary, at 6*s* 9*d* the gallon; ſherry, at 5*s* the gallon; and white-wine, at 4*s* 3*d* the gallon; ſo as that the whole mixture may be 90 gallons, to be ſold for 6*s* the gallon: How-much of each ſort will

compoſe

compoſe the mixture?—*Anſw.*(the differences being found, as afore, n. [c]) As 60 (the ſum of the differences) to 90 (the quantity of the mixture) So (1) 21 (the difference, or quantity of malaga, found by the difference of the rates) to 31 $\frac{1}{2}$ (the quantity of malaga for the mixture ſought) (2) 18 (the difference) to 27 (the quantity of the wine) &c.

Note—I. In mixtures, *one ingredient may be ſuch, as to bear no value in the mixture*; but only to encreaſe the quantity, and diminiſh the value. Therefore let its rate be repreſented by 0: as water mixt with wine; braſs, or other alloy, mixt with gold and ſilver. *For example:* (1) If 8 gallons of wine, at 9 ſhillings per gallon; 12 gallons, at 8*s*, are mixt together: how much water muſt be added to make the mixture worth only 6*s* per gallon? (*Anſw.*) I find the mixture-rate of the 8 gallons, and 12 gallons: then, I take 20 gallons at that rate, to mix with water, whoſe rate is 0; which is done according to the inſtructions in note [f]. (2) A goldſmith would mix gold 18 carats fine, 20 carats fine, 24 carats fine; and a quantity of alloy, to make the mixture 19 carats fine: How much muſt be taken of each? Repreſent the rate of the alloy by 0, and proceed as in caſe 2d.—II. Beſide the mixture of liquors, or any other kind of things, the ſame rules are applicable where *perſons* are the ſubjects. Thus: (1) 8 men, being boarded at the rate of 6*l* a quarter, for every man; 6 women, at 5*l* for each woman; and 4 children, at 2*l* for each child: How much does each perſon pay a quarter; taking them at an equal rate, one with another? This is plainly a queſtion of alligation medial; and to be ſolvd after that manner. (2) If the quarter's board for a man is 5*l*, for a woman 4*l*, for a child 3*l*, and for a ſervant 1*l*: How many men, women, children, and ſervants may be taken to board; ſo as their board, at an equal rate, may come to 3*l* 5*s*, for each perſon? This is alſo a plain queſtion of alligation alternate.—III. The rules of alligation may alſo be applied to the mixture of bodies, with reſpect to their *ſpecific gravities*, (or bulks, which is in effect the ſame thing) thus: (1) If there are given the ſpecific bulks of ſeveral bodies (or ſpecific gravities, by which the bulks may be found) together with the quantities or weights of each put into a mixture. (*Example*) Suppoſe 10 ounces of metal, whoſe ſpecific bulk is 3 (that is, 3 cubical inches to 1 ounce) are mixt with 14 ounces of another, whoſe ſpecific bulk is 2: What is the ſpecific bulk of the mixture? (*Anſw.*) $\frac{12}{29}$: found thus: If 1 ounce makes 3 cubical inches, 10 ounces will make 30: and, if 1 oz makes 2; then 14 oz make 28: and, laſtly, if 24 (*i. e.* 10 and 14) ounces make 58 (*i. e.* 30 and 28) cubical inches; 1 oz will make $\frac{12}{29}$. Then, the ſpecific gravities of the metals that are mixt, and of the compound, are $\frac{1}{10}$, $\frac{1}{14}$, $\frac{29}{12}$. (2) Having the ſpecific bulks (or gravities, by which the bulks are found) of ſeveral bodies to be mixt, and the ſpecific bulk (or gravity) to which a mixture of theſe bodies are to be reduc'd: To find the proportional quantities to be taken of each; that the mixture may bear the given rate of the ſpecific bulk (or gravity) Take the given ſpecific bulks of the bodies to be mixt: link them together: then take, and place their differences from the ſpecific bulk of the mixture, the ſame way as taught in alligation alternate; and you have the anſwer. (*Example*) Suppoſe two metals, whereof the one has 2 cubical inches to 1 lb weight, and the other 5: What proportion of weight of each muſt be taken, to make the mixture 3 cubical inches to 1 lb. (*Anſw.*) 2 lb of the 1ſt to every one of the other, as in the margin. (*Note*) By this rule is the famous queſtion ſolvd about Hiero, king of Syracuſe's crown: He gave a certain quantity of pure gold to make a crown: but ſuſpecting the goldſmith had mixt ſilver with it, he deſird Archimedes to diſcover it,

cub. inch.		2	2	lb weight
	3			
		5	1	

if poſſible; who did it by this means: When he went into a bathing tub, he reflected that every body, immerſt in water, muſt put as much water out of its place as is equal, in bulk, to it-ſelf. Therefore he took a quantity of pure gold, and another of ſilver, each of the weight of the crown; or, as ſome ſay, cauſd a crown to be made of pure gold; and another, of ſilver; each of the ſame weight with the firſt crown; and meaſurd their ſpecific bulks by the bulks of the quantities of water put out of its place' by the immerſion of each of the three crowns (or of the ſuſpected crown, and of each of the maſſes of pure gold and ſilver; which would put out the ſame quantity of water, whatever ſhape they were in) and, by compariſon of the three ſpecific bulks, he found how much

much gold and silver was in the mixt crown; which may be done after the manner of the example in note [e].

h The mixture of copper with gold and silver (calld the *alloy*) is partly to make those metals harder for wear; and partly to defray the expenses of coining; no seignorage * being now paid for coining mony.

* *Seignorage* is a duty belonging to a prince for the coining of mony; which has been different, in different nations, and reigns.——In England, in the 18th year of K. Charles II, it was abolisht by an act of parliament; by which it was enacted that all mony should be struck at the public expense. So that weight is returnd for weight to all persons, who carry their gold and silver to the mint.

i *That is,* If any quantity, or weight, of fine gold be divided into 24 equal parts, (calld *carats*) and 22 of those equal parts be mixt with 2 of the like parts of copper; that mixture is calld *Standard* gold: on which the goldsmiths generaly work.——*NB.* (1) The old sterling, or right standard gold of England (which obtaind till the 18th of Henry VIII) was 23 car. $3\frac{1}{2}$ grains of fine gold, and $\frac{1}{2}$ grain of alloy: which alloy, according to the red book, might be silver, or copper. (2) If, by assaying any quantity of gold by the coppel [or crucible, in which it is melted] it loses nothing of its weight; it is fine gold *. If the loss be $\frac{1}{24}$ part they call it 23 carats fine, or one carrat better than standard. If it has lost $\frac{2}{24}$ parts; it is 22 carats fine, or standard: if $\frac{3}{24}$; it is said to be 21 carats fine, or rather, one carat worse than standard: and so in proportion, as it happens to be better, or worse.

* But it is observd, that, what care soever is taken in purifying *gold*, to clear it from dross; it *can never be brought to* 24 *carats*; but, still, comes short of $\frac{1}{4}$ of a carat, or one grain. This grain they call a 16th: and this 16th they divide into two 8ths; and each of those 8ths into two 16ths: on which calculation, they say gold may be purified as far as the first 16th of the second 8th; but no further.

k *That is,* Eleven ounces, and two penny-weight of fine silver, and eighteen penny-weight of copper, being melted together, is esteemd the true standard for silver coin, calld *Sterling* silver. And so, in proportion, for a greater, or lesser quantity, than for gold.

The *value* is here given in round numbers: in the notes, more precisely.——*NB.* In different reigns the value of gold and silver has been raisd, and lowerd. V. Folkes, Leake, Nummi britannici historia, &c.

A *pound* averdupois of copper is coind into 23 pence. Therefore (1) the Weight of a *half-penny* is 3.82 drams (2) and the Value of an *ounce* 5.75 farthings.

By the indentures of the mint (43 El. 2 C. 1. 22 C. 2. 1 J. 2.) 62*s* were to be coind out of a *Pound*-troy of silver.——The true Weight, therefore (1) of a *crown* is about 1 dw. 8.496 gr. (2) of a *shilling* 92.903$\frac{1}{5}$ grains.

By the indenture of the mint (22 C. 2) 44$\frac{1}{2}$ guineas were to be coind out of a *Pound*-troy of gold.——The true Weight of a *guinea*, therefore, is 129.43 gr.—— and (at the rate of 21*s.* per guinea) the Value (1) of an *ounce* is £ 3 18 1, 2.697 (2) of a *grain* q 7.812$\frac{1}{2}$. Nearly. V. notes [e f g].——*NB. To find the Value of Foreign Coins*, according to the present value of the English (suppose, for instance, a piece 23 car. 2 gr. fine) Having found the fineness by the coppel——To know the *value of an ounce of it*, say: As 22 car. (the fineness of the English standard) to 4 l (the value of an ounce of our coin) so is 23 car. 2 gr. (the fineness of the foreign coin). Then——For the *value of the coin*, say: If the value of 1 oz be £ 4 5 5 1.8; what will be the value of a coin, weighing so-much (as it is found to weigh).

ANNUITIES.

I. In Arrears.

1. *At Simple interest.*

ANN [a] [in Arrears [b]] at Simple interest: Find (I) the *Amount* [c], thus: Sum of the series to th' years, less 1 [d], into I [e] add N T. [f]

(II) *An-*

3 (II) *A'nnuity'*: the Amount by. Súm into Rate, more the years; gives [g].

4 (III) *Ráte:* A, lefs N' into T, by N into Sum of fer. lefs 1 [h].

5 (IV) *Time:* Take N' into R' (the firft térm of a próg by that difference)

6 Thén take the Súm of the féries: Add N' into númber more by one [i].

II. *At Compound intereft.*

7 A'nn (in Arrears) at Compound íntereft: Fínd (V) the *Amount*, thus:

8 Geo-próg Rate to the number o'th'years [k]: into N fum o'th' feries [l].

9 (VI) *A'nnuity'*: the Amóunt by th'Amount of 1' (into th'Time) pound [m].

10 (VII) *Tíme:* A of P-correfpond by its P: Rate involve to the quotient [n].

Rate . . . . find by . . . . *Algebra* [o].

II. The PURCHASE,

1. For a CERTAIN NUMBER of YEARS.

I. *At Simple intereft.*

11 Ann [Purchǽfe] Simple íntereft [p] (VIII) *Wórth*: Sum of difcounts for each Year [q].

12 (IX) *A'nnuity'*: given Worth by Wórth of 1 póund for years given [r].

13 (X) *Tíme:* N by feries of A of 1 póund; till the quóte gives Worth given [s].

II. *At Compound interest.*

14 A'nn (Purchase) Compound ínterest (XI)
Wórth to find: príncipal-sum find,
15 óf which the 'N's 1 year's ínterest: Thén,
Worth of thát for the Time—Then,
16 Thís present Wórth from its príncipal—
The Remainder's the Worth of the N
sought [t].
17 (XII) *A'nnuity*: Worth of N sought, b'y
Worth of 1 pound for Time [u].
18 (XIII) *Tíme*: Find a príncipal, whereóf 1
year's Interest is the N—Hence
19 Táke given Wórth—The remaínder's the
Wórth of that príncipal—Then, That
20 Príncipal by its Wórth gives the power of
the Tíme for the years sought [w].

2. For Ever.

21 Ann (for Ever) at Cómp. int. (XIV) the
Worth, the Príncipal-sum is
22 of which 1 year's ínterest is the Rént, or N
given [x].
23 (XV) *Rate* (for ever) the Wórth more annu-
ity by the Worth, is [y].
24 (XVI) *Annuity* (for ever) the Wórth into Ráte
less the Worth, is [z].

3. In Reversion.

25 Ann (in Reversion [aa]) at Compound interest:
To find (XVII) the *Value*:
26 (1) First find the Worth (2) Then, what P
will amount to that worth, till Commence-
ment [bb].

(XVIII)

27 (XVIII) *Principal:* (1) Find A till cómm (2) Then what N will prodúce that A, for time [cc].

28 (XIX) *Time:* Find A till comménce. (2) Then, what T will gíve that A, for time [dd].

29 4. In Case of Fines; take the needful directions in Notes, as follow [ee].

a An *annuity*, or Pension, is a sum of money payable, every year, for a certain number of years, or for ever. And though it be divided into half year-, or quarterly payments *, it still goes under the general name of annuity; because the whole payments make so much in a year.

NB.—*The initial letters*, in the following questions and solutions, are the same as in the article Interest, note [a].—*For the readier calculating* of annuities, it is generaly thought the most convenient method, to have tables ready-made, extending to the greatest number of years that ordinarily occur in that business; and for several rates of interest, that are most likely to occur: by means of which the answers of the most useful problems may be easily found *. —*But*, inasmuch as the greatest burthen of the work is the finding the power or product of the rate, or sum of it, and 1 year's interest, multiplied continualy into itself, as the rules direct (which, if the number of years in the question is great, becomes very tedious) it may suffice to give a table of the powers of several rates of interest carried to a convenient length; which are the amounts of 1 *l* principal for 1, 2, &c. years, at compound interest, according to problem V. †, That in the margin, at 5 per cent, to 31 years; is an example,

Amounts of 1 *l* at 5 per cent. for a year, &c.

1	1.05
2	1.025
3	1.157525
4	1.215506
5	1.276281
6	1.340096
7	1.407100
8	1.477455
9	1.551328
10	1.628895
11	1.710339
12	1.795856
13	1.885649
14	1.979932
15	2.078928
16	2.182874
17	2.292018
18	2.406919
19	2.526950
20	2.653298
21	2.785962
22	2.925261
23	3.071524
24	3.225100
25	3.386355
26	3.555673
27	3.733456
28	3.920129
29	4.116135
30	4.321942
31	4.538039

whic

which may be extended to more years; and the like made for other rates of interest ‡. V Fractions, note [n].

* The problems, that follow under this head, are calculated on the suppofition of annual payments: but the rules are applicable to half-yearly or quarterly-paid annuities, the fame way as to yearly payments: only taking T to reprefent the number of half-years, or quarters, that an annuity continues; R, the intereft of 1 *l* for $\frac{1}{2}$ or $\frac{1}{4}$ of a year; and N, the half-year's, or quarter's payment.

† The tables, which are common upon this fubject, are limited to 1 *l*.—Thus, we have tables (1) of the *amounts* of 1 *l*, for 30 or 50 years, at feveral rates, compound intereft. (2) of the prefent *worths* of 1 *l*, due after any number of years, from 1 to 30 or 50. (3) of the amounts of 1 *l annuity*. (4) of the prefent worths of 1 *l* annuity (5) of the annuity to be purchas'd for 1 *l*.—By means of which the anfwer to the feveral problems is not a little facilitated.

‡ *NB*. This table was made by completing the multiplication at every ftep; and then taking the firft 6 decimal places. Alfo, when the figure in the 7th place exceeded 5, 1 was added to the 6th place: which makes the error lefs; only it makes it exceffive, inftead of defective.

b An annuity is faid to be *in arrears*; when the debtor keeps it in his hand for a certain number of years, paying the whole at laft with intereft, for every year after it falls due.

c The amount of an annuity, forborn for any number of years, is the total of the feveral years with the intereft due upon each—*NB*. If an annuity is to be bought off, or paid all-at-once, at the very begining of the firft year; the price, which ought to be paid for it, difcounting for the advancement, is calld the *prefent worth* of it for fo many years.

d *For example*. Seven years : the fum of the feries, lefs 1 *, is $1 + 2 + 3 + 4 + 5 + 6 = 21$: found (more readily) by progreffion, thus: $1 + 6 = 7$: then 6 (the feries) $\times$ 7 the fum of the extremes 1 and 6) $= 42 \div 2 = 21$.

* Whatever the time is, there is due upon the firft year's annuity as many years intereft as the whole number of years lefs; and gradualy 1 lefs upon every fucceeding year, to the laft but one: upon which there is due one year's

year's intereſt, and none upon the laſt. Wherefore, in the whole, there is due as many years intereſt of the annuity, as the ſum of the ſeries, 1, 2, 3, &c. to the number of years leſs one.—Conſequently, one year's intereſt, multiplied by this ſum muſt be the whole intereſt due: to which the whole annuities being added; the ſum is plainly the amount.

e The *intereſt* of the annuity is—the rate; if the annuity be 1 *l*—the product of the rate and annuity; if the annuity be more than 1 *l*.

f *That is*, the product of the annuity and time, or the whole annuity.

For example. [Given n t r; to find A] What is the amount of 50 *l* annuity for 7 years, allowing ſimple intereſt, at 5 *l* per cent, for every year after it falls due? —*Anſw.* $[1s^t - 1 \times i + nt = a]$ 21 (the ſum of the ſeries of the number of years, leſs 1) × 2.50 (the product of the rate and annuity) = 52.5 (the whole intereſt due upon the annuity) + 350 (the product of time and annuity) = 402.5: that is, 402 *l*, 10 *s*; the amount ſought.

g *For example:* [Given a r t; to find N] What annuity will, in 7 years, amount to 402 *l* 10 *s*: allowing 5 per cent, ſimple intereſt?—*Anſw.* $\left[\frac{a}{sr+t} = n\right]$ 402.5 (the amount) ÷ 8.05 (the ſum of the ſeries 21) × .05 (the rate) + 7 (the time) = 50 *l*; the annuity ſought.

h *For example:* [Given a n t; to find R] At what rate of intereſt will an annuity of 50 *l* amount to 402 *l* 10 *s*, in 7 years, at ſimple intereſt?——*Anſw.* $\left[\frac{a - nt}{ns} = r\right]$ 402.5 (the amount) — 350 *l* (the annuity 50, × 7, the years) = 52.5 ÷ 1050 (the annuity 50 *l*, × 21 the ſum of the ſeries, leſs 1 †) = .05, the rate ſought.

† Viz. 1 + 2 + 3 + 4 + 5 + 6 = 21.

i *For example:* [Given a n r; to find T] In what time will 50 *l* annuity amount to 402 *l* 10 *s*, at 5 per cent.

Anſwer. 50 × .05 = 2.5 for the firſt term of a progreſſion. Then, pro-

	rn	2rn	3rn	4rn	5rn	6rn
	2.5 +	5 +	7.5 +	10 +	12.5 +	15
Sums :	7.5	15	25	37.5	52.5	
× 50 :	150	200	250	300	350	
Sums :	157.5	215	275	377.5	402.5	

ceed

ceed as in the margin: where it may be obſervd (1) that 2.5 is the common difference of the progreſſion: for, $2.5 \times 2.5 = 5$: and $5 + 25 = 7.5$: &c. (2) that 2.5 (the 1ſt term) $\times$ 5 (the 2d term) $= 7.5$ (plac'd under the 2d term) and $25 + 5 + 75$ (advancing to the third ſtep) $= 15$ (plac'd under the third term) &c. (3) that 50 (the annuity) $\times$ 3 (the number of the terms ſumd, more by 1) $= 150$ (plac'd under the ſecond term) and, likewiſe, $50 \times 4 = 200$ (under the third place) &c. (4) that the ſums of the ſeries, and the products of 50, added together, bring us (in courſe, at the fifth ſtep) to a ſum equal to the given amount. (5) that the number multiplied into the annuity, in that laſt ſtep (viz. 7) is the time ſought. —*NB.* If you never find a ſum equal to the amount; then the problem is impoſſible in whole years.

k *That is*, of the geometrical progreſſion—Make 1, the leaſt term; the rate, the ſecond; which conſequently, is the ratio of the progreſſion, by which every term is to be multiplied, to produce the next.—— Carry this to as many terms as there are years——Its ſum is the amount of 1 *l* annuity for the given time.

l The ſum of the ſeries for the given time *, multiplied into the given annuity, gives the amount ſought.

For example: [Given n r t; to find A] What is the amount of an annuity of 40*l*, to continue 5 years, allowing compound intereſt at 5 per cent. *Anſw.* $\left[\frac{rt}{r-1} \times \dot{n} = a\right]$ Of a geometrical progreſſion, begining with 1, whoſe ratio is 1.05, the fifth term is $\overline{1.05}|^{4} = 1.21550625$: and the ſum of the ſeries is 5.52563125 †. which multiplied into 40, the product is 221.02525, the amount of 40*l* annuity.

* *To find the ſum* moſt eaſily; multiply the laſt term into the rate (or ratio) which produces a power of the rate, whoſe index is the time; and, from the product take 1, the firſt term: then, divide the remainder by the rate leſs 1: the quote is the ſum. V. note †.

† For, $\overline{1.05}|^{5} = 1.2762815626$; and $\overline{1.05}|^{5} - 1 = 2762815625$: which divided by $1.05 - 1$, or .05; the quote is 5.52563125, the amount of 1 *l* annuity for 5 years.

m *For example:* [Given a r t; to find N] What annuity will amount to 221 *l* 6*d*, in 5 years, at the rate of 5 per cent,

cent, compound intereſt? *Anſw.* $\left[\frac{a}{21}\right]$ 221.025 (the amount given) ÷ 5.52563125 (the amount of 1*l* annuity in 5 years) = 39.999 = 39*l* 19*s* 11*d* 3*q*, &c. or 40*l* nearly: which it would have been preciſely; had we taken 221*l* 0*s* 6.06*d* (or 221.02525) for the amount, as in the preceding problem.

n *For example:* [Given a n r; to find T] In what time will 40*l* annuity amount to 221.02525*l* at the rate of 5 per cent—*Anſw.* To find a correſponding principal, ſay .05 : 1 : : 40 : 800. Then 800 (the correſponding principal) + 221.02525 = 1021.02525: which, divided by 800, the quote is 127628152625; equal to the fifth power of 1.05, or $\overline{1.05}^5$: ſo that 5 is the number of years ſought.

o Here, and in the following problems, I might ſay, with Mr Malcolm (p. 608) that, There is no rule, within my limits, that will ſolve this problem—But, as Mr Hill (p. 343) has helpt us to an arithmetical expedient; the reader will not be diſpleasd with a clearer and conciſer account of it; which I have given under the head of Approximation.

p The rule, here given, is that of Kerſey, ſupported againſt Moreland, Ward, &c. by Malcolm: and is certainly true, in conſiſtence with the ſuppos'd condition, or agreement of the allowing ſimple intereſt; but not abſolutely ſo. For, if we enquire what (in ſtrict equity, and juſtice) ought to be paid for the annuity; then, the rule does not ſhow it: ſince it gives too-much. The true price, Mr Malcolm (arithm. 6.10. p. 600) obſerves, muſt be found by diſcounting compound intereſt. Nor is this contrary to law: for, though, when an annuity is in arrears, the law forbids taking compound intereſt; yet, in the purchaſe of an annuity, if the buyer offers ſuch a price, as allows him compound intereſt for the advance of his mony; he does nothing contrary to the law; becauſe, in buying, a man may offer what price he thinks fit: and he has this good reaſon for it, that, by putting-out his mony, and lifting it, at every year's end, he can improve it by compound intereſt. But, to ſhow, further, how unjuſt ſimple intereſt is, in the purchaſe of annuities; Mr Malcolm gives us an example. An annuity of 50*l* is to be bought for 40 years, diſcounting

ing simple interest, at 5 per cent. The price, according to Moreland's rule, is 1316*l* 13*s* 4*d*: a sum, of which one year's interest exceeds the annuity. Would not one think, then, he had made a pretty bargain, to give, for an annuity to continue only 40 years, a sum, which would yield him a greater yearly interest for ever? If it is also calculated by the other rule; the same will happen, as (he tells us) he has actualy found: though it is much less than the other; as it does not exceed 1100.

q *For example:* [Given a r t; to find W] What is the present worth of an annuity of 100*l*, to continue 5 years, discounting at the rate of 6 per cent, or .06 to 1*l*—— *Answ.* Find the present worth of each year, by itself, discounting from the time it falls due (V. Rebate) the sum of all these is the present worth sought.

	years		as	to	so is	to	
Thus the Amount of 1*l*... for	1	is	1.06	1	100	94.33962	&c.
	2		1.12	1	100	89.28571	
	3		1.18	1	100	84.74576	
	4		1.24	1	100	80.64516	
	5		1.30	1	100	76.92307	
						425.93932	

NB. The work will be somewhat easier, if you find the present worth of 1 *l* annuity for the given time; and, then, multiply that by the given annuity. The product is the present worth: because of the proportionality of annuities, and their present worths.

r *For example:* [Given r t w; to find N] What annuity, to continue 5 years, is worth 220*l* present worth; allowing simple interest at 5 per cent?—*Answ.* 4.3641 (the present worth of 1 *l* for 5 years) ÷ 220 (the present worth of the annuity sought) = 50.399, the annuity sought.

s *For example:* [Given n w r; to find T] What time must an annuity of 50*l* 8*s* continue, to be worth 220*l* ready mony, at the rate of 5 per cent?—*Answ.* 50.4 (the annuity) ÷ 1.05 (the amount of 1*l* for 1 year) = 48. And 50 4 ÷ 1.10 (the annuity of 1*l* for 2 years) = 45.818. And 50.4 ÷ 1.15 (the amount of 1*l* for 3 years) = 43.827. And 50.4 ÷ 1.20 (the amount of 1 *l* for 4 years) = 42. And 50.4 ÷ 1.25 (the

(the amount of 1 *l* for 5 years) = 40.32——Then 48 + 45.818 + 43.827 + 42 + 40.32 = 219.965.—— This sum, then, being nearly the value of 220, the present worth given: the number of quotes (to-wit, 5) is the number of years sought.

t *For example:* What is the present worth of an annuity of 40*l*, to continue 5 years, discounting at 5 per cent? ——*Answ.* (1) To find a principal sum, whereof 1 year's interest is the annuity (to-wit, 40*l*.) Say, .05 : 1 : : 40 : 800. Then (2) To find the present worth of 800*l* (the principal sum found) Say 1.05 (the amount of 1 *l* for 5 years) involv'd 5 times, = 1.276281 (the present worth of 1 *l* for 5 years) and 800 ÷ 1.276281 = 626.8212 (the present worth of 800*l*) (3) Then 626.8212, subtracted from 800 (its principal) gives 173.1788 (the present worth of the annuity sought).

u *For example:* What annuity, to continue 5 years, will be purchasd for 173*l* 3*s* 7*d*; allowing compound interest at 5 per cent?—*Answ.* 173.1788 (the present worth of the annuity sought) ÷ 4.329 (the present worth of 1 *l* annuity, 5 years) = 40.004 (the annuity sought).

w *For example:* What time must an annuity of 40*l* continue, to be worth (of ready mony) 173*l* 3*s* 7*d*; allowing 5 per cent, compound interest?—*Answ.* (1) 800*l*. (the principal sought *)—173.1788 (the given worth) = 626.8212 (the present worth of 800*l*, due at the end of the time sought) Then 800 ÷ 626.8212 = 1.27678 (the power of the 5th root, nearly) So, the time sought is 5 years.

* Found, as in problem XI.

x *For example:* What is the price of a perpetual annuity of 40*l*, discounting at 5 per cent, compound interest? ——*Answ.* $\left[\frac{n}{r-1} = W\right]$ 1.05 (the rate)— 1 = .05. Then, As .05 (the rate less 1) to 1: So is 40*l* (the annuity) to 800*l* (the price, or present worth of the annuity to continue for ever)—*Note*, The reason of this rule seems of its self obvious. For, it is plain, that, Since a year's interest of the price is the annuity: therefore there can neither more, nor less, be made of the price than of the annuity; whether we employ it by simple, or compound interest.

y *For example:* In the preceding question [given w n;

to find R) Say $\left[\frac{w+n}{w}=r\right]$ 800 (the worth) $+$ 40 (the annuity) $=$ 840 $\div$ 800 $=$ 1.05 (the Rate.)

For example: In the preceding queſtion [given w r; to find N) Say [wr—w $=$ n] 800 (the worth) $\times$ 1.05 (the rate) $=$ 840 —800 (the worth) $=$ 40*l* (the annuity).

An annuity or yearly rent, *in reverſion*, is, when it is not to be enterd upon till after ſome time, or number of years are paſt.

For example: Suppoſe it were requird to compute the preſent worth of 75 *l*, yearly rent; which is not to commence, or be enterd-upon, till ten years hence, and then to continue ſeven years after that time; at 6 per cent, and compound intereſt?—*Anſw.* (1) Firſt (by problem XI) the preſent worth of 75 *l*, to continue 7 years at 6 per cent compound intereſt, will be found to be 418.6783. (2) Then (by problem XII) the principal of that worth (viz. 418.6752*l*) or the ſum it will amount-to, put-out 10 years, will be found to be 233.7877. That ſum, therefore, is the preſent worth of 75 *l* per annum, in reverſion, &c. as was requir'd.

For example: What annuity, or yearly rent, to be enterd-upon ten years hence, and then to continue ſeven years; may be purchasd for 233 *l* 15 *s* 9 *d*, ready mony; at 6 per cent, and compound intereſt?—*Anſw.* (1) Firſt (by V) the amount of 233.7877*l* (the preſent worth of an annuity to be enterd-upon after 10 years, at 6 per cent, compound intereſt) will be found 418.6752 *l*. (2) Then (by VI) the yearly rent (which, being ſold, will produce that amount for the preſent worth, at the ſame rate, and forborn 7 years) will be 75 *l* (the annuity ſought).

For example: The preſent worth of a leaſe in reverſion is 233.7877 *l*. The leaſe is 75 *l* a-year; and commences 10 years hence; and the allowance to the purchaſer is 6 per cent. I would know the time of its continuance.—*Anſw.* (1) Firſt (by V) the amount of 233.7877 (the worth given) is 418.6752. (2) Then (by VII) the time (which the yearly rent, given, is ſold-for, to produce that amount for the preſent worth at the ſame rate) will be 7 years.

Annuities, and rents of houſes, or lands, are of the ſame nature; wherein the ſame queſtions occur as to their being

being in arrears, or being purchasd—But, with reſpect to leaſes, there ariſe queſtions with ſome different circumſtances, owing to the practiſe of taking what they call *fines*: which is a ſum of mony paid at the begining of the leaſe, beſides the yearly rent —The following queſtions, with a general direction for the ſolution, will be ſufficient on this ſubject.

I. There is a piece of land worth 20 pound yearly rent, and 100*l* fine, for a leaſe of 21 years. The maſter is willing to quit the fine, and increaſe the rent: What ought the rent to be?—*Rule*. Find what rent, or annuity, to continue 21 years, 100*l* will purchaſe, diſcounting at the agreed rate of intereſt. The ſum of that, and the former rent, is the rent ſought.——*Obſerve*. If the whole is not to be taken-away; find the annuity anſwering to the part taken-away.

II. A piece of land is worth 12*l*, yearly rent, and a fine of 30*l*, for 19 years. The farmer is willing to pay more fine; and reduce the rent to 20*l*. What ought the fine to be?—*Rule*. Take the difference of the two rents (30 and 20) and find the preſent worth of an annuity equal to the difference for the ſame time (19 years.) That is the additional fine to be paid.—*Obſerve*. The ſame way the whole rent may be taken-away.

III. There is a farm to be let for 21 years, at 10*l*, yearly rent; and 20*l* fine. If the ſame be let for 30 years at the ſame rent; What ought the fine to be?—*Rule*. Find what annuity 20*l* will purchaſe for 21 years, at the agreed rate. That, added to the rent 10*l*, is the true rent with no fine. Therefore, find the preſent worth of that annuity, to continue 30 years: it is the fine ſought.

IV. A perſon has ſeven years to run of a leaſe of 21 years; for which he paid 40*l* fine, and 15*l* yearly rent. He would renew the leaſe to 16 years from this time; that is, for 12 years after the firſt leaſe expires. What fine ought he to pay?——*Rule*. Find what rent, for 21 years, the given ſum 40*l* will purchaſe: Then, find the preſent worth of this yearly rent to continue 12 years. Laſtly, find the preſent worth of this laſt preſent worth; rebating for 7 year's time, that remains of the old leaſe. This is the fine to be paid.

APPROXIMATION.

APPROX. a branch of False, for the finding the *Rate* of annuities [a].

Rate to find, in the doctrin of annuities, is a problem best solvd by algebra (V. Annuities, note [c]) But, for the sake of such as are unacquainted with that science, I have here added, what Mr Hill (p. 343) recommends, in this case, the expedient of *approximation*; which he looks-upon as the most concise, and quickest method we can use.—The procedure is as follows:

In case of Arrears (annuities, amount, and time, being given) make two or three trials, till you get the answer betwixt two of the nearest results. The nearer the results approach to the amount, the better. And, interest being seldom above 10 *l* or under 5 *l* per cent, a supposition between these two cannot err much from the truth. Then the work may be performd by proportion——*For example:* An annuity of 20 *l* per annum is offer'd to be let for 180 *l* 10*s*, to be paid at the end of the said term: What interest is allow'd in this bargain?—*Answ.* First I make a supposition at 8 per cent; and, by problem V, (Annuit.) I find the amount, at that rate, to be 178.456; which is too little by 2.044 *l*. . . Wherefore, because I see I am near, I make my second trial at 8 *l* 10*s* per cent: and, working as before, I find the amount to be 181.21; whereby I see I have overshot the truth by 71; and I see the answer is bounded betwixt 8 *l* per cent, and 8 *l* 10 *s* per cent. . . By these two suppositions, and their respective errors (as in the rule of False) I find the rate as follows: (1) As 2.745 (the sum of the errors; to-wit, 2.044 + 71) to 5 (the difference of the suppositions; to-wit, 8 + 8.5) So is 2.044 (the former error) to .371: which, because less than the true amount, being added to the former supposition, gives 8.371 (the rate of interest sought: (2) Or, As 2.745 to .05: So is 71 (the latter error) to .129: which, because more than the true amount, being subtracted from the latter supposition gives 8.371; the rate of the interest sought, as afore.

In case of Purchasing (annuity, present worth, and time of of continuation, being given) proceed as before——*For example:* An annuity of 20 *l* per annum, to continue for 7 years, is sold for 100 *l* ready mony. What rate of compound interest has the purchaser, for the mony?—*Answ.* (1) First I make my supposition at 9 per cent: and (by problem XI) I find the present worth of 20 *l* per annum, to continue 7 years, is 100.659056; which should have been 100 *l*: wherefore the error is .659056. (2) Then, seeing the supposition was short, I make my next supposition at 9 *l* 5 *s*: and (by the same problem) I find that the said annuity, for the same time, will be worth 99.82 *l*; which should have been 100 *l*: by which I see that I have supposd too-much; and the error is .18. (3) Then, As .839 (the sum of the errors) to .25 (the difference of the suppositions) So .18 (the latter error) to .0536: which subtract from the former supposition (because it was too-great) and there will remain 9.1964 (or 9 *l* 3 *s* 11 *d*) for the rate sought.

BARTER.

1 Ba'rter, exchánge of commodities: the rúle to propórtion 'em ăs follows:

2 Whát's to be chángd, Value: thén, see what
That will púrchase of T'other [a].

3 I'f an advánc'd price of óne, a propórtionable fínd for the other [b].

a *For example:* Two merchants barter. *A* would exchange cw 5 3 14 of pepper (worth 3 *l* 10 *s* a-pound) with *B*, for cotton (worth 10 *d* a-pound). How much cotton must *B* give to *A* for his pepper?——*Answ.* (1) Find the value of the pepper, thus: As 1 lb to £ 3 10 : : cw 5 3 14 to £ 20 11 3 (2) Then see how much cotton that will purchase, thus: As 10 to 1 lb : : £ 20 11 3 to cw 4 1 17½. (3) And so-much must *A* have for his cw 5 3 14 of pepper.

b *For example:* Two merchants barter, thus: *A* has 36 yards of cloth, worth 9 *s* 2 *d* a-yard, ready mony;

ut, in barter, will have 11 *s* a-yard. *B* has shaloon, worth 2 *s* 1 *d* a-yard, ready mony. Now, how-many yards of the shaloon must *B* give, to make his gain, in the barter, equal to that of *A*'s?——*Answ.* (I) Having first found what advance *B* ought to make per yard on his shaloon, in proportion to what *A* has done upon a yard of his cloth, thus: As 9 *s* 2 *d* (the worth of the cloth per cloth per yard) to 11 *s* (the advanc'd price) so 2 *s* 1 *d* (the worth of the shaloon per yard) to 2 *s* 6 *d* (the advanc'd price of the shaloon) (II) Say, as before, note [a]. (1) As 1 yard to 11 *s* (the advanc'd price of one yard) so is 86 yards (the whole of the cloth) to 946 *s* (the advanc'd value of all the cloth). (2) Then, If 2 *s* 6 *d* will buy 1 yard of shaloon (at its advanc'd price) how-many yards will 946 *s* buy? the answer will be $378\frac{2}{5}$ yards: which is what *B* is to give of his shaloon, to *A*, for his 86 yards of broad cloth.

COMBINATION.

COMB. or how-óft any number of things may chánge their position [a].

Changes: — ónce 2 is 2.—then, 2 into 3 is 6 — then

6' into 4's 24'— and so ón [b], to the térm to-bȩ-varied [c]:

So L--éf is ádz [d]: P--oidy, uzoz: N--oztez, taue: eieiyz [e].

If two, or more, are the sáme; the *whole* chánges by thóse of the *same* Quote [f].

Choices. (1) OF, to the number *up* multiply. (2) IN, to the same number, *downward.* (3) This by That divide: the quotient gives the choices [g].

Compositions: Of 2 ín 10, Square; óf 3 in 10, Cube the numbers [h].

Combina-

a Combinations are diſtinguiſht into changes, choices, and compoſitions—*Changes* (Permutations, Variations, Alternations) are ſuch combinations of any number of things, wherein reſpect is had to the order of the whole, either as to place, or ſucceſſion. (1) In regard of *place*; when any number of things being propoſd, the number of different ways theſe things may be diſpos'd in an equal number of determind places, ſo that they ſhall never be all in the ſame places. As, Suppoſe 6 things, A, B, C, D, E, F, are to be diſpos'd in 6 places: This may be done various ways, according to the different places every one may poſſeſs, regard being ſtill had to the whole: *i. e.* if any two, or more of them change places: that makes a new alternation, or order of the whole; though all the reſt remain unchang'd. (2) In regard of *ſucceſſion*; when ſeveral things may be taken, or orderd in ſucceſſion one after another. For example, In the taking of A, or B, or any one of them, 1ſt, or 2d, &c. And, as the taking any one of them 1ſt, or 2d, &c. may be calld puting them in the 1ſt, or 2d, &c. place of the ſucceſſion; this ſhows the coincidence of theſe two ways of ordering things as to the number of changes: for they are reducible to one notion of place, either as it relates to ſpace (which is more ſtrictly calld place) or to time, or ſucceſſion; which, as to the number of changes, is the ſame. For, places cannot be better diſtinguiſht than by numbering them 1ſt, 2d, 3d, &c. and the order of ſucceſſion of things is diſtinguiſhable no other way than by marking which thing is 1ſt, 2d, 3d, &c.—*Choices* (or Elections) are combinations, which regard not the order of the whole; but the way of taking a particular number out of the whole. Thus, ſuppoſe a leſſer number of things is to be taken out of a greater, and we are at liberty to take them out of any part of the whole; the number of ways this may be done, ſo that ſome (one, at leaſt) ſhall be different in every choice or combination, is calld the choices of that number of things in the other. For example, If 4 men are to be drawn out of a 100, the number of ways this can be done, ſo as ſome one of them ſhall be a different man, is the choices of 4 men (or any other thing) in 100.——*Compoſitions* are limited elections. Thus, conceive two or more different ſets (or ſyſtems) of things, containing each the ſame,

ſame, or a different number of things: then, ſuppoſe we are to chooſe, out of the whole, a number of things either equal, or unequal to the number of ſets, ſo that we take ſome part out of every ſet *; the number of choices, thus limited, is calld the compoſition of that number of things, out of that number of ſets. For example: Suppoſe 16 companies of men; 16 men may be drawn out of theſe, various ways; taking only 1 man out of each company: and the number of choices we can make (with this limitation, of one out of each company) is the compoſitions of 16 in the 16 companies.

* If poſſible: that is, if the number of ſets be greater than the number to be choſen. For, then, we may take any choice of a number of the ſets, equal to the number to be elected.

b *That is*, Reſuming the laſt product (24) and multiplying it into the next digit (5) &c.

c *For example:* In this verſe ('Tu in me ita es, hem! in te ut ego ſum: ac tu me ibi ama, ut te ego amo hic jam') the words being 22, may be plac'd 1,124.000, 727.777,607.680,000 different ways.

d *That is*, 5 things multiplied into 24 (the product of the preceding multiplications, or the changes of 4) admit of (adz) 120 variations: and, conſequently, 6 (6 × 120) makes (oidy) 720: and ſo of the reſt.

e And thus may be known (without begining the ſeries) any changes, as far as 10. For (N--oztez, taue .. ei eiyz) 362,880 (the changes of 8) × 9 = 3.628,800; and ſo on *.

Examples: (I) Hereby may be known how many ways the letters of a name, or word, may be varied; and differently diſposd by way of anagram: out of which thoſe of uſe may be gatherd, neglecting the reſt. As, for example: the word 'Roma', conſiſting of 4 different letters, may admit of 24

Roma	Orma	Mroa	Arom
Roam	Oram	Mrao	Armo
Rmoa	Omra	Mora	Aorm
Rmao	Omar	Moar	Aomr
Raom	Oarm	Maro	Amro
Ramo	Oamr	Maor	Amor

changes, as in the margin: of which only ramo, oram, mora, maro, armo, amor, are ſignificant †. (II) Six gentlemen, that were traveling, met-together (by chance) at a certain inn upon the road; where they were ſo

pleaſd

pleasd with their host, and each other's company; that, in a frolic, they made a contract to stay at that place, so long as they, together with their host, could sit every day in a different order, or position, at dinner. This will be found near 14 years. For, they, being made 7 with their host, will admit of 5040 different positions: but 5040, being divided by $365\frac{1}{4}$, the number of days in one year, will give 13 years and 291 days. (III) In St. Mary le Bow's church, Cheapside (before the fire, in 1666) were 12 bells. Suppose it were requird to tell how many several changes might have been rung upon those 12 bells; and, at a moderate computation, how long all those changes would have been ringing once over. In Answer, (1) First $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 10 \times 11 \times 12 = 479001600$ the number of changes. (2) Then, supposing there might be rung 10 changes in one minute (to-wit, $12 \times 10 = 120$ strokes in a minute, which is two strokes in a second of time) according to that rate, there must be allowd 47900160 minutes, to ring them once over ‡. (IV) The two following verses [Lex, rex, grex, res, spes, jus, thus, sal, sol, (bona) lux, laus. Mars, mors, sors, fraus, fæx, styx, nox, crux, pus (mala) vis, lis] the sense remaining good, and the verse true, may be varied 79833600 ways §: which would compose above 249 volumes; each volume containing 2000 pages; every page divided into two columns, and each column to contain 80 verses; which, at a penny the sheet, would amount to 518 pounds, 15 shillings; and, supposing them bound for 5 shillings a volume, the binding would cost 62 pounds, 5 shillings; and the worth of the whole would be 581 pounds. (V) The 24 letters of the alphabet will admit of 620448401733239439360000 several variations. If, with these, you take-in the several variations of 2, 3, 4, 5, 6, &c. letters; there will arise thence such a vast number of words, that if a man could read 50 thousand words in an hour, which is more than the psalms of David contain; and, if there were a hundred thousand millions of men, they would not speak these words, according to their hourly proportion beforementiond, in a hundred thousand years; a thing seeming most impossible and incredible, yet most certain and infallible in computation.

Thus

Thus we learn how to find the number of changes of any number of things. But, if it ſhould alſo be requir'd actualy *to take them all out*, or repreſent them (for example) by letters: there is one certain method of proceeding, by which we can go through the whole, with the greateſt eaſe and diſtinctneſs; ſo as to run no hazard (or the leaſt poſſibility) of omiting any change, or taking any one oftener than once. This method will be made clear by a few examples: (I) For two things, a b; the changes are 2; a b, and b a.

(II) For three things, a b c; the changes are 6, which you ſee already taken-out in the margin; only, to ſave ſuperfluous writing, they may be orderd as above: where becauſe every letter poſſeſſes the firſt place twice (to-wit, till the remaining two have chang'd twice) therefore I write that letter down but once in the 1ſt place, ſuppoſing it to belong to the 1ſt place of the next change, which is left not filld-up. (III) For 4 things, a b c d; the changes are 24, as they are here repreſented: where every letter poſſeſſes the firſt place 6 times; (to-wit) till the remaining 3 have chang'd 6 times: whoſe changes are orderd the ſame way as in the preceding example.

a	b	c	b	a	c	c	a	b
	c	b		c	a		b	a

a	b	c	d	b	a	c	d	c	a	b	d	d	a	b	c
		d	c			d	c			d	b			c	b
	c	b	d		c	a	d		b	a	d		b	a	c
		d	b			d	a			d	a			c	a
	d	b	c		d	a	c		d	a	b		c	a	b
		c	b			c	a			b	a			b	a

(IV) For 5 things; a b c d e, their changes are 120 (= 24 × 5) taken as here repreſented. Where obſerve, that, becauſe the changes of 4 are 24; ſo, in taking-out thoſe of 5, every letter muſt poſſeſs the 1ſt place 24 times;

A	b	c	d	e	c	b	d	e	d	b	c	e	e	b	c	d
			e	d			e	d			e	c			d	c
		d	c	e		d	b	e		c	b	e		c	b	d
			e	c			e	b			e	c			d	b
		e	c	d		e	b	d		e	b	c		d	b	c
			d	c			d	b			c	b			c	b

B	a	c	d	e	c	a	d	e	d	a	c	e	a	c	d
			e	d			e	d			e	c		d	c
		d	c	e		d	a	e		c	a	e	c	a	d
			e	c			e	a			e	a		d	a
		e	c	d		e	a	d		e	a	c	d	a	c
			d	c			d	a			c	a		c	a

And so on,

i. e. till the remaining 4 letters make 24 changes: which are taken-out according to the method of example 3. ——*NB.* (1) By these examples, *the method for any other number* may be easily understood; one depending always upon the preceding. So, if there were 6 things, whose changes are 720 (= 120 x 6) each of them must possess the 1st place 120 times; to-wit, till the remaining 5 make their 120 changes. And, observe, that, as every letter has the 1st place as oft as the changes of the remaining number; so, while it possesses the 1st place, the letter next it (in the first change of those wherein it has the 1st place) possesses that next (or 2d) place, as oft as the number of changes of the remaining letters after this one: and, then, the next letter is advanc'd into that 2d place: and so on; till they are all successively in the 2d places. The same is to be observ'd of the 3d, and 4th, &c. places. Then, when all the letters, after the 1st, have possest the 2d place; a new letter is-advanc'd into the 1st place: and, so, the changes proceed with that letter in the 1st place, as it did before. (2) But, it may be observd, that, *The number of changes grow so fast* upon the series of numbers, that the changes of a small number of things can never be all represented. For example: The changes of 10 are 3628800: and allowing a man to take-out 300 of them every hour, it would cost him 304 days to finish them all; though he workt-at-it night and day, without interruption. But, if we only double the number of things; *i. e.* take 20: the changes are 187,146.308,321.280,000; so great a number, that, if a man could take-out 500 of them every hour, it would take-him upwards of 42 thousand million of years to finish them all. For, divide the changes by 500, the quote is 374.292,616.642,560 hours; which, divided by 24, quotes 15.595,525.693,440 days; which makes 42,727.330,666 years, and 70 days. (3) As to the combinations, distinguisht by the names of *choices,* and

and *compositions*, the doctrin of them is too abstruse, and so far out of the way of ordinary occasions; that it would be improper to treat of them in a system of this nature. The curious may be satisfied with what they will find on this subject in Malcolm, arithm. 5. 6. p. 514.

If the word *Philippa* were given, which consists of 8 letters, of which (without considering those which are of the same sort) the changes will be 40320: but because I is twice repeated, divide 40320 by 2, the changes on two letters; and the quote is 20160: and this, divided again, by 6 (the changes on 3, because P is thrice repeated) gives in the quotient 3360; which are the changes in the word Philippa. Or, If I had divided 40320 by 12 (because 2 times 6 is 12) the quotient would give, in the answer, at one operation, the same as before.

If two bells more had been added to the aforesaid 12; they would have advanc'd the number of changes (and consequently the time) beyond common belief. For 14 bells would require (at the same rate of ringing as before) about 16575 years to ring all their different changes.

For, if we suppose the words *bona*, and *mala*, continualy to keep the same (to-wit, the 10th) place, the rest being 11 in number, (indifferently changing place with any other in the same verse) the number of variations of 11 places will be 39916800: which, doubled (for the number of changes in both verses) makes 79833600.

For example.——Of 6 things, whereof 3 are the same, to find the changes: Say, the whole changes of 6 different things are 720; those of 3 are 6: then, $720 \div 6 = 120$.—Suppose 8 notes of music, whereof 3 are the same, and 2 are the same; but different from the former 3; and both different from the remaining 3 (as *fa*, *fa*, *fa*, *sol*, *sol*, *la*, *mi*, *fa*) What is the variety in the succession of these 8 notes? (*Answ.*) The changes of 8 different notes are 40320: of 2 there are 2, and of 3 there are 6: then $2 \times 6 = 12$; and $40320 \div 12 = 3360$, the variety sought.

Thus, the choices OF 4 IN 9 are 126. For (1) $1 \times 2 \times 3 \times 4$ (the series, *upwards*, to the number to be elected) multiplied continually together, $= 24$. (2) $9 \times 8 \times 7 \times 6$ (the series, *downwards*, to the same number of terms, out of which the election is to be made) multiplied

tiplied continualy together, $= 3024$. (3) Then, $3024 \div 24 = 126$, the number of the choices of 4 in 9*.

To take-out all the elections of any number out of a greater, the method may be conceivd from the following example.——The elections of 3 out of 5 things (a, b, c, d, e) are 10: the disposition of which is as in the margin; and may be taken-out, thus: First, I take-out the three first letters as they stand in order, a b c: then I put another in the first place (on the right) successively in the order of the letters, till there is not another behind: then I put a new letter in the second place (on the right) keeping it there till I change all the letters in order, that are in the first place: and, then, I put a new letter in the third place, keeping it there till I change all the letters in the second place, as oft as possible; that is, so as there remain enow behind, to make-out the number: and, with each of these, in the second place, I change all those in the first place: and so on, if there are more things elected; as may appear from the following example.——The elections of 4 in 7 things (a, b, c, d, e, f, g) are 35; as in the margin: the order of which, being carefully considerd, is sufficient direction for any other case . . . Only it may be obſervd, that, when g comes in the first place (on the right) the letter, in the second place, is chang'd; and there it stands, till g comes again in the first place, and then it is chang'd again; and so on, till f comes in the second place: and then the letter, in the 3d place, is chang'd; and so it stands till the same changes, as before, fall upon the first and second places; that is, till f g come together in the first and second places: and then the letter, in the 3d place,

a	b	c	a	d	e
a	b	d	b	c	d
a	b	e	b	c	e
a	c	d	b	d	e
a	c	e	c	d	e

a	b	c	d				g
			e			f	g
			f		e	f	g
			g	b	c	d	e
		d	e				f
			f				g
			g			e	f
		e	f				g
			g			f	g
		f	g		d	e	f
	c	d	e				g
			f			f	g
			g		e	f	g
		e	f	c	d	e	f
			g				g
		f	g			f	g
	d	e	f		e	f	g
				d	e	f	g

place, is again chang'd: and ſo it goes on till e comes in the third place; and then the 4th place is chang'd; and ſo on, till ſuch a letter comes in the laſt place; that, what are behind in the order of the letters do juſt make-up the number elected.

NB. (1) In any given number of quantities, the number of combinations increaſe, gradualy, till you come about the mean numbers; and ſo decreaſe, gradualy, again. So, in 8 quantities, there are more combinations of 3 and 5, than of 2 and 6; and more of 2 and 6, than of 1 and 7: as may be ſeen in the following table. (2) If, the number of quantities be even, $\frac{1}{2}$ the number of places ſhows the greateſt number of combinations, that can be made in thoſe quantities. So, if the number of quantities be 8; the $\frac{1}{2}$ of which is 4, ſhows the greateſt number of combinations in theſe quantities will be of 4 in 8, as in the table. But (3) If the number of the quantities be odd; then thoſe 2 numbers, which are next together, and whoſe ſum is equal to the given number of quantities; ſhow the greateſt number of combinations. So, of 7 quantities, the greateſt number of combinations will be of 3 and 4 quantities in 7; and are equal, as in the table.——*Example.* How many locks, whoſe wards differ, may be unlockt with a key of 8 ſeveral wards? (*Anſw.*) 255 locks: 8 whereof may have one ſingle ward; 28, double wards; 56, treble wards; 70, four wards; 56, five wards; 28, ſix wards; 8, ſeven wards; and 1 lock, eight wards: as appears by the upper table in the margin.

1	In 8 =	8
2		28
3		56
4		70
5		56
6		28
7		8
8		1

1	In 7 =	7
2		21
3		35
4		35
5		21
6		7

And ſo on, *increaſing the powers*, according as your number of quantities increaſe.—*For example* (I) What number of chances are there on 2, 3, 4, 5, and 6 dice? (*Anſw.*) On 2 dice (by ſquaring the 6 ſides, will be found) 36 chances: on 3 (by cubing the ſides) 216: on 4 (by increaſing the powers) 1296: on 5, 7776: on 6, 46656. (II) What number of compoſitions of 3 letters in 20? (*Anſw.*) 8000; the cube of 20. (III) What number

number of combinations of 6 letters, in 24, or in the whole alphabet? (*Answ.*) 191102976; the squard cube of 24. (IV) What number of hexameter and pentameter verses, may be made out of the following lines?

HEXAMETER.	PENTAMETER.
Turbida. ignea. pessima. horrida. aspera. martia. barbara. lurida. effera.	Tetrica. ardua. perfida. improba. sordida. impia. tristia. turpia. noxia.
Fata. signa. damna. bella. vincla. sistra. castra. scorta. tela.	Præstabunt. præscribunt. concludunt. prædicunt. perficiunt. consummant. conglomerant. significant. procurant.
Sequi. foris. pati. tuis. domi. patet. puto. palam. ferunt.	Dura. acta. vina. verba. dicta. facta. labra. arma. astra.
Præmonstrant. proritant. promittunt. protendunt. producunt. monstrabunt. progignent. prænarrant. promulgant.	Dolosa. pudenda. proterva. nefanda. cruenta. superba. molesta. sinistra. maligna.
Tempora. pocula. prælia. verbera. lumina. fœdera. agmina. crimina. sidera.	Nova. aliis. tibi. viris. scio. mea. malis. vides. mihi.
Dura. sæpe. quædam. acerba. prava. multa. dira. nigra. sæva.	NB. *Take any one word out of each line, and you will have a true verse.*

(*Answ.*) (1) In the Hexameters: there being 6 lines, and 9 words in every line; the squard cube of 9 gives 531441 * (2) In the Pentameters: there being 5 lines, and 9 words in every line; the sursolid, or 5th power of 9, gives 59049 verses. (3) In All 590490: a number of verses, that would make above 45 volumes as big as Virgil †. (V) What number of compositions may there be of the 24 letters of the alphabet, accounting them by 1 and 1, by 2 and 2, by 3 and 3, and so on to 24? (*Answ.*) (1) If we account, each time, 24; the answer would be 1333735776850284124449081472843776. (2) But, if we are to find all the numbers preceding in geometrical progression under it (according to the rule in progression) the stating will be 23 : 24 :: 1333735776850284124449081472843775 : 13917242888725299425-

99942512849340220 0; which is the number of compoſitions ſought.

* So many verſes may be made out of the tables of hexameters, without taking notice of the permutation of places. For, you may change moſt of the 1ſt, and the 6th line, into the 5th, and 2d line.

† For 590490 (the number of verſes, that may be made by the words in the table above) ÷ 13016 (the number of verſes in Virgil) = 45 volumes, and 4771 verſes.—*NB.* To give this feat an air of myſtery . . . The author, John Peter (Sept. 29, 1677) diſtributed the letters of thoſe words into tables. (1) For the Hexameters there are 6 tables: each table has 10 cells a-croſs: and as many as are neceſſary to complete the words downwards. In theſe, the letters are ſo diſposd, that, if you take any of the firſt 9, and add every 9th till the word is completed; you will have the ſeveral words as in the tables; and, by that means, an hexameter verſe. (2) For the Pentameters, the method is the ſame . . . And, to ſtrengthen the paradox, he entitled the piece Artificial Verſifying; whereby any one of ordinary capacity, though he underſtands not one word of latin, may be taught immediatly to make 590490 hexameter and pentameter verſes, true latin, true verſe, and good ſenſe.

DIVISION.

1 DI'V [a]. (1) Say How-óft -for in -dénd [b]; or the 1ſt in the 1'ſt [c]. (2) By the anſwer (*which is to be plac'd in the quotient*)

2 Múltiply-ſór; (3) and the próduct Subtract from the -dend, by addition [d].

3 Thén, *for next ſtép*, advance 1' in the -dénd; and count-báck, i'th' remainder,

4 Só many ás are i'th' -ſór: There begín, as at firſt; and ſay, How-oft, &c. [e].

5 *NB*. I'f by the 2d you Bórrow no móre than you Pay by the 1ſt: Right [f].

Compendiums.

6 *Ciphers*, i'th' end of the -ſór; Set-off ſo-many places i'th' -dend; Reſt [g].

7 -ſor *ſingle Digits* Quote under; the Reſt to the next place prefixing [h].

Compound Division

8 of Different Denominations: ſee Practice.

a There are other ways of diviſion; 6 of which may be ſeen in Webſter, and 9 in Allingham. The following (of which I find no account in authors) is offerd as much the *ſhorteſt, and eaſieſt*; and, by the diſpoſition of the figures, the moſt commodious for operation, proof, valuation of remainders, &c. *. V. notes [d] [e].—*The Expedients for the dividing large ſums*, are by Logarithms, by Neper's bones (V. Multiplication, note [b]) and by Tabulating. V. Tabulating.

* *An example* will ſhew the difference: Here, in ſo ſhort a ſum, in the *common* way, there are no leſs (beſides dots, and daſhes) than 18 figures to write; in the *other*, only 4, or 5. Beſide the ſtraggling ſituation of the ſeveral members of the operation; more particularly of the diviſor, and quotient: which are at ſuch a diſtance, as render it inconvenient to multiply the one into the other.

```
The Common way.          By my Rule.

24) 1212289 (50512       1212289 (24
    120                    10241  50512
    ---
      122
      120
      ---
        28
        24
        --
         49
         48
         --
          1
```

b *For example*: To divide 36 by 12, ſay How-oft 12 (the Diviſor) in 36 (the Dividend): or 'The 12ves in 36'?—Anſw. 3; the Quotient, without any Remainder *.

 For

For $3 \times 12 = 36$, which is the surest method of *Proof*; to-wit, If the quotient, multiplied into the divisor, plus the remainder, be equal to the dividend: but, for a shorter, V. Proof.

* Mr Hatton, in his mathematical manual (p. 183) among his numerical novelties, observes that the number 362880 may be continualy divided by a different digit, from 1 to 9 inclusive; without any *remainder* of any of the dividends: which cannot be said of any other.

c *For example:* To divide 365 by 121, say How-oft 1 (the 1st of the divi-*sor*) in 3 (the 1st of the divi-*dend*): or, rather (taking the two first) How-oft 12 in 36.—Answer, 3. V. note [d]. (*NB*) But here arises a *Difficulty*, to-wit, To hit-upon the proper answer. To settle this Point is the business of line 5.

d *For example:* To divide 365 by 121, say, as above (note [c]) The ones in 3—Answ. 3; which set-down in the quotient, as in the margin. Then, by this answer, multiply 121 (the divisor) and, at the same time, at each step, subtract the product (without setting-it-down) from 365 (the dividend) Saying $3 \times 1 = 3 + 2$ † (to be set-down, as you speak it, under the 5, *viz.* the 3d under the 3d) $= 5$. Then $3 \times 2 = 6 + 0$ (to be set-down under the 6, to-wit, the 2d under the 2d) $= 6$. Then $3 \times 1 = 3 + 0$ (as in the last) $= 3$. So, the Quotient is 3; the Remainder (which, in working with the pen, may be separated, by a dot or comma, from the rest of the remainder) 2: *i. e.* $\frac{2}{121}$. V. Fractions, and Rule-of-three, note [b] III, IV.

Dividend		*Divisor*
365	/	121
02		3
Remainder		*Quotient*

† Rather than 3 from 5, and there remains 2. V. Subtraction.—*NB* The *advantage* of this method of subtraction is, that the last sound in the mouth of the operator does more readily remind him of what he borrowed; and so secures against mistakes in paying.

e *For example:* To divide 365365 by 121, say (1) for the first dividual, or partial dividend, How-oft 1 in 3, &c. as in note [d]. Then (2) for the 2d Step, advance one place in the dividend, to-wit, to 3; and count-back (in the remainder) so-many figures as there

365365	/	121
02156		3019
106		

there are places in the divisor, to-wit, 3: so, the reckoning will end in 0: which (since you cannot have 1 in 0) enter in the quotient. Then (3) for the 3d Step, do as in the 2d; and the reckoning will end in 2: and There begin, as at first; and say How-oft 1 in 2, &c. Then (4) for the 4th Step, do as in the last; and the reckoning will end at 11: and There, again, begin, as at first; and say, as afore, How-oft 1 in 11, &c. V. note [f].

f *For example:* In the 4th step of note [e], the question is How-oft 1 in 11? answer 9 (more than which is never to be enterd into the quotient). Now, *To see whether it will go*; that is, whether it be not too-much; say (in operating by the 1st figure) $9 \times 1 = 9 - 11$ (remains) 2, to pay. Then (in operating the 2d figure) say $9 \times 2 = 18$: which, to subtract it from 6, obliges to borrow no more than 2. So, since, By the 2d, you borrow no more than you pay in the first, you are right; provided you have taken the first-less than what is too-much.

g *Thus*, Dividing (1) by 10, is cuting-off the last figure of the dividend. (2) by 20, is halving all but the last. (3) by 200, all but the two last, &c.—which places, thereby set-off, are to be considerd as the rest, or remainder.

h *That is*, To divide by a single digit, or any two such as can be managd as one (*e.g.* 11, 12, &c.) without seting-down the divisor, place the quotient under the dividend: and, for the manner and use of working in this way, V. Reduction, note [a], 1.

EQUATION.

1 Equ [a]. As the sums are to 1′: So the sums (into th' times) to the true time;

2 When what is due, at different times, may (at once) be discharged [b].

a *Equation of Payments* is, when several debts are payable at several terms (bearing no interest till after the term of payment) to find a term, at which (if they are all payd) neither

neither debtor nor creditor loſes any thing. The doing of this is calld equating the terms of payment; that is, reducing them to one.

For example: *A* is indebted to *B*, 100 *l*; to be paid at the end of three months: alſo 200 *l*; to be paid at the end of 4 months: and 300 *l*; to be paid at the end of 5 months: Now, to prevent the trouble of many meetings, they agree to have but one payment of the three ſums, at one time: The queſtion is, when that muſt be, without loſs to either.——Anſw. As 600 (*l.* the ſums, or total of the debts) to 1: So 2600 (*l.* the ſums, each into their time) to 4 $\frac{1}{3}$ months: at the end of which time, if the 600 *l* be payd, neither party will ſuſtain loſs.

O R

more accurately and unexceptionally

(according to Mr Malcolm, 6. 10)

as in the anſwer to the following queſtion:

There is 100 *l*, payable 1 year hence; and 105 *l*, payable 3 years hence: What is the equated time, allowing ſimple intereſt at 5 per cent per annum?

100 *l.* the firſt debt:	100 *l.* the one debt:	105 *l.* the other:
105 with int. at 5 *l.*	× 1 its time =	× 3 its time =
205 ÷ 5 (the int. = 41	100 the product.	315 the product.
+ 4 (the ſum of times) 4		
The (I) numb. found: 45		

Then 100 + 315 = 415 ÷ 5 = 83 + 3 (the product of the two times) = 86 (the II number found). Then the ſquare of 45 (the I number) is 2025: of which the $\frac{1}{4}$ part is 506.25: from which taking 86 (the II number) the difference is 420.25: the ſquare root of which is 20.5.——This, ſubtracted * from 22.5 (the $\frac{1}{2}$ of number I) gives 2 (years) the true anſwer †.

NB. This root, being *added to*, or *ſubtracted from* the $\frac{1}{2}$ of the I number; the ſum, or the difference, will be the time ſought——To know *which* is the anſwer; you muſt apply both, according to the conditions of the queſtion. Thus (1) If you take the *ſum*; then, if that is a time greater than the time to the laſt-payable debt; the difference will be the time ſought. Or (2) If you take the *difference*; and that be leſs than the time to the term of the firſt-payable debt; the ſum is the time ſought. But (3) Having tried either, and found it betwixt the terms

of

of payment of the two debts; you may try if the other does not cast it beyond the last, or within the first term: for, in this case, that, which was first tried, is the answer. But (4) If both give times betwixt the two given terms; then you must examin which of them will make an equality of interest, and discount. V. Rebate.

† This is also provd by *application*. For this time (to-wit, 2) being exactly in the middle betwixt the two given times; the interest of 100 *l*, for 1 year, is equal to the discount of 105 *l*, for 1 year; each of them being 1 *l*.

NB. If there be *more debts than two*; find an equated time for the two, that are first payable. Then consider their sum as a debt payable at that equated time. And, find another equated time for that debt, and the next of the given debts. And, so on, through as many as are given.

EVOLUTION.

1 Év. the resólving a power ínto the párts it's composd-of [a].

2 *Squáre* is the product óf any number ínto it self [b]: And

3 *Cúbe*'s the square ínto th' same númber [c]: The *Higher powers* ríse in proportion [d].

4 *Square to Extract*

is to find the side of an area given.

For the Manner *see Note* [e]: *For the* Use *see Note* [f].

a When any number (calld, on this occasion, the *root*) is drawn into it self; and, afterwards, into that product, &c. it is said to be so often *involvd* into it self; and takes the name of a *Power*. Thus — 2 × 2 is the Square; or 2d power — 2 × 2 × 2 is the Cube, or 3d power — 2 × 2 × 2 × 2 is the Biquadrat, or 4th power — 2 × 2 × 2 × 2 × 2 is the Sursolid, or 5th power — &c.

b *Thus* 9 is the square of the root 3: to-wit, 3 × 3 = 9.

Thus

Thus 27 is the cube of the root 3: to-wit, $3 \times 3 = 9 \times 3 = 27$.

The root, ſquare, and cube, take their names from geometrical extenſions. (1) A Root is repreſented by a line, or ſide; having but one extenſion, to-wit, that of length only. (2) The Square is a plane, or figure of two dimenſions; having equal length and breadth. (3) The Cube is a ſolid body of three dimenſions; having equal length, breadth, and thickneſs—— But, beyond theſe three, nature proceeds not, as to local extenſion: that is, the nature of place or ſpace admits no room for other ways of extenſion, than length, breadth, and thickneſs: Neither is it poſſible to form, or compoſe any figure, or body, beyond that of a ſolid. And, therefore, all the ſuperior powers above the cube, or third power (as the Biquadrat, or fourth power; the Surſolid, or fifth power, &c. *) are beſt explain'd and underſtood by a rank or ſeries of numbers in geometrical proportion. For inſtance, ſuppoſe any rank of geometrical proportionals, whoſe firſt term and ratio are the ſame: and to them let there be aſſignd a ſeries of numbers in arithmetical progreſſion, begining with an unit, or 1; whoſe common difference is 1 (V. Progreſſion) Thus:

Then are theſe numbers, in geometrical

1	2	3	4	5	6	7	*Exponts*
2	4	8	16	32	64	128	*in* ∺

progreſſion, produc'd by a continued multiplication of the firſt term into it ſelf. And thoſe in arithmetical progreſſion (calld the indices, or exponents of the powers) ſhow what degree, or power, each term in the geometrical proportion is of. For example, in the above ſeries, 2 is both the firſt term or root, and common ratio of the ſeries. Then $2 \times 2 = 4$ the (ſecond term, or) ſquare: And $2 \times 2 \times 2$ (or 4×2) $= 8$, the (third term, or) cube: &c.

The *Superior powers* had particular names among the antients: but they are very complex and burthenſome to the memory; and tend no way to the improvement, or eaſineſs of the ſcience: whereas it is obvious that we have no more to do, but diſtinguiſh them by their order in the ſeries of products, calling the firſt product the firſt power; the ſecond product, the ſecond power; and ſo on: whereby theſe names do, of themſelves, in a very ſimple and eaſy manner, diſtinguiſh the ſeveral powers, in conſe-

quence

quence of the general definition of a power: for they express the number of multiplications of the root in the production of each power; which the ancient names do not. —*NB.* On account of this conveniency it is, that, though the terms of root and powers, properly speaking, ought always to be contradistinguisht; so that the products only should be calld powers: yet, here, the first root is also calld the first power; that the same figures might, both express the number of the factor, and give denomination to the power.

The method of extracting the Square root is as follows: Having pointed the resolvend (begining with units) according to the number of places in the power [to-wit, 2, for the square root; 3, for the cube; 4, for the biquadrat; &c]—Enter into your quotient 3 (the greatest square that is containd in the first period pointed-out to the left-hand) and multiply it into it self (3 x 3) subtracting the product (to-wit, 9) from the period: the remainder will be 1 ——To this remainder (1) Bring-down the next period (to-wit, 27) (2) Then, doubling the quotient-root (to-wit, 3) for a divisor, ask how-oft 6 in 12, the unit-place being excluded. (3) The answer, 2, enter in the quotient: (4) And subtract the square of it (to-wit, 2 x 2 =) 4 from 7: remains 3; which set-down underneath. (4) Then multiply it into the divisor 6; and subtract it from the rest of the resolvend, as in common division: remains 0.—To the remainder, (to-wit, 3) in like manner, (1) Bring-down the next period (to-wit, 45) (2) And, having doubled the quotient-roots (to-wit, 32) for a new divisor (3) Ask how-oft 64 (the doubled roots) in 34, the unit excluded, as before. (4) The answer, 0, enter in the quotient, and in the divisor also. And—To the resolvend (1) Bring-down the next period (to-wit, 16) (2) And ask how-oft 640 in 3458 (all of the resolvend but the unit's place) or 6 in 34: put the answer (to-wit, 5) in the quotient. (3) Then, subtract the square of it

Divisors	Resolvend	Roots
3	1027458916	/ 32054
6	127	32054
640	34589	into it self
6410	256416	gives
....	00000	102745 &c.

it (to-wit, 5 x 5 =) 25 from (9, borrowing 2, to-wit) 29: remains 4. (4) Then, multiply it into the divisor (to-wit, 640) and subtract the products from the rest of the resolvend: the whole remainder will be 2564.——To this, again, bring-down the next period; and proceed as afore *.—PROOF: 32054 x 32054 = 1027458916 †.

NB. (1) When the resolvend is not a true figurate number, according to the proposd power (that is, is not a perfect square, cube, &c.) something will remain after the extraction has been made through all the points. Such numbers are calld *surd numbers*; and their roots can never be truly found: but will become a continued series ad infinitum; if to the remainder there be still annext ciphers according as the proposd power requires, to-wit, by twos, in the square; threes, in the cube; fours in the biquadrat, &c. and the operations continued-on as before. For example, if it were requird to extract the square root of 6968; the last remainder will be 79; to which add 00; and proceed as by rule: the square will come-out in decimals (by continuing to add ciphers) ,4745, &c. And, in this manner, the root of a surd number may be continued-on to what exactness you please, but cannot be truly found. (2) What is here done in whole numbers, may be done (in like manner) in decimals, and mixt numbers: as also in vulgar fractions; by changing the given fractions into decimals.

For the Cube, or other Higher power, the Method is the same; the differences being accommodated according to the nature of the power. Thus —[Rule] Every third figure, begining from unity, is first to be pointed; if the root to be extracted be a cubic one: or every fifth; it be a quadrato-cubic (or of the fifth power) and then, such a figure is to be writ in the quotient, whose greatest power (that is, whose cube, if it be a cubic power; or whose quadrato-cube, if it be the fifth power, &c.) shall either be equal to the figure or figures, before the first point; or next less under them. And then, having subtracted that power, the next figure will be found by dividing the remainder (augmented with the next figure of the resolvend) by the next least power of the quotient multiplied into the index of the power to be extracted; that is, into the triple square, if the root be a cubic one: or into the quintuple biquadrat (that is, five times the biquadrat) if the

the root be of the fifth power, &c. And, having again subtracted the power of the whole quotient from the first resolvend, the third figure will be found by dividing that remainder (augmented by the next figure of the resolvend) by the next least power of the whole quotient, multiplied by the index of the power to be extracted. Thus [Example] To extract the cube root of 13312053, the number is first to be pointed after this manner, to-wit, 13312053 (to-wit, at unity, and every third figure from it) then, you are to write the figure 2, whose cube is 8, in the first place of the quotient; as, that which is the next least cube to the figures 13 (which is not a perfect cube number) or as far as the first point; and, having subtracted that cube, there will remain 5; which being augmented by the next figure of the resolvend 3, and divided by the triple square of the quotient 2, by seeking how many times 3 × 4, or 12 is contain'd in 53; it gives 4, for the second figure of the quotient. But, since the cube of the quotient 24, to-wit, 13824, would come-out too great to be subtracted from the figures 13312, that precede the second point; there must only 3 be writ in the quotient. Then the quotient 23 being in a separate place multiplied by 23, gives the square 529; which (again) multiplied by 23, gives the cube 12167: and this, taken from 13312, will leave 1145; which augmented by the next figure of the resolvend 0, and divided by the triple square of the quotient 23 (to-wit) by seeking how many times 3 × 529 or 1587 is contain'd in 11450; it gives 7, for the third figure of the quotient. Then the quotient 237, multiplied by 237, gives the square 56169; which again, multiplied by 237, gives the cube 13312053; and this, taken from the resolvend, leaves 0. Whence it is evident that the root sought is 237.

		13312053	(2 3 7
Subtract	cube	8	
12)	rem.	53	(4, or 3
Subtract	cube	12167	
1587)	rem.	11450	(. . . 7
		13312053	
	rem.	 0	

f *The use* of this rule is very considerable in many branches of geometry, and other parts of the mathematics: but, because the operations, that show the use of it,

vould be unintelligible without a knowlege of the prin-
:iples of thoſe ſciences; it would be abſurd to exemplify
he application of them here. V. Part II. pref.

EXCHANGE.

EXCHANGE, the barter of Coins, according to Par [a], or to Courſe [b], thus:
Coin, by reduction, *value* [c]: *exchange*, by diviſion i'th' ſame name [d];
Or, by the rule-of-three, when it can't well be dóne by diviſion [e].

Par of exchange is what one nation *ſhould* allow another in exchange; which is certain and fixt, according to the intrinſic value of the coins of each.

Courſe of exchange is what one nation *will* allow another in exchange; which is uncertain and contingent, ſometimes more, ſometimes leſs; according as mony is plenty or ſcarce, or according to the time allowd for payment, *&c.*——For the ſhowing the *exchange-value by inſpection*, volumes of printed tables calculated at the uſual rates, are in almoſt every merchant's counting-houſe.

——The uſual exchange is, between *London* and (1) *France:* in Crowns. (2) *Germany:* in Florins. (3) *Italy:* in Ducats, or Pieces of 8. (4) *Netherlands:* in Pundts. (5) *Portugal:* in Millreas. (6) *Spain:* in Rials and Pieces of 8. . . . For the value of which, &c. ſee the Tables, note [e].

For example: To *value* 118 crowns, 1 livre, 11 ſous, 1 denier, and $\frac{1}{3}$; multiply the crowns into the number of livres that make a crown, to-wit, 3; adding the 1 livre, and ſo on, as in common reduction, to the loweſt name; to-wit, thirds of a denier: the product will be 256000: which divided by 40 (the number of 3ds of a denier, that make 1 penny engliſh) gives 6400 *d*; that is (by reduction upwards) £ 26 13 4.

For example: ——How-much french mony muſt I have in *exchange* for 40 marks? (Anſw.) A mark is 13 *s* 4 *d*;
tha

that is, in the loweſt name, 160d. 40 marks, therefore, are (40 × 160) 6400 d: which divided by a french crown (to-wit, 4s 6d) in the ſame name (to-wit, 54d) gives 118 crowns: remains 28; that is, in the next lower name (to-wit, livres) 1 livre. for, 3 (the number of livres in a crown) × 28 = 84 ÷ 54 = $1\frac{30}{54}$ livres. Then 30 (the remainder) × 20 (the number of ſous in a livre) = 600 ÷ 54 = $11\frac{6}{54}$ ſous. Then 6 (the remainder) × 12 (the number of deniers in a ſou) = 72 ÷ 54 = $1\frac{18}{54}$ or $\frac{1}{3}$ denier. And ſo-much muſt I have for 40 marks—I would have, in exchange for 309l 8s, an equal number of crowns and dollars; the crowns, at 5s 6d; the dollars, at 4s 5d. (Anſw.) 309l 8s = 74256d. And 5s 6d × 4s 5d = 119d. Then 74256 ÷ 119 = 624, the number of crowns and dollars I am to have.——A Bill of exchange * was accepted at London, for the payment of 400l ſterling, for the like value deliverd in Amſterdam at 1l 13s 6d, for 1l ſterling. How-much mony was deliverd at Amſterdam? Anſw. 670l flemiſh. For, 1l = 240d; and 1l 13s 6d = 402d. Then 240 : 402 :: 400 : 670, the anſwer requir'd. V. Practiſe.

* *The Form of a bill of exchange:* Rotterdam, April 10, 1746, for £ 1272 13 4 flemiſh, at 33s 4d per pound ſterling. 'At uſance, pay this my firſt of exchange, unto Mr. Edward Jones, or his order, twelve hundred ſeventy-two pounds, thirteen ſhillings, and four pence flemiſh; exchange, at thirty-three ſhillings and four pence per pound ſterling; for the value receiv'd of Mr. John Hall: and account it to your humble ſervant, Herman Vanderſtagen. ——Here Hall pays the mony in Holland (and is calld the *remitter*) to Vanderſtagen (who is the *drawer*) drawing his bill on the Varelſts, (his correſpondents at London) to pay the value to Jones at London, who is Hall's *correſpondent*.' To Meſſ. *A* and *B* Varelſt, merchants in London.

e *As it generaly happens* in Queſtions (I) relating ſimply to the *par* of exchange, (II) wherein *gain and loſs*, and the *allowances to factors*, are conſiderd, (III) or that relate to the *arbitration of exchange*.

I. *In queſtions relating ſimply to the* Par *of exchange*. ——1. If the proportion is given betwixt two ſpecies directly; the ſolution is by one operation of the rule of three. For example: A merchant, at Amſterdam, paid

150 guilders for 13 *l* 15 *s* sterling, receivd by his correspondent at London: (1) What is the rate of exchange? or what is 1 guilder valued-at in english mony? . . . Say, If 150 guilders give 13 *l* 15 *s*; what will one guilder? Answ. 22 *d*. (2) What is one pound sterling valued-at in dutch mony? . . . Say, if 13 *l* 15 *s* give 150 guilders; what will 1 *l*? Answ. $10\frac{10}{11}$ guild.——2. When the proportion is given between each of the two species in question, and a third species: the solution is by two operations of the rule of three. For example, I would exchange 200 ducats, worth 7 *s* a-piece, for dollars at 4 *s* 8 *d* a-piece. (1) How many dollars ought I to have? . . . Say, If one ducat give 7 *s*? what 200? Answ. 1400 *s*. Then, If 4 *s* 8 *d* give one dollar, how many will 1400 *s*? (2) If 4 *s* 8 *d* give 1 dollar, how many will 7 *s*? Answ. $1\frac{1}{2}$. so that one ducat is worth $1\frac{1}{2}$ doll. . . . Then, say, If 1 duc. give $1\frac{1}{2}$ dollar; how many will 200 give? (3) Had it only been requird to find the direct proportion betwixt crowns and dollars: then, say, If 7 *s* give 1 ducat; how many will 4 *s* 8 *d*? Answ. $\frac{2}{3}$ of a ducat . . . Or, say, If 4 *s* 8 *d* give one dollar; how many will 7 *s*? Answ. $1\frac{1}{2}$ dollar.——3. When the proportion is given betwixt one species and another; betwixt this other and a third; betwixt this third and a fourth; and so on; as far as you please to find the exchange betwixt the first and last species: the solution is by one fewer operations of the rule of three than there are different species; in manner of the following question: *(For example)* Exchange betwixt London and Amsterdam being at 1 *l* sterling for 38 *s* flemish; betwixt Amsterdam and Francfort,' at 6 *s* flemish for 66 cruitzers; betwixt Francfort and Paris at 54 cruitzers for one crown: what is the exchange, according to that course, betwixt London and Paris?—Answ. 1 *l* for $7\frac{20}{27}$ crowns; found thus: Set-down the given terms, as in the margin; and, working from the left-hand to the right,

Lond.	Amst.	Francf.	Paris
1 *l* =	38 *s*		
	6 *s* =	66 cru.	
		54 cru. =	1 cr.
1 *l* =	38 *s* =	418 cru. =	$7\frac{20}{27}$ cr.

Say: If 6 *s* give 66 cru. what will 38 *s*? the answer is 418 cru. which is set under Francf. Then, say: If 54 cru. give 1 crown; what 418 cru.? the answer is $7\frac{20}{27}$ cr. which

which is set under Paris. And, thus, the exchange betwixt London and Paris is found to be at 1 *l*; for $7\frac{20}{27}$ crowns. (*NB*) (1) The undermost line shows not only the exchange betwixt the first and last places; but also betwixt any two of them: the quantities, in that line, being evidently all equal in value, from the nature of the operation. (2) If there are two different given species for one place, they must be reduced to one species. So, if the exchange betwixt Amsterdam and Francfort, were exprest by 36 stuyvers for 66 cruitzers; then we must first reduce the 38*s* to stuyvers, or the 36 stuyvers to shillings, by the known relation of stuyvers and shillings; which is 6 stuyvers to one shilling, Or, if it were 36 stuyvers for 1 florin; then you must also reduce the 1 florin to cruitzers, or 66 cruitzers to florins. And, if this reduction cannot be done; that is, the relation of these species is not known, the question cannot be solvd. (3) If there is another given quantity of the first and last place; to find a quantity of equal value in the other, it is a plain application of the rule of three, from the rate of exchange found as was observ'd upon the preceding question. (4) All these operations of the rule of three may be reduc'd to one division, thus: multiply the consequents of all the proportions (that is the first number under every place) for a dividend; and all the antecedents (or second numbers under every place) except the first, for a divisor: the quotient will be the number sought of the species of the last place, equal to the number under the first place. Thus, in the preceding example, 38 multiplied into 66, produces 2508 [the number of crowns, being 1, does not multiply] Then 54, into 6, produces 324: and 2508, divided by 324, produces $7\frac{20}{27}$ *.

* The reason of this will be manifest, by considering how the several operations of the rule of three are made. For, the answer of the first operation is the quote of 38 multiplied into 66, and the product divided by 6: which we may express thus: $\frac{38 \times 66}{6}$. Then, for the second operation, it is the last answer multiplied into 1 (which is still $\frac{38 \times 66}{6}$) and the product, divided by 54: which is $\frac{38 \times 66}{6 \times 54}$; according to the direction now given. And,

how many places so-ever there be, the reason is manifestly the same. V. Proportion.

II. *In questions wherein* GAIN and Loss, *and the* Allowances to FACTORS *are considerd*; the solution is as follows: *For example*——*A*, of London, draws upon *B*, of Amsterdam, 500 guilders at 22*d* per guilder: for which *B* redraws upon *A* at 21*d* per guilder, with provision at $\frac{1}{2}$ per cent, and ten guilders of brokerage. (1) How much will *A* pay? and (2) Whether has he gaind or lost? (Answ.) Say, As 1 guilder to 22*d*: so is 500 guilders to 11000*d*, receivd by *A* for the draught: Then, As 100 to $\frac{1}{2}$; so 500 to $2\frac{1}{2}$, the provision due to *B*; which, with 10 guilders brokerage, added to 500, makes $512\frac{1}{2}$: for which he draws on *A*. Therefore, Say: As 1 guilder to $21\frac{1}{2}d$: so $512\frac{1}{2}$ to $11018\frac{3}{4}$. So *A* (1) pays, for the redraught, $11018\frac{3}{4}d$; and (2) loses $18\frac{3}{4}d$. (*NB*) (1) If *A* had remited to *B*, with orders to remit the value back again: then, having found what *B* receives by *A*'s remitance: from that subtract *B*'s provision, and brokerage; the remainder is what he remits to *A*: whose value being found, the comparison of that, and of what *A* paid for the remitance, shows what he gains or loses. (2) If *A* draws upon *B*, and afterwards remits the value to him; he must add the provision, due to *B*, to the Sum which *B* paid; and remit the total. (3) If *B*, by *A*'s order, draw upon him, and afterwards remits him the value; then *B* deducts his provision, and double brokerage, from what he receivd by the draught; and remits the remainder. (4) In all the cases, where *A* draws, or remits; you must also consider what brokerage it may have cost him, in order to know his gain or loss.——If exchange from London to Amsterdam is at 1*s* 10*d* for 1 guilder; and to Paris, at 3*s* 8*d* for 1 crown: also, from Amsterdam to Paris, at 40 stuyvers for 1 crown: Whether is it more profitable that London remit directly to Paris, or by way of Amsterdam? that is, remit to Amsterdam, to be remited from that to Paris, (Answ.) Find (by the rule of conjunct proportion) what 1*l* sterling is worth at Paris, according to the course with Amsterdam; and, also, according to the exchange directly with Paris: the comparison of these values of 1*l* gives the answer. (*NB*) (1) What allowance is due to the factor at Amsterdam is to be deducted from the mony he receives; that is,

the

the value of 1 *l* sterling in guilders: and the remainder is what he remits to Paris. (2) If there are more than 3 places in the question; and the exchange is given betwixt one and another in a series, and also betwixt the first and last: to find which is most profitable, to remit from the first to the last place directly, or through all these places: you must find what is the exchange between the first and last place, according to the courses through all the other places; and compare that with the given exchange betwixt the first and last place.

III. *In questions relating to what is call'd the* ARBITRATION *of Exchange*, the Solution is as follows: *For example*——*A*, of Rochel orders *B* of Amsterdam to draw upon him at $97\frac{3}{4}$ sols for 1 crown, and to remit the same to Hamburg at 34 sols, for 1 dollar. *B*, cannot draw, but at 97 sols for 1 crown, how ought he to remit to follow his order? (Answ.) at $33\frac{17}{23}$ sols for 1 dollar: Found thus: as $97\frac{3}{4}$ to 97, so 34 to $33\frac{17}{23}$. For, the course being below the order in the draught to Rochel, it ought to be so proportionaly in the remittance to Hamburg . . . Or, the reason of the work may be conceivd thus: If, for 1 cro. which *A* pays at Rochel, he gets only 97 sols at Amsterdam, by the course; instead of $97\frac{3}{4}$ (which was his order) then, for 1 dollar, he receives at Hamburg, he ought to pay proportionably fewer sols than 34; which was his order.——*A*, of Amsterdam, orders *B* of Amsterdam to remit to Rouen, at $103\frac{1}{2}$*d* flemish, for 1 crown; and to draw the same on him at 225 gros for 1 *l* flemish: *B* cannot draw under 230 gros. How ought he to remit, to follow his order? (Answ.) At $101\frac{1}{2}$*d* flemish for one crown; Found thus: as 230 to 225: so is $103\frac{1}{2}$ to $101\frac{1}{4}$. For, if *A* pays at Coningsberg, more gros than order (for 1 *l* receiv'd at Amsterdam) he ought to receive, proportionaly, more crowns than order at Rouen (for $103\frac{1}{2}$*d* paid at Amsterdam): or, which is the same thing, he ought to pay proportionaly less than order, at Amsterdam, for 1 crown receivd at Rouen.

Coning.		Amst.		Rou.
		d		cro.
gross		$103\frac{1}{2}$	=	1
225	=	1 *l*		
330	=	1 *l*		

F A L S E.

FALSE [a]: Suppositions and Errors multiply cross-ways: the Products, added, divide by the Sum of the errors; *if supps more* AND *less* [b]: But,
If more OR *less*; subtract, and the Difference by th' difference of err. div [c].
If only one supposition; the truth may be found by proportion [d].

When a question cannot readily be applied to the rule of three, or any of the vulgar rules in arithmetic: the best expedient for such as are not acquainted with algebra, is the rule of false (as it is commonly calld) which teaches us, by false terms suppos'd, to discover the true terms requird.——*By way of distinction* this rule may be divided into that of single, or double position. (1) The rule of *single* position is, when (at once, *viz.*) by one false position, we have means to discover the true resolution of the proposd question. V. note [d]. (2) The rule of *double* position is, when two false positions are supposd for the solution of the question propounded. V. note [b], &c.——*To know whether a question be resolvable by the rule of false, or not* (1) When a question requires some given number to be divided by the number sought, or any part of it: also when the number sought, or some part thereof is to be squar'd, cub'd, &c: likewise, when some parts of the number sought are to be multiplied one by the other: the ordinary rule of false will be useless. For example: 'What number is that, by which if 360 be divided, the quotient will be 24? Here, if two positions, or feign'd numbers, be taken; and 360 be divided by each of them: the errors will not be in the same proportion with the differences between the two numbers sought and the two feignd numbers: and therefore the rule of false will be usd in vain. Yet, if it be askt What number is that, which being multiplied by 24, the product will be 360': the answer to this latter ques-

tion

tion is the same with the answer to the former, and may be found by the rule of false. (2) But, when the question requires the number sought to be increast, lessend, multiplied, or divided by some given number in any of those cases: such analogy will arise as will give the true answer in the rule of false; to-wit, when the first error has such proportion to the second, as the difference between the number sought and the first feignd number. Observe, therefore, what operation the question requires to be performd with the number sought, and some given number, or numbers: the same kind of operation, in every respect is to be made with each of the two feignd numbers (commonly calld positions) and the said given number or numbers, which threefold process being finisht (whether it be by any one, or all of these rules, to-wit, addition, subtraction, multiplication and division) there will arise three remarkable numbers or results; to-wit, one proceeding from the true number sought; and two others resulting from the two feign'd numbers: Then, from these three results the errors are collected; which are nothing else but the differences between the true result, and each of the two false results.

b *For example:* Admit a church has a chancel 40 foot long; and that the ground, taken-up by the belfrey, is $\frac{1}{4}$th of the chancel, and $\frac{1}{6}$ of the nave; the nave 3 times the length of the belfrey, and $\frac{3}{4}$ of the chancel. How long is the whole church, within the walls; and every part of it? (Answ.)——Suppose the nave of the church 150 feet. (1) $\frac{1}{6}$th of that is 25: $\frac{1}{4}$th of the chancel, 10: in all 35, for the belfrey. (2) Then the nave, according to the question, is 3 times that, to-wit, 105; and $\frac{3}{4}$ths of the chancel, to-wit, 30: in all 135. (3) Which being less than 150 suppos'd, the error is 15.——Supposing the nave be 102. (1) $\frac{1}{6}$th of that, is 17: $\frac{1}{4}$ of the chancel, is 10: in all 27 for the belfrey. (2) Then, 3 times that belfrey, is 81: and $\frac{3}{4}$ths of the chancel, is 30: in all 111. (3) which being more than the 102 supposd, the error is 9——Now, (1) The product (cross-ways) of 150 (the 1st supposition) into 9 (the 2d error) is 1350: and of 102 (the 2d supposition) into 15 (the 1st error) is 1530. (2) These added together (the suppositions being, the one, more; the other, less) make 2880. (3) which divided by 24 (the sum of the errors) give 120 for the

the length of the nave. (4) And, the chancel being 40; and the belfrey ($\frac{1}{6}$th of 120, and $\frac{1}{4}$th of 40; that is) 30: the length of the whole church will be 190.

For example: Three merchants built a ship, which cost 1600*l*. *A* paid a sum not-known: *B* paid double to *A*, within 50*l*. *C* paid as much as *A* and *B*, wanting 100*l*. What did each pay of the cost? (Answ.)——Supposing *A* paid 200*l*; *B* must have paid 35; and *C* 450: in all 1000*l*; less than the cost (to-wit, 1600) by 600, for the 1st error.——Supposing *A* paid 250*l*; *B* must have paid 450; and *C*, 600: in all 1300; less also than the cost by 300.——Now, (1) The product of 200 (the 1st supposition) by 300 (the 2d error) is 60000: and 250 (the 2d supposition) by 600 (the 1st error) is 150000. (2) Then (the suppositions being both less than the truth) subtract the one from the other; the difference will be 90000. (3) which divided by 300 (the difference of the errors) gives 300*l* for *A*: consequently 550, for *B*; and 750, for *C*: which make-up the cost, to-wit, 1600*l*.

For example: Three men built a house, which cost 300*l*. *A* paid a sum unknown: *B* twice as much: *C* 3 times as much. What did each pay of the 300? (Answ.)——Suppose *A* paid 40*l* then *B* must pay 80; and *C*, 120: in all 240.——Then say (240 : 40 : : 300 : 50) If 240 arises from supposing 40: from 300 will arise 50 for *A*: consequently, for *B*, 100; for *C*, 150: in all 300.

FELLOWSHIP.

FELL. for the keéping accounts in párt-
nership; wíth, or without time.
A's Stocks of áll to the *gain*: so each man's
Stock to his *share* [a]: Or
Gain by stóck; into th' quótient, each
stock [b]——*If with time*; into th' time,
stocks [c],
Stócks to find: A's gain to stocks; so each
man's gáin to his stock is [d].

Three

a Three partners make a joint-stock. *A* puts-in 5 *l*, *B* 10 *l*, *C* 20 *l*. With this they trade; and gain (or lose) 12 *l*. What is each partner's share?——Answ. As 35 (the whole stock of all the partners) to 12 (*l*. the gain or loss) so is 5 (*l*, *A*'s stock) to his share of the gain or loss, to-wit, *l* 1 14 3 $1\frac{5}{7}$.——And, in like manner, may be found the shares of the other two partners: which, if they make-up the whole gain or loss, show the work to be right. But,

b To answer questions of this nature, *the readiest way*, is (decimaly) to divide the gain by the stock; and, into the quotient, to multiply each partner's stock.——Thus (to solve the preceding question) 12,0000 (the gain) ÷ 35 (the stock) = ,3428: and this ,3428 × 5 (*A*'s stock) = 1,7140: that is £ 1 14 3 2 nearly——And so of the rest.

c *If the stocks are in trade for different Times* [as, Suppose *A* and *B* join in partnership upon these terms, to-wit, *A* agrees to lay-down 100 *l*; and to employ it, in trade, 3 months. Then *B* is to lay-down his 100 *l*: and, with the whole stock of 200 *l*, they are to trade 3 months more. Now, at the end of that time, they find their gain to be 21 *l*. What, then, is each man's share of the gain according to his stock, and the time of employing it?]——The answer is found as afore, with this difference only, that each man's stock is to be multiplied into the time it is in trade——Say, then, As 900 (*l*, the whole stock, each part being multiplied into its time) to 21 (*l*, the gain) So is 600 (*l*, *A*'s stock multiplied into its time) to *A*'s share, to-wit, 14 *l*.

d *For example:* Three partners make a joint-stock of 35 *l*; with which they trade, and gain 12 *l*: of which £ 1 14 3 $1\frac{5}{7}$ comes to *A*'s share. What was his stock?——Answ. As 12 *l* (the whole gain) to 35 *l* (the whole stock) so £ 1 14 3 $1\frac{5}{7}$ (*A*'s gain) to 5 *l* (*A*'s stock)——And, in like manner, the gain of the other two being given, their stock may be found by the same proportion, V. note, [a].

e *In such questions where each person's stock Varies by addition and subtraction*, we must consider how-long each part of the varying stocks continued in company; and multiplying them by their times, the sums of these products are the numbers, by which the division is to be made

Fo

—*For example*: Suppose *A* put in 40*l*; and, at 4 month's end, took-out 10*l*; and, at 2 months thereafter, put-in 30*l*: *B* put-in 50; and in 3 months, put-in 20*l*; and, at 8 month's end, they balance their accounts; and find 18*l* gaind: what is the share of each? ... Here, we must consider how long each part of the varying stocks continued: and, multiplying them by their times, the sums of these products are the numbers, by which the division is to be made; as follows:

A had 40*l* for 4m.	then 30*l* 2m.	then 60*l* 2m.	*B* had 50*l* 3m.	then 70*l* 5m.
160	60	120	150	350

The sum of *A*'s several products (to-wit, 160 + 60 + 120) is 340: of *B*'s (to-wit, 150 + 350) is 500 .. Then 340 + 500 = 840 .. And 840: 18 :: 340, and 500, severaly, to the shares of 18 sought.—*A Complex question* under this head (to give a specimen of unraveling an intricacy) demands here an eclaircissement. (Quest.) *A*, *B*, and *C* keep company: *A* put-in, the 1st of march, 60*l*. *B* put-in, the 1st of may, 160 yards of broad-cloth: and *C* put-in, the 1st of june, 240 ducats. On the first of january following they accounted their gain; of which *A*, and *B* took-up 456*l*; *B* and *C* took-up 431*l*; and *C* and *A* took-up 375*l*. The question is, What was gaind as well in the whole, as a-part? What *B* valued a yard of cloth at? and What were *C*'s ducats per piece? (Answ.)——To find the Gains. (I) for the Whole gain: 456 (*A* and *B*'s gain) + 431 (*B* and *C*'s gain) + 375 (*C* and *A*'s gain) = 1262: the half of which (every man's mony being nam'd twice) to-wit, 631, is the whole gain. (II) For the several gains: (1) *A*, 631 (the whole gain)—431 (*B* and *C*'s gain) = 200, *A*'s gain (2) *B*, 631 (the whole gain) --375 (*C* and *A*'s gain) = 256, *B*'s gain. (3) *C*'s gain, therefore (to make-up the whole gain) must be 175*l*. ——To find the value of a yard of *B*'s broad-cloath. (1) First say, If 200*l* (*A*'s gain) come from 60*l* (*A*'s stock) what will 256*l* (*B*'s gain) come from. Answ. 76.8*l*. (2) Then, say If 10 months (*A*'s time) come from 76.8*l* (the answer to the former stating) what will 8 months (*B*'s time) come from. Answ. (by inverse proportion, less time requiring a greater stock) 96*l*, the value of the whole cloth. (3) Then, If 96 *l* be the value of 160 yards; What is the value of 1 yard? Anſw. .6 = 12 *s*. —To find the value of *C*'s ducat (after the ſame method) (1) Firſt 200 : 60 : : 175 : 52.5 *l*. (2) Then 10 : 52.5 : : 7 : 75 *l* = 240 ducats. (3) Then 240 *duc.* : 75 *l* : : 1 *duc.* .3125 *l* = 6 *s* 3 *d*.—Of the like nature with the foregoing are ſuch queſtions as this: Three perſons, *A*, *B*, *C*, hire (together) certain paſture-ground, for 24 *l*: in which *A* keeps 40 cows, for 4 months; *B* keeps 30 cows, for 2 months; and *C* keeps 36, for 5 months. How-much of the rent ought each of them to pay? (Anſw.) Multiply each perſon's number of cows by the time they were kept; and, by theſe products, proportion the rent. And, if the partners take-out, and put-in cattle, at different times; then work as in the preceding queſtion.

In caſes of Factorſhip, ariſe ſuch queſtions as theſe.— I. A merchant delivers to his factor 100 *l*; allowing him to join to it 30 *l*: and values his ſervice worth 40 *l*. What ſhare of the gain ought the factor to have? For the (Anſw.) ſubtract 40 from 100, which leaves 60; and proportion the ſhares of gain to 60 (for the merchant) and 70 (that is, 40 and 30) for the factor.——II. A merchant's real ſtock being 100 *l*, and the factor's 30 *l*; who receivd $\frac{1}{3}$ of the gain? What was his ſervice valued at? (Anſw.) Find the 3d part of 130; from which take 30: the remainder is the anſwer.——III. A merchant's real ſtock being 100 *l*, and the factor's ſervice valu'd at 20 *l*; who receivd $\frac{1}{2}$ of the gain; What was the factor's real ſtock? (Anſw.) 60; becauſe 20 and 60 make 80, the half of 160, the total real ſtock.——IV. The merchant's real ſtock being 100 *l*, and the factor being allowd $\frac{1}{4}$ of the gain for his ſervice: What real ſtock muſt he join to have $\frac{1}{3}$ of the gain? (Anſw.) When the factor gets $\frac{1}{4}$ (without any real ſtock) his ſervice is there valued at 25 *l*. With this value of his ſervice proceed to find the real ſtock, that he muſt have, to get $\frac{1}{3}$ of the gain by the methods of queſtion 3. (Note) In the preceding queſtions we may ſuppoſe 2, or more merchants, with the factor: it will be eaſy to apply the ſame rules, by adding the ſtocks of all the merchants into one ſum; and conſidering that, as one ſtock. And then, beſides what is already demanded, it may alſo be demanded to find the gain of each merchant. Thus, by the firſt method of an imaginary ſtock, what remains to the merchants after the factor's part is deducted, muſt be divided in proportion to their real ſtocks. By the real ſtocks we muſt divide the factor's eſtimation into parts proportiond to the merchant's real ſtocks; and take the parts anſwering to each from itſelf: the remainders are the numbers by which the merchants ſhares are to be proportiond.——V. A merchant's real ſtock being 120*l*, and the factor's 60: they agreed, that, at a year's end, the factor ſhould have ½ of both the ſtocks and gain: but they broke-up at 8 months end, having gain'd 150*l*. How-much ought the factor to have? (Anſw.) Here, it is plain the factor, for 12 months ſervice, was to have not only the gain of 30*l*, of the merchant's ſtock; but alſo 30 of the ſtock itſelf. So that his ſervice was valued at 30*l* real ſtock; but, the ſociety laſting only 8 months; it is plain he ought only to have 20*l* (which is to 30*l*. as 8 months to 12) And this, added to his own 60, makes 80*l*: which he receives of the real ſtock: and the merchant's part being 100*l*; then it is as plain that the 150*l* gain muſt be divided into 2 parts, proportiond to theſe ſtocks 80, and 100.

In other caſes relating to Stocks, Gain, &c. there occur other queſtions; for the ſolution of which it may not be improper to give ſome more particular hints: as——I. *A*, *B*, and *C* make a ſtock; whereof *A* has 20*l*; *B*, 30*l*. They gain 36*l*: whereof *C* got 16*l*. What was *C*'s ſtock, and the gain of *A* and *B*? (Anſw.) Take 16 from 36; and the remainder, 20, is the ſum of the gain of *A* and *B*; which, being divided in proportion to their ſtocks, gives their ſhares: Then find *C*'s ſtock in ſuch proportion to his gain, as *A*, or *B*'s ſtock to his gain.——II. *A* put into a common ſtock 20*l*; and *B*, 144 ducats. They gaind 60*l*: of which *A* got 38*l*. What was the ducat valued at? (Anſw.) Take 38 from 60: the remainder, 22, is *B*'s gain: Then, ſay, As 38*l* (*A*'s gain) to 20*l* (his ſtock) ſo is 22*l* to a 4th term; which is *B*'s ſtock: Then, if 144 ducats give that ſtock; what is 1 ducat worth?——III. *A*, *B*, and *C*, make a common ſtock of 468*l*: with which they trade, and gain a certain ſum: whereof the ſhares of *A* and *B*, together, made 64*l*; of *B* and *C*, 58; of *A*, and *C* 70*l*. What is the particular ſtock and gain of each partner? (Anſw.) Add 64, 58, and 70: the ſum 192*l*, is double the total gain; becauſe each partner's

ſhare

ſhare is twice contain'd in it. Therefore the half of it, 96 *l*, is the total gain: from which take 64 *l* (*A* and *B*'s ſhare) the remainder, 32, is *C*'s ſhare; which, taken from 58 *l* (*B* and *C*'s ſhares) leaves 26 *l*, for *B*'s ſhare: which, taken from 64 *l* (*A* and *B*'s ſhare) leaves 38 *l*, for *A*'s ſhare: Then, having the particular gains, divide the total ſtock proportionaly.——IV. *A* has in ſtock 35 *l*, and *B* 20 *l*. They agreed that the gain be divided, ſo as *A* have 10 per cent, and *B* only 8. How is 40 *l* to be divided betwixt them? (Anſw.) Find what is due to 35 *l*, at the rate of 10 per cent; and to 20 *l*, at the rate of 8 per cent: then divide the total gain (40 *l*) in proportion to thoſe ſums. For, the only meaning, ſuch a queſtion can have, is, That the gain be proportion'd to what 35 would draw, of 10 per cent; and 20, of 8 per cent: and not, That *A* has realy 10 per cent; and *B*, 8; for their ſtocks. For, they will have more or leſs, according as the total gain happens to be.——V. *A* and *B* were in company, thus: *A* had 50 *l*, in ſtock, for 10 months; and *B* had his ſtock in, for 8 months; and receiv'd equal ſhare of the gain: What was *B*'s ſtock? (Anſw.) Since their gain was equal, ſo muſt the products of their ſtocks, and times. Wherefore multiply *A*'s ſtock and time (to-wit, 50 *l*) by 10: the product is 500; which divide by *B*'s time, 8; the quote (62 *l*, 10 *s*) is *B*'s ſtock: Or, which is the ſame, make this proportion: As *B*'s time (8 months) to *A*'s time (10 months) ſo, reciprocaly, is *A*'s ſtock (50 *l*) to *B*'s, 62 *l*, 10 *s*. (Note) If we ſuppoſe *A*'s gain is to *B*'s in any other proportion, as 2 to 3: then, becauſe the gains are proportional to the products of ſtock and time; ſay, as 2 to 3: ſo is 500 *l* (the product of *A*'s ſtock and time) to a 4th, to-wit, 750 *l* (the product of *B*'s ſtock and time) which, therefore, divided by 8 (*B*'s time) the quote is 93 *l*, 15 *s*; for *B*'s ſtock.——VI. *A* receives (of gain) 20 *l*, for 8 months: *B*, 25 *l*; for 7 months: and *C*, 36 *l*; for 5 months, The ſum of the products of their ſtocks and times is 520 *l*. What were their ſtocks? (Anſw.) Divide 520 *l* in 3 parts, proportion'd to 20 *l*, 25 *l*, and 36 *l*: then divide each of theſe parts by the reſpective times, 8 months, 7 months, and 5 months: the quotes are the ſtocks ſought. (Note) If inſtead of the particular times, the ſtocks were given; and the times requir'd: the operation is the ſame. For, 520 being resolvd into 3 parts proportiond to the gains, divide these parts by the stocks; and the quotes are the times.——VII. *A* gains 20 *l*; and his stock is 15 *l* more than *B's* stock; whose gain is 12 *l*. What are the particular stocks? (Answ.) Say: As the difference of the gains is to the difference of the stocks: so is each of the particular gains to the correspondent stocks. For, since the sum of the gains is to the sum of the stocks as each gain to its stock: then, from the nature of proportion, the difference of gain is to the difference of stock, as each gain to its stock.——VIII. *A* gains 20 *l*, in 6 months; *B*, 18 *l*, in 5 months; and *C*, 28, in 9 months; whose stock is 72. What are the stocks of *A* and *B*? (Answ.) Multiply *C's* stock and time: the product is 648 *l*. Then, As 28 *l* (*C's* gain) to 648 *l*: so are 20 *l*, and 18 *l*, to the products of *A's*, and *B's* stock and time; which being found; divide them by their times; and the quotes are the stocks. (Note) If, instead of the real sums of gains, there were given 3 numbers in the same proportion as the real gains; the work is the same. (2) Or, suppose, instead of the particular gains, that *A* has $\frac{1}{3}$ of the whole gain; and *B*, $\frac{2}{5}$: then, we must add these fractions; and take the sum from 1: the remainder is the fraction of the total gain, which *C* has. And, then, use these fractions, as the particular gains. (3) Again, if their particular gains and stocks are given, with the time of one partner; to find the times of the rest: the work is also the same.——IX. *A*, *B*, *C* have a common stock of 1000 *l*. *A* gains 100 *l*, for 9 months; *B*, 80 *l*, for 12 months; and *C*, 120 *l*, for 8 months: What were the particular stocks? (Answ.) Divide each partner's gain by his time; and then divide 1000 *l* into 3 parts, proportiond to those quotes. (Note) If, instead of the total stock, and particular times (as above) were given the particular stocks, and total time: to find the particular times; the solution is after the same way, and for the same reason; to-wit, dividing the particular gains by their stocks; and proportioning the times to those quotes. ——X. *A* has 200 *l* more stock than *B*: but *A* continued his, only 5 months; and *B*, 9; and drew equal gains: What are the stocks? (Answ.) As the difference of times to the difference of stocks: so is *A's* time to *B's* stock; and *B's* time to *A's* stock. Or, having one stock; by that,

that, and the difference, find the other.——XI. *A*, *B* and *C* have 100*l*, to be divided among them, in such manner that 2 times *A*'s share be equal to 3 times *B*'s; and 4 times *B*'s be equal to 5 times *C*'s; What are their shares? (Answ.) It is plain, by the conditions, that, as oft as *A* gets 3; *B* must have 2: also, as oft as *B* gets 5, so oft must *C* get 4. Then, say: As 5 to 4: so is 2 to $1\frac{3}{5}$. So that, as oft as *B* gets 2, so oft *C* gets $1\frac{3}{5}$: but, so oft, also, *A* gets 3: therefore the proportions of the shares sought are 3, 2, $1\frac{3}{5}$; or 15, 10, 8; according to which 100*l* is to be divided. (Note) Suppose the conditions thus; $\frac{1}{2}$ of *A*'s share is equal to $\frac{2}{3}$ of *B*'s: and $\frac{2}{3}$ of *B*'s equal to $\frac{5}{7}$ of *C*'s: we may find the proportions of their shares, the same way as before.——XII. A father, ignorant of arithmetic, orders his estate, of 500*l*, to be divided among 3 sons; so as the eldest have $\frac{1}{2}$; the second, $\frac{3}{5}$; and the third, $\frac{4}{7}$: What is each son's part? (Answ.) Here it is impossible to give them these shares; because $\frac{1}{2}$ $\frac{3}{5}$ and $\frac{4}{7}$ exceed the whole. And therefore the meaning of the question must be understood to be, the dividing 500*l* into 3 parts, that bear such proportion to one another as these fractions. And the like is to be understood of all divisions propos'd in this manner; whether the parts propos'd exceed, or come-short of, the thing to be divided.——XIII. It is propos'd to divide 300*l* among 3 persons, so *A* gets 6*l* more than $\frac{1}{2}$, *B* 12*l* more than $\frac{1}{3}$, *C* 8*l* less than $\frac{2}{3}$, What gets each? (Answ.) According to the most obvious sense of this question, the meaning of it is, that the shares be in proportion to the sum of 6*l*, and $\frac{1}{2}$ of 300*l*, for *A*; 12*l*, and $\frac{1}{3}$ of 300*l*, for *B*; and $\frac{2}{3}$ of 300*l* (wanting 8*l*) for *C*.——XIV. Three persons, *A*, *B*, and *C*, buy a ship; of the price whereof *A* paid $\frac{5}{8}$, *B* $\frac{3}{7}$, and *C* 140*l*. How-much money paid *A*, and *B*? and What part of the ship had *C*? (Answ.) Add the fractions $\frac{5}{8}$ and $\frac{3}{7}$; and take the sum from 1: the remainder is the part of the ship belonging to *C*. Then, say, If *C*'s part cost 140*l*; What cost the sum of *A* and *B*'s parts? And, having found that, divide it into 2 parts, proportion'd to one another as $\frac{5}{8}$ to $\frac{3}{7}$.——XV. There were (at a feast) 20 men, 30 women, and 15 servants; for every 10*s* that a man paid, a woman paid 6, and a servant 2: How-much did every man, woman, and servant, pay of 24*l*? (Answ.) Multiply 20 into 10, 30 into 6, and 15 into 2. Then divide 24*l* into three parts, proportiond to these products (to-wit, 200, 180, and 30) and you have the total paid by the 20 men, 30 women, and 15 servants: each of which sums, being divided by their respective numbers of persons, gives the payment made by each individual. (Note) (1) Suppose the conditions such, that a man pays 3 times as-much as a woman, and 2*s* more: that a woman pays double of a servant, and 1*s* more. To find their shares, multiply 2 by 20, and 1 by 30: the products 40 and 30 (equal to 70*s*.) take from 24*l*: the remainder is 20*l* 10*s*. Then, because a man pays triple of a woman, suppose a man pays 3, a woman pays 1; and, because a woman pays double of a servant, if a woman pays 1, a servant pays $\frac{1}{2}$: so, their proportions are 3, 1, $\frac{1}{2}$; or, in whole numbers, 6, 2, 1; that is, 6, for a man; 2, for a woman; and 1, for a servant. Multiply these by their respective numbers of persons: the products are 120, for 20 men; 60, for 30 women; and 15, for 15 servants. Then divide 20*l* 10*s*, in three parts, in proportion to one another, as 120, 60, and 15; and divide these parts by their respective numbers of men, women, and servants: the quotes are what each man, woman, and servant, pays of the 20*l* 10*s*. Lastly, to a man's share of this add 2*s*; to a woman's 1*s* and you have their complete payments of the whole 24*l*. (2) If, instead of adding, it had been proposd to subtract [as if a woman pays 1*s* less than the double of a servant; then add 30*s* to 24*l* (subtracting what a man pays more than triple of a woman) and, in the last part, instead of adding, subtract 1 from the woman's part of the sum divided.——XVI. A father, dying, left his wife with child; to whom he bequeathd (if she had a son) $\frac{1}{3}$ of his estate; and $\frac{2}{3}$ to the son: But (if she had a daughter) $\frac{1}{3}$ to her, and $\frac{2}{3}$ to her mother. It happend that she had both a son, and a daughter: How shall the estate be divided, to answer the father's intention? (Answ.) As the father plainly designd the son to have double of the mother's part; and the mother, double of the daughter's part: therefore, for every 1, the daughter had, the mother must have 2; and the son, 4: and in proportion to these numbers 1, 2, 4, must the estate be divided. (Note) Suppose that the mother had a son, and a daughter, who livd; but herself died in the birth: How is the estate to be be divided betwixt the son, and the daughter? (Answ. Find the parts belonging to mother, son and daughter: then, divide the mother's part betwixt the children according to the rule of heir-ship in the country where the question arises.

FRACTIONS.

VULGAR.

Reduction [b].

1 *TO the Lowest terms:* each by 2' [c], or 5' [d] or other cómmon divisor *.

2 *Tó Common-dén:* mult the déns; numer each into áll-but-its-own den [f].

3 *To a Símple, a compound:* núm into núm; into den, den [g].

4 *Tó an Impróper, a mixt:* into den the integer; add num [h].

5 *To a Míxt, an improper:* númer by dénominator [i].

6 *Tó a Single, a fráction-of-fráction:* When the integral part is

7 (1) Núm into dén of the fráctional, plus its núm: into den, den [k].

8 (2) Dén into dén of the fráctional, plus its núm: into num, den [l].

9 *Tó a Greater name, a mixt made impróper:* a cómpound to simple [m].

10 *Tó a Less name, a greáter:* the núm, into the párts down to th' given [n].

11 *To a Fráction, a whóle:* 1 the dén: or, for núm; into whole, den [o].

12 *Tó Decimáls:* numerátor (with cíphers) by dénominator [p].

Tó a certain num or dén: as the óne to the óther, so sought is [q].

Cómmon Divísor, *for lówering to th' léást*, is the Láſt; to be found thus:
Gréater by léſs: the divíſor by réſt: and ſo ón, till reſts nothing [s].

Operations.

[*Vúlgar*] ADD [s] and SUB [s], the núms: having brought 'em to óne common -nator.
MÚLTIPLY num into núm; into dén, den [t].
DIVIDE, as follows:
Fór *numer:* num of -dénd into den of -fór: th' others *den* give [u].
[*Mixt*] into th' Integer *múltiply*; by th' Fráction *divide* -cand: and *add* Both [w].

DECIMAL.

[*Décimals*] as I'ntegers: Tŏ A'DD, or Subtract; place éach to its value [x]:
Cúting-off pláces in A'DD SUB, the móſt [y]: in MÚLT, both the factors [z].
A'nd, to the próduct, when féwer the pláces, prefixing ciphers [aa].
DI'V: To the dívidend's make équal the quótient's wíth the divisor's [bb]:
Thérefore, when léſs; ciphers ádd to the dívidend [cc]; prĕfíx to the quotient [dd].

Valuations

[*of Vulgar*] [*and Decimal*]
I'nteger (ín lower náme) into númer by dénominator [ee].

USE.

Use.

26 Use of Decimals: an easier working than with *Vulgars* [ff].

a For the *nature* of fractions, both Vulgar and Decimal, V. Arithmetic: note [c].——As to the *operation* of fractions, it is a good observation of Dr. Wells's, that the common way of placing the denominator under the numerator, with a line between, occasions some seeming difference between the operations of integers, and common fractions. In order to the taking-away of it, he advises to write common fractions as we write numbers of several external denominations; that is, to place the denominators at the head, or toward the top of the numerators of their respective common fractions. Namely, as we denote two shillings and six pence, thus, over the figures, $\overset{s.}{2}\ \overset{d.}{6}$: so he thinks it would be better to denote the same by common fractions, thus 2^{20} (to-wit, of a pound) 6^{12} (to-wit of a shilling) than, as usualy, thus: $\frac{2}{20}$. and $\frac{6}{12}$. For, the former way being the same whereby integers of several external denominations are denoted; the working of common fractions, when exprest after the same way, will more appear to be agreeable to the working of those, than if the common fractions were exprest the common way.——Thus $\frac{8}{12}$ and and $\frac{3}{12}$, with their denominators a-top, or rather affixt (as in the margin) appear to be wrought after the manner of common operations in integers.

Addit.	Subtr.	Multip.	Divis.
8^{12}	8^{12}	8^{12}	24^{12}
$+3^{12}$	-3^{12}	$\times 3^{12}$	$\div 3^{12}$
$=11^{12}$	$=5^{12}$	$=24^{144}$	$=8^{12}$

b The *reduction* of fractions being in order to prepare them for adding, subtracting, &c. it was necessary to treat of it, before an account could be given of the operations.

c *Halving* the numerators and denominators of a fraction (1) often gives a fraction in the lowest terms: thus $\frac{20}{48} = \frac{10}{24} = \frac{5}{12}$ (2) or readily offers a common divisor: thus,

thus, $\frac{96}{120} = \frac{48}{60} = \frac{24}{30} = \frac{12}{15} \div 3$ (the common divisor) $= \frac{4}{5}$.

When the numbers end in a cipher, or 5; dividing by *five* will abbreviate a fraction. Thus $\frac{25}{350}$ will be $\frac{1}{14}$. for, $25 \div 5 = 5$: and $350 \div 5 = 70$. Then $5 \div 5 = 1$: and $70 \div 5 = 14$.

For example: To bring to the lowest term $\frac{84}{96}$; Say, 96 (the greater) $\div$ 84 (the lesser) $= 1$: rests, or remains 12. Then 84 (the divisor) $\div$ 12 (the remainder) $= 7$: remains 0. Therefore 12 (the last divisor) in 84, 7 times; in 96, 8 times: hence, in the lowest terms, $\frac{7}{8}$. ——*Note,* If the last divisor be 1: the fraction cannot be reduc'd to lower terms.

For example. (I) $\frac{2}{3}$ and $\frac{3}{4}$: (1) for the Denom. $3 \times 4 = 12$: (2) for the Numer. $2 \times 4 = 8$, and $3 \times 3 = 9$. So, the fractions equal to $\frac{2}{3}$ and $\frac{3}{4}$ (having the same denom.) are $\frac{8}{12}$ and $\frac{9}{12}$. (II) $\frac{2}{3}$ and $\frac{4}{6}$ and $\frac{3}{4}$: (1) for the Denom. $3 \times 6 \times 4 = 72$ (2) for the Numer. $2 \times 6 \times 4 = 48$: and $4 \times 3 \times 4 = 48$: and $3 \times 6 \times 3 = 54$. So, the equivalent of fractions (with one common denominator) are $\frac{48}{72}$ and $\frac{48}{72}$ and $\frac{54}{72}$. V. note 8.

Thus $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{6}$ will be $\frac{15}{48}$.——In like manner Fractions of diverse denominations may be brought into one denomination by involving the less into the parts of a greater. Thus (1) $\frac{3}{4}$ of a penny may be reduc'd to the proper fraction of a greater name, to-wit: $\frac{3}{4}$ of $\frac{1}{12} = \frac{3}{48}$ *s*: and $\frac{3}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$ (or $\frac{3}{4}$ of $\frac{1}{240}$) $= \frac{3}{960}$ *l*. So, (2) $\frac{3}{7}$ of an ounce, reduc'd into the fraction of a cw, will be $\frac{3}{7}$ of $\frac{1}{28}$ of $\frac{1}{4}$ of a cw $= \frac{3}{784}$. And, so, of any other.

Thus $3\frac{2}{4} = \frac{14}{4}$: to-wit, $4 \times 3 + 2 = 14$, the numerator to 4.

Thus, $\frac{14}{4} = 3\frac{2}{4}$: to-wit, $14 \div 4 = 3$; remains 2, that is $\frac{2}{4}$ or $\frac{1}{2}$.

For example: To reduce $\frac{42}{49}\frac{7}{8}$ to a single fraction, (1) 42 (the numerator of the integral part) $\times$ 8 (the denominator of the fractional) $+$ 7 (the numerator of the fractional) $= 343$, for the new numerator. (2) 49 (the denominator of the integral part) $\times$ 8 (the denominator of the fractional) $= 392$, for the new denominator. So, the single fraction, to which this fraction-of-fraction is reduc'd, will be $\frac{343}{392} = \frac{7}{8}$.

For

l *For example:* To reduce $\frac{7}{19\frac{3}{5}}$ to a single fraction (1) 19 (the denominator of the integral part) × 5 (the denominator of the fractional part) + 3 (the numerator of the fractional) = 98, for a new denominator. (2) 7 (the numerator of the integral part) × 5 (the denominator of the fractional) = 35, for a new numerator. So, the single fraction, to which this fraction-of-fraction is reduc'd, will be $\frac{35}{98} = \frac{5}{14}$.

m *Thus*, To reduce $3\frac{1}{2}d$ into the proper fraction of a pound: $3\frac{1}{2}$ being made an improper fraction (by line 4) to-wit, $\frac{7}{2}$: say $\frac{7}{2}$ of $\frac{1}{12}$ of $\frac{1}{20}$ (or $\frac{7}{2}$ of $\frac{1}{240}$) = $\frac{7}{480}$. V. note p.

n *Thus*, To reduce $\frac{7}{480}l$ to the fraction of a penny, of the same value; 7 (the numerator) × 20 (shillings, the next inferior denomination) = 140 × 12 (pence, the next, and sought) = 1680. Therefore $\frac{1680}{480}d = \frac{7}{480}l$.

o *Thus* 3, a whole number, exprest fraction-wise is $\frac{3}{1}$. —Or, If you would reduce a whole number to a given denominator; multiply the given denominator into the whole number: thus 3, with 6 (for a denominator) will be $\frac{18}{6}$.

p *For example:* $\frac{5}{7}$ of a pound (5,00000000 ÷ 7) will be .71428572, for, As 7 (the denom.) to 5 (the numer.) So 100000000 (the denominator, of the decimal, understood) to .71428572 the numerator of the decimal exprest) *—*In like manner* may be exprest, decimaly, the parts of Coins, Measures, Time, Weights, &c. E. G. (I) *Coins:* (1) 5*s* is $\frac{5}{20}$: (by line 12) = .25: for 5.00 ÷ 20 = .25. (2) 14*s* 3*d* 2*q*. Say 14 × 12 + 3 (to reduce the *s* to *d*) = 171 *d*. Then 171 × 4 + 2 (to reduce the *d* to *q*) = 686 *q*. Then (960 being the integer reduc'd to the same name; to-wit, farthings) the fraction will be $\frac{686}{960}$: (V. note m) which (by line 12) will be .714; or, more fully, .71428572 +. (II) *Measures;* 2 pints (1 gallon, the integer) will be .25: for 2 pints = $\frac{2}{8}$ of a gallon: which (by line 12) = .25. (III) *Time:* 45 minutes (the integer an hour) will be .75: for $\frac{45}{60}$ (by line 12) = .75 +. (IV) *Weights:* (1) 9 *oz* (i. e. $\frac{9}{12}$) will be .75. (2) 8 *oz* 19 *dw* 8 *gr* (i. e. 4304 *gr*) will be $\frac{4304}{5760}$: reduc'd, .746 +.

* *The Reverse*, or the reducing a decimal to a vulgar fraction—of a Denominator requird; say, 100000000:

7142

71428572 : : 7 : 5.——of a Numerator requird; say, 71428572 : 100000000 : : 5 : 7.

How, more readily to express Mony and Time, in decimals. V. Interest.

Thus any one may make decimal tables, of all sorts, for himself; or rather find the decimal he wants on any occasion: which is incomparably better than to depend on tables ready made. Of these tables Mr Hill (p. 175) gives us 4 pages; and even requires (p. 182) one of the tables to be got-by-heart by every learner. To facilitate which, he proposes an expedient as follows: The decimals of 1 penny (a shilling being the integer) are .08333; of 11 pence .91666, &c. To get them the more easily, read them (says he) thus: For 1; nought, eight, and all threes: for 11, nine, one, and all sixes: and so on; as if the taking the pains to get and retain them, with the danger of losing or misremembering them, were preferable to dividing (for instance) 1.000 by 12, &c. when you have occasion for it; and would be sure of it: or, to multiply the integer (in lower name) into a decimal; when you want to know the value of it. E. G. .08333 × 12 = .99996, almost 1 *s*: which is the true estimate of the decimal. V. Interest——And

Thus it is (without any more ado) that *Sexagesimal fractions*, about which Mr Weston makes such a pother (arithm. p. 308—317) are reduc'd to decimal. *For example:* 365 days, 5 hours, 49′ 16″ 46‴ in decimals would be 365.2425. for, 46‴ (by line 12) is .7666‴. Then 16″ + 46‴ = 16.7666″ ÷ 60 = .2794′. Then 49′ + .2794′ = 49.2794′. And (minutes being the 60ths of an hour) 49.2794′ ÷ 60 = 8213. Then 5 h. + .8213 h = 5.8213 h. And (hours being the 24th of a day) 5.8213 ÷ 24 = .2425 days. Then 365 d + .2425 d = 365.2425 days; the decimal sought. ——NB. The decimals thus found, the solution of any question, wherein there are sexagenary progressionals, will be much shorter and easier. *For example:* Suppose the diurnal mean motion of the sun were sought (its annual course, through the whole zodiac, being perfected in 365 d. 5 h. 49′ 16″ 46‴) the stating would be: As the annual (time aforementiond) to the diurnal time (24 hours) So is the mean annual motion (through 360 degrees) to the diurnal motion, or the number of degrees it advances

in

in a day. The operation, in ſexageſimals, would be very laborious, requiring various reductions: but, in decimals, it will ſtand thus: 365.242555 days : 360 degrees : : 1 day : .985646374 degrees; that is (by line 20) $59' \; 8'' \; 19''' \; 37''''$ &c.

q *Thus*——In *vulgar* fractions (1) To reduce $\frac{3}{4}$ to a fraction of the ſame value, whoſe numerator ſhall be 15: Say, As 3 (the numerator) to 4 (the denominator) ſo is 15 (the numerator given) to 20, the denominator ſought, to make the fraction of the ſame value with the fraction propoſd. (2) To reduce $\frac{3}{4}$ to a fraction of the ſame value, whoſe denominator ſhall be 20 : ſay (reverſely) 4 : 3 : : 20 : 15——In *decimals* the method is the ſame.

r *Thus* (I) $\frac{4}{8} + \frac{2}{8} = \frac{6}{8}$. (II) $\frac{2}{3} + \frac{4}{5}$: that is (by line 2) $\frac{10}{15} + \frac{12}{15} = \frac{22}{15}$: that is (by line 5) $1\frac{7}{15}$. (III) $\frac{7}{8}$ of a pound $+ \frac{2}{3}$ of a ſhilling $+ \frac{3}{4}$ of a penny [that is (by line 3) $\frac{7}{8} \; \frac{2}{60} \; \frac{3}{960}$: that is (by line 2) $\frac{403200}{460800} \; \frac{15360}{460800} \; \frac{1440}{460800}$] $= \frac{420000}{460800}$. (IV) $\frac{15}{42} + \frac{3}{8}$ of $\frac{2}{3}$ [that is (by line 3) $\frac{15}{42} + \frac{6}{24}$, or (by line 1) $\frac{1}{4}$; and (by line 2) $\frac{42}{168} + \frac{60}{168}$] $= \frac{102}{168}$. (V) $17\frac{3}{4} + \frac{1}{3}$ of $\frac{3}{4}$ [that is (by lines 4 and 3) $17\frac{71}{4} + \frac{6}{12}$: that is (by line 2) $\frac{352}{48} + \frac{24}{48}$] $= \frac{876}{392}$: that is (by line 5) $18\frac{12}{48}$, or $18\frac{1}{4}$. (VI) $1\frac{1}{2} + 74\frac{3}{5}$ [that is (by line 2) $1\frac{5}{10} + 74\frac{6}{10}$: and $\frac{5}{10} + \frac{6}{10} = \frac{11}{10}$: that is (by line 5) $1\frac{1}{10}$: ſo $1 + 74 + 1\frac{1}{10}$] $= 76\frac{1}{10}$.

s *Thus* (I) $\frac{1}{4} - \frac{3}{4} = \frac{2}{4}$. (II) $\frac{3}{4} - \frac{2}{3}$ [that is (by line 2) $\frac{8}{12} - \frac{9}{12}$] $= \frac{1}{12}$. (III) $\frac{2}{3}$ of $\frac{3}{4} - \frac{13}{14}$ [that is (by line 3 and 2) $\frac{224}{378} - \frac{351}{378}$] $= \frac{127}{378}$. (IV.) $\frac{3}{7}$ of $\frac{5}{9}$ of $\frac{2}{3}$ $-$ 7 [that is (by line 3 and 11) $\frac{33}{189} - \frac{7}{1}$: that is (by line 2) $\frac{30}{189} - \frac{1323}{189}$] $= \frac{1293}{189}$: that is (by line 5) $6\frac{159}{189}$: that is (by line 1) $6\frac{53}{63}$. (V) $2\frac{3}{4} - 11\frac{2}{3}$ [that is (by line 4) $\frac{11}{4} - \frac{35}{3}$ (by line 2) $\frac{33}{12} - \frac{140}{12}$] $= \frac{107}{12}$: that is (by line 5) $8\frac{11}{12}$. (OR) $2\frac{3}{4} - 11\frac{2}{3}$: that is (by line 2) $2\frac{9}{12} - 11\frac{8}{12}$. Then, to ſubtract numerator 9 from 8, borrow an integer of the mixt number; and ſay, 9 from 12 (the denom.) $= 3 + 8 = 11$: then (for the integers) 1 (that I borrowd) $+ 2 = 3 - 11 = 8$: ſo the anſwer is (as afore) $8\frac{11}{12}$.

t *Thus* (I) $\frac{7}{8} \times \frac{3}{4} = \frac{21}{32}$. (II) $11\frac{2}{3} \times \frac{3}{4}$ [that is (by line 4) $\frac{35}{3} \times \frac{3}{4}$] $= \frac{105}{12}$: that is (by line 5) $8\frac{9}{12}$. (III) $11\frac{2}{3} \times 2\frac{3}{4}$ [that is (by line 4) $\frac{35}{3} \times \frac{11}{4}$] $= \frac{385}{12}$: that is (by line 5) $32\frac{11}{12}$. (IV) $\frac{2}{5} \times 7$ [that is (by line 11) $\frac{2}{5} \times \frac{7}{1}$] $= \frac{14}{5} =$ (by line 5) $2\frac{4}{5}$. (V) $7\frac{5}{8} \times 4$: that is (by line 4 and 11) $\frac{16}{8} \times \frac{4}{1} = \frac{244}{8}$: that is (by line 5) $30\frac{4}{8}$.——

Note, Multiplication of fractions diminishes the value, in proportion as the multiplication of whole numbers increases it. Thus $\frac{1}{8}\,l$ (or $30\,d$) $\times \frac{1}{8}\,l$ (or $30\,d$) $= \frac{1}{64}\,l = 3\,d : 3\,q$ *. So $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$. V. Leybourn, curs. mathem. p. 38.

The same in *decimals*: $.125 \times .125 = .015625 = 3\,d\ 3\,q$.——Yet it is observable, that the product will alter in value, according as you alter your integer. Thus, suppose the former question were propounded, and a shilling to be the integer; then $.125\,l = 2.5\,s \times 2.5 = 6.25\,s$, or $6\,s\ 8\,d$.

Thus, (I) $\frac{4}{9} \div \frac{3}{5} = \frac{20}{27}$. (II) $8 \div \frac{5}{6}$ [that is (by line 11) $\frac{8}{1} \div \frac{5}{6}$] $= \frac{48}{5}$. (IV) $3\frac{9}{8} \div 2$ [that is (by line 4 and 11) $\frac{33}{8} \div \frac{2}{1}$] $= \frac{33}{16}$. (V) $\frac{2}{11} \div \frac{2}{5}$ of $\frac{5}{7}$ [that is (by line 3) $\frac{2}{11} \div \frac{10}{35}$] $= \frac{70}{110}$; or (by line 1) $\frac{7}{11}$.

For example:——In 276 barrels of raisins, each $3\frac{1}{4}$ cw; How-many cw? (Answ.) $276 \times 3 = 828$: then, $276 \div 4 = 69$: then, $828 + 69 = 897$ cw, in the 276 barrels. ——In 24 cases of tobacco, each $2\frac{3}{4}$ cw; How-many cw? (Answ.) $24 \times 2 = 48$: then, $24 \div \frac{2}{4}$ (or half) $= 12$; and $24 \div \frac{1}{4}$ (or quarter) $= 6$: then $48 + 12 + 6 = 66$ cw, in the 24 cases. V. Tables: note [b].

That is, Place the commas, or separating points, directly under one another; and the figures, according to their respective values, or distances from unit ——And, if the numbers, given to be added, are not of the same denomination; they must be brought to the same. Thus (1) to *add* $.725\,l$ to $.625\,s$; having prepard the biger by multiplication (as in line 25) it will be as in the margin, at *A*; or the lesser, by division (to-wit, $62500 \div 20$) it will stand as at *B*. (2) To *subtract* $.625\,s$ from $725\,l$; the terms being prepard as afore, the work will stand as at *C* and *D*.

A	14.500
	625
	15.125
B	.725
	.03125
	.75625
C	14.500
	625
	13.875
D	.725
	.03125
	.69375

That is, In addition and subtraction (having plac'd the numbers according to the directions of note [x]) add, and subtract them, after the manner of integers; cuting-off so many places as are most in any of the given numbers. The work will stand as in the margin, at *E* and *F*. *That*

E	To	3.875
	add . . .	.75
	and . . .	13.6634
	Total	18.2884
F	From	3.024
	take . . .	2.23
	Remains . . .	.794

z *That is*, In multiplication, cut-off so many places as there are in both the factors: e. g. .75 × .5 = .375; in which product the number of places are equal to those of the two factors.

a a *Thus*, .0347 × .0236 = 81892: to which [the number of places being fewer (by 3) than those of both the factors] prefix 000; and the true product will be .00081-892. So 36.252 × .00032 = .0116064.——*Note*

I. *When any propos'd number of decimals are to be multiplied into* 10, 100, 1000, 10000, *&c.* it is only removing the separating point, in the multiplicand, so many places towards the right-hand as there are ciphers in the multiplier. Thus, .578 × 10 = 5.78: and .578 × 100 = 57.8. Again, .578 × 1000 = 578: and .578 × 10000 = 5780.

II. *To abbreviate multiplication to so many places as may serve the purpose* *.—Rule † (I) Place the factors in their natural order. (II) Then (having counted the number of decimals in both) from their sum subtract the number you would have: and cut-off, from the right, in the multiplicand, so many figures as the remainder. (III) Then (1) By the 1st figure of the multiplier, multiply only those to the left of the line of separation, adding what would be carried by the multiplication of 2 figures to the right ‡; and set-down the product under the first figure multiplied. (2) By the 2d figure of the multiplier, begin with the next figure (to the right) of the multiplicand; and set-down the first figure of the product under the first of the preceding multiplication. (3) By the 3d figure, take-in the next (to the right) in the multiplicand, *&c.* proceeding with the rest in like manner——Example: 45.4789 × 6.235. (1) *At large*, the work will stand as in the margin at *A*. (2) *To retain only 3 decimals*, Take 3 from 7 (the number of all the decimals) the remainder is 4: cut-off, therefore, 4 figures of the multiplicand from the right; and begin to multiply into the next to the left, proceeding according to the above-directions; and the operation will advance as in the margin at *B*. (3) *To have only the integers*: for 7 (the sum of the decimals) the line of separation will

```
A .. 45.4 789
        6.235
    ---------
     2273 945
    1 3643 67
    9 0957 8
  272 8734
  -----------
  283.5609 415
```

cut off, not only all the multiplicand; but alſo 1 figure of the multiplier; as at C, in the Margin: and, then, the operation will proceed thus: 3 × 0 (the place to the left of 4 in the multiplicand) = 0 + 1 (that I carry from 3 times 4, the figure to the right) = 1; which I ſet-down. Then, 2 × 4 = 8 + 1 (that I carry from 2ce 5) = 9. Then, 6 × 5 = 30 + 3 (that I carry from 6 times 4, plus 6 times 7, to-wit, 28; which being above 25, I carry 3) = 33. Then 6 × 4 = 24 + 3 (that I carry) = 27 ††.

B . . . . 45|.4 789
6.235

45 . . .	×	5 227
454 . .		3 . . . . 1 364
4547 .		2 . . . . 9 c96
45478		6 . . 272 873
		283.560

C
45.4 78 9
6.23|5
1
9
273
283

For the moſt part we have occaſion for *no more than* three or four figures after the ſeparatrix. In ſuch caſes, to cut-off the following places will be of great eaſe and uſe, on many occaſions: more particularly in reſolving adfected equations; in calculating of trigonometrical problems by the natural ſines and tangents, &c.

The common Method, in this caſe, that has been handed-down from Dr. Record (1327) to Mr. Holiday (1746) is to reverſe the order of the figures of the multiplicator (which is unnatural, and troubleſome) and to have a careful regard to ſet-down the unit's place, in the multiplier, underneath the proper figure of the multiplicand, according to the deſignd product; which adds (not a little) to the encumbrance.——That, which I have here given (how-obvious-ſoever it may appear, becauſe natural and eaſy) was firſt publiſht by Capt. Wilkinſon, in his beautiful tables of intereſt, &c. to whom, therefore, the curious are obligd for the uſeful diſcovery.

As to the Allowance for what may be carried from the columns neglected, Mr Malcolm (p. 142) ſays it is altogether a gueſs; inaſmuch as we may, very often, make the product leſs than it ought to be, by 1 or 2, in the laſt place; which, he adds, can ſcarcely be helpt, otherwiſe than by making one or two more columns than the number

ber of decimal places one would have in the product; and so cutting-off the two last places from the product. ——How this may be in the common method, I have not considerd: but, for ought I have found in a variety of cases in Capt. Wilkinson's method, there is a sufficient certainty, by observing the following *Rule*: to-wit,

If the next figure on the right hand of that you begin-with (in the multiplicand) multiplied into the figure of the multiplicator you are working-with, gives a product betwixt 5 and 15, carry 1: if the product be above 15 and less than 25, carry 2: and, if it arise to any number betwixt 25 and 35, carry 3: and, so, on.

† Note—*In case of decimals only*, the procedure is the same. Thus, .23456 × .23456. (1) To have a product of 6 figures, the work will stand as at *D*. (2) To have a product of 3 figures, the line of separation being plac'd so as to cut-off two figures of the multiplier (according to the preceding directions) the operation will come-out, as at *E*—*NB* (1) To the products of both (*D* and *E*) is prefixt a cipher; to supply the defect of one place, according to the instructions given, line 22. (2) To prevent mistakes of the eye, in the operation; it may be convenient to dot the figures, as you proceed, both in the multiplicator and in the multiplicand.——This method of contraction may sometimes be usd with advantage *in whole numbers*: as in the following astronomical calculation, and the like. Let the sun's declination be requird, when it is in taurus 27°. 34′; its greatest declination being 23° 29′. This will be found by the rule of proportion, thus: As the radius to the sine of the sun's greatest declination: so is the sine of its longitude, to the sine of its present declination, &c.

```
D . . .2|3456
      .2 3456
      -------
          14
         117
         938
        7037
       46912
      -------
     .055018
```

```
E † . . 1
        7
       47
     ----
     .055
```

H 3 that

† Say, *as at* C (p. 76) 4 × 0 (*the place to the left of* 2 *in the multiplicand*) = 0 + 1 (*that I carry from* 4 *times* 2, *to the right*) = 1. *Then* 3 × 2 = 6 + 1 (*that I carry from* 3 *times* 3) = 7: &c.

that is as in the margin at *F*: where observe, that, because the five last figures of the product are to be cut-off,

Full way		*Abridg'd*
F . . 100000 :	39848 : : 84402	*G* . . 39848
	84402	84402
	79696	1
159	3920	159
1593	92	1594
31878	4	31878
10000) 33632	50896 (19° 39′	33632

for the five ciphers of the divisor; the remaining figures (to-wit, the five first) being the quotient, and sufficient for this use, may be securd by abridging the work; as at *G*.

bb *Thus*, (I) .8030 ÷ .22 — 3.65. (II) 8.030 ÷ 22 = .365. (III) 8321.9 ÷ 73.2 = 113.

cc *Thus* (I) 22 ÷ .365 [that is (ciphers added to the dividend) 22.000 ÷ .365] = 60: Or, 22.0000 ÷ .365 = 60.2. (II) 22 ÷ 3.65 [to-wit, 22.0000 ÷ 3.65] = 6.02.

dd *Thus* 7.25406 ÷ 957 = 758: to which (to make-up the places of parts requird) 2 ciphers must be prefixt: so the quotient will be .00758.——*Note*

I. *When any proposd number of decimals are to be divided by an unit, with any number of ciphers after it*; it is only removing the separatrix so many places towards the left as there are ciphers in the divisor. For example: If 17.28 were to be divided by 10 the quotient will be 1.728: by 100 = .1728: by 1000 = .01728: by 10000 = .001728.

II. *To Abbreviate division to so many places as may serve the purpose*, Mr. Ward (p. 68) gives us an expedient: but as the attendances in the execution of it are not a little encumbering; and the way of dividing, which I have proposd will bring the operation into less compass than his contracted form: it would be a fault to give a detail of it here.

III. *The Remainder*, after division, is neglected in the application of decimals: though it is certain that, where there is a remainder, the division is not perfect——The deficiency, in this case, depending on the true value of the remainder, Mr Malcolm (p. 144) has shown us, as a part of of the theory fit to be known, firſt how that deficiency is to be found; and then what is to be added to the quote already found, to make the complete quote.

ee *For example:*——The $\frac{5}{7}$ of a pound, What? Anſw. (I) 5 (the numer.) × 20 (*s.* to-wit, 1 *l:* or the integer in the next lower denomination) = 100 ÷ 7 (the denom.) 14 *s.* remains 2; to-wit, $\frac{2}{7}$ of a ſhilling. (II) Then (to value that) 2 × 12 (*d.* to-wit, 1 *s.*; the next lower denomination) = 24 ÷ 7 = 3: remains 3; to-wit, $\frac{3}{7}$ of a penny. (III) 3 × 4 (*q.* to-wit, 1 *d*) = 12 ÷ 7 = 1 *q.* and $\frac{5}{7}$ of a farthing; *i. e.* almoſt another.——.714 of a pound, What? Anſw. Multiply the decimals, as in the margin; the value will appear to be nearly the ſame as that of a $\frac{5}{7}$. V. Tables note [b].

Decimal	*Vulgar*
.714	5 × 20
20	7 ÷ 100 = 14 *s.*
s. 14.280	remains 2
12	2 × 12
d. 3.360	7 ÷ 24 = 3 *d.*
4	remains 3
q. 1.440	3 × 4
and .$\frac{440}{1000}$	7 ÷ 12 = 1 *q.*
or ... $\frac{11}{25}$	remains 5 = $\frac{5}{7}$

ff *The great Advantage*, propoſd by the uſe of decimal fractions, is a more ſimple and eaſy operation than what vulgar fractions (taken, either in their proper form, or as mixt integers) do require. How the application is made, for anſwering that end, and how far it is a real advantage; will appear from the following conſiderations. (1) In the firſt place, this is very evident, that if, inſtead of the ſubdiviſion of coins, weights, and meaſures, and other kinds of quantities uſeful in ſociety, which now obtain; there were one ſtandard ſuperior ſpecies, and all the ſubdiviſions were decimals (whether the ſeveral parts were alſo diſtinguiſht by names, or only by their decimal denominations: it were the ſame thing to the purpoſe) then the common operations would be as ſimple and eaſy as whole numbers: the rules and reaſons of which may appear from the preceding doctrin. But, ſuppoſing this were ſo, yet either we could not entirely avoid the conſideration of vulgar fractions, or we muſt admit of ſome inaccuracies in calculations, which are unavoidable with decimals; and which will be of more or leſs conſequence, in different circumſtances. For, we have ſeen that decimals

cimals will have remainders (becauſe every number is not an aliquot part of every other) and then the quote is not complete without bringing-in a vulgar fraction: and therefore, if we take the quote without this correction, it is leſs than juſt, according to the value of the remainder, or rather the value of the vulgar fraction that is neceſſary to complete it. Now, if the number, found by this diviſion, is the final anſwer of a queſtion, which is to be applied in no farther calculation, than if it is brought ſo low as to be leſs than any quantity of that kind that is uſd (for example the ſmalleſt real coin, or weight, *&c.* that has any name, or diſtinct being in ſociety) then the defect is not to be complaind-of; becauſe, if you do complete the quote, the additional part is of no uſe. But, if a quote is to be further employ'd in calculation, eſpecially if it is to be multiplied; the defect may become conſiderable; and it will be the more ſo, as the multiplier is greater, and alſo according to the value of the integer.—Now the only remedy for this, while we uſe none but decimal fractions, is to bring the diviſion very low; that is, to carry-it-on till the denominator be very large and conſequently what is deficient be very little. But, then, this inconveniency will frequently happen; that, by this means, we ſhall have large numbers to work-with, which will prove more troubleſome than the method of vulgar fractions. (2) The uſe and application of decimals will more fully appear under the head of intereſt, annuities, &c. As to which application this in general only needs to be further obſervd here, that, any integer being conſiderd as the higheſt denomination, all numbers, or quantities, leſs than that, are to be expreſt, decimaly, by taking the decimal of that integer, anſwering to that leſſer quantity; and, in the ſame queſtion, uſing decimals of the ſame integer for all numbers of the ſame kind (that is, for all numbers of mony uſe the ſame integer as 1 *l.*) Then multiply, and divide, by theſe numbers, according to the rules of decimals. (3) In the laſt place, it may be obſerv'd that moſt queſtions, in common buſineſs, are ſooner done without decimals, by the common method of reduction. But, when to uſe decimals, or the common methods; muſt be left to every body's own choice: and, indeed, a good deal of practiſe will be neceſſary to enable one to chooſe judiciouſly.

Gain

GAIN *and* LOSS.

1 GAIN find the príce: then As ág to gain-ág; ſo the príce to the anſwer [a].

2 Lóss take from ág: then As ág to the loſs; ſo the price to the anſwer [b].

a *For example:* A draper buys 2795 ells flemiſh of ghenting at 22 ½ *d* the ell engliſh. It is requird to know at what price the cloth muſt be ſold, to gain 15 *l* 10 *s* per cent.——Anſw. The price, found by the rule of three, is *l* 157 4 4 1. Then, As 100 *l* to *l* 115 10 (that is, the gain + 100) ſo *l* 157 4 4 1 (the price given for the cloth) to *l* 181 11 9 $\frac{1}{60}$ (the price, for which it is to be ſold, to gain 15 *l* 10 *s* per cent.)

b *For example:* Suppoſe the aforeſaid cloth were to be ſold, ſo as to loſe 15 *l* 10 *s* per cent.——(Anſw.) Firſt, the loſs being ſubtracted from 100 *l*, leaves 84 *l* 10 *s*. Then, As 100 to 84 *l* 10 *s* (the value of 100, the loſs being deducted) So *l* 157 4 4 1 (the price given for the cloth) to *l* 132 16 11 3 $\frac{102}{120}$ (the price it muſt be ſold at, to loſe at the rate of 15 *l* 10 *s*. per cent)

To theſe may be added a ſpecimen of *Such queſtions, as require ſome caſting-about to prepare them for a ſolution.* ——I. Having ſold 2 yards of cloth for 11 *s* 6 *d*, I gain'd at the rate of 15 per cent; but, had I ſold it for 12 *s*, What is the rate of the gain per cent? (Anſw.) (1) Say as 11 *s* 6 *d* is in proportion to 115 *l*: ſo is 12 *s* to a 4th term; which I find to be 120 *l*: and ſo 20 *l* is the anſwer of the queſtion. (2) Or, from the 1ſt ſale and rate of gain, find the prime coſt of 1 yard. It is 10 *s* (for, as 15 to 100; ſo is 11 *s* to 10 *s*) Then, the 2d ſale being 12 *s*, the gain is 2 *s*. Therefore, ſay, If 10 gain 2, what will 100 gain? It is 20 ——II. Having bought a parcel of goods for 18 *l*, and ſold the ſame immediately for 25 *l*, with 4 months credit: What is gaind per cent per annum? . . . Say, by the rule of five, If 18 *l* in 4 months gain 7; what will 100 *l* gain in 1 year? (1) If the gain per cent per annum is given (ſuppoſe 12 per cent) to find the time that ought to be allowd, ſay, If 100 *l* gain

12 *l*

12 *l* in one year, In what time must 18 *l* gain 7 *l*? (2) Or, if the rate of gain is given, with the prime cost and time, To find the selling price, say, If 100 *l* in 1 year gain 12 *l*, What must 18 *l* gain in 4 months? which is to be added to the prime cost. (3) If the rate of gain, time, and selling-price are given, To find the prime cost (as suppose 4 months allow'd for payment of 25 *l*, by what was gain'd at the rate of 12 *l* per cent per annum) First find 4 months interest of 100 *l* at the propos'd rate, which add to 100: Then say, As that sum is to 100, so is 25 *l* to a 4th term; which is the sum sought.

GOLDEN RULE.

1 GÓLDEN [a]: one státing all quéstions resólves in propórtion [b]; the Rule this:
2 *Conditional*, in one line; and, ópposite, thĕ térms *Corresponding* [c].
3 -D'END is the *-ducing* of óne, into *-duc'd* of the óther; the rest -SOR [d].
4 *Nó -duc'd*: the fácit of óne line divide by thát of the other [e].

a *So*, may this rule be well calld, by way of eminence; though the name is commonly appropriated to what is usualy calld the rule-of-three. V. Rule-of-three: under which head is handled (most commodiously) the doctrin of proportion, as generaly deliverd by arithmeticians.

b *Whether* Single [1], or Compound [2]; Direct †, or Inverse ⸸.—— [1] *Single*, when 3 numbers are given, to find a 4th proportional. † Direct, when more requires more; or less, less. V. Note [e]. examp. I. ⸸ Inverse, or Reciprocal, when more requires less; or less, more. V. examp. II.—— [2] *Compound*, when 5 numbers are given, to find a 6th proportional. † Direct. V. examp. III. ⸸ Inverse. V. examp. IV.

For

c For *examples* of placing the terms, See the indenture of note [e].

d *That is*, The producing [1] terms of one line, multiplied into the produced [2] of the other, give the dividend: and the reſt of the terms, multiplied together, give the diviſor. So the quotient (or anſwer) falls to the blank. —[1] *Producing* terms are ſuch as jointly produce an effect; or, that are conſiderd as a cauſe, with the adjuncts of time, meaſure, diſtance, *&c.*—[2] *Produced* terms are ſuch as are connected with the others under the character of price, purchaſe, produce, gain, loſs, intereſt, advantage, value, or quantity of work, *&c.*

e *To exemplify* the whole —*Queſt.* (I) If 2 *lb* of tobacco coſt 4 *s*: what will 6? (II) How-much ſtuff (yard-broad) will line 10 yards of cloth, yard-and-quarter broad? (III) At the rate of 6 per cent, per annum; What is the intereſt of 200 *l* for 18 months? (IV) If 6 buſhels of oats will ſerve 4 horſes 8 days; How-many days will 21 buſhels ſerve 16 horſes?

EXAMPLES.

Single (Rule of 3)	I	2 *lb*		4 *s*
		6		
Compound	II	4 qrs ... *Broad*		
		5	10 *Long*	
	III	*l* 6, intereſt : *l* 100, principal :	12 mo.	
		200	18	
	IV	4 horſes : 8 days :	6 buſh.	
		16	21	

—*Anſw.* (I) 4 *s* (the price, or the produced term of one line) × 6 (the producing term of the other) = 24 (the dividend) ÷ 2 (the reſt, or remaining term) = 12 (for the blank, to-wit) the anſwer. (II) 5 × 10 = 50 (the facit of one line, for the dividend; there being no produced term) ÷ 4 (of the other line) = $12\frac{2}{4}$ or $\frac{1}{2}$ yards. (III) 6 × 18 × 200 = 21600 ÷ (100 × 12) 1200 = 18 *l*. (IV) 21 × 4 × 8 = 672 ÷ (6 × 16) 96 = 7 days.—*Note:* This anſwerd by two poſitions in the Double rule-of-three * (1) The former is in direct proportion: 6 buſhels : 8 days : : 21 buſhels : 28 days. (2) The latter, in reciprocal proportion: 4 horſes : 28 days : : 16 horſes : 7 days.

* *So* this rule is calld by ſome, on account of its having two ſtatings, which (in ſome problems) are requird for the anſwer: by others, the *rule-of-five*; by reaſon of

of its having 5 numbers given, to find a 6th.——*NB.* All questions of this rule are such as include two questions of the rule-of-three, so dependent upon one-another, that the answer of the first being made the middle term of the second, the answers of both have the same signification; and the last is the final answer of the question.

INTEREST.

SIMPLE

INTEREST [a] ínto a húndredth o'th' Rate, the Príncipal and Time [b].

(I) '*Amount* to Fínd: add the príncipal tŏ th' ínterest thence accruing [c].

(II) *Príncipal* tŏ Fínd: The amount, by tíme-into-rate, more unit [d].

(III) *Ráte*; int by tíme-into-príncipal [e]; (IV) *Tíme*; int by ráte-into-príncipal [f].

COMPOUND

I'NT. *upon* I'NT. (V) Into th' húndredth o'th' Ráte, the *Amóunt* of each year gives [g].

Or, into P', power of Ráte; to-wit, ínto it self, less 1 time [h].

(VI) *Príncipal:* A' by R [i]. (VII) *Tíme:* A by P', Rate invólve to the quotient [k].

(VIII) *Rate:* Amount by Príncipal: Quote evólve to the root-power [l].

READILY TO EXPRESS *the decimal fractions of Money:*

Dou ble

9 Double first is Shillings: i'th' second 5''
One: rest and 3d are Farthings.
10 Bating 1 'bove 23: adding half for each 5'
in the 4th place [m].

Time.

11 Half-year ,ú: Quarter ,el: Month ,zeitit:
Day ,yydoio [n].

Readily to Find
the number of days

from such a day in one month to such a day in another.

12 Days to the End of the first, from beginning
o'th' last, add-together:
13 Months-between, into ib: less ones for
months iz: and for feb, three [o].

[a] *Interest* is the use, or sum of mony, reckond for the loan or forbearance of some *principal* sum, lent for, or due at, some certain *time*; according to some certain *rate* (per cent. that is) by the hundred. (I) Simple interest, according to law, ought not to be above 5 pound for the use of 100, for 1 year; and 10 for the use of 100, for 2 years; and so on, for a greater, or lesser sum in proportion to the time proposd. (II) Compound is that, which is counted from the principal, and simple interest forborn; as the interest still becomes due: thence calld interest upon interest. This, being renderd illegal *, is seldom allowd; except it be by particular contract, or in purchasing of annuities, or taking leases in reversion, &c. V. Annuities.——NB. *The short way* of expressing the problems in the doctrin of interest and its appendants (which I have given in brackets, to catch the eye) (I) may be presented by the initial, or commanding letters: to-wit, *a*, amount; *i*, interest; *n*, annuity; *s*, sum; *p*, principal; *r*, rate; *t*, time; *w*, present worth: (II) and, in the disposition of them, it may be observd that

letters (1) put-together, like a word, denote Multiplication; (2) on each side of a line, Division; (3) when superior, Involution. . . Thus (1) $prt = i$ (note [b]) imports that the Principal, Rate, and Time, multiplied into each other, give the Interest. (2) $\frac{a}{rt} + 1 = p$ (note [d]) that the Amount (divided by the product of Rate, multiplied into the Time) plus 1, gives the Principal. (3) $\frac{a}{p} = r^t$ (note [k]) that the Amount divided by the Principal, gives the Rate involvd into the Time, &c.

But, abstracting from the reason of the law (which may be the encouraging of trade, by employing mony, that way, rather than upon interest) If taking interest be (at-all) just; compound interest cannot be unreasonable. For, if I can demand my interest, when it is due; I may take that interest and lend it out again upon interest to any other person. Why, then, may I not lend it out also to the person who has my principal sum? And, in point of right and justice, it is the same thing if I continue, or have that interest in his hands. There is the same reason that it should bear interest, after it becomes due; as that the original sum should do so.

For example: [Given prt; to find I] What is the interest of 200*l* at 5 per cent (1) for a year; (2) for half a year (3) for 91 days.——Answ. [$prt = i$] (1) 200 (the principal) × ,05 ($\frac{1}{100}$dth o'th' rate) = 10,00 (that is, 10*l* interest for 200*l*) for a year. (2) 10,00 (the interest of 200*l* for 1 year) × ,5 (the $\frac{5}{10}$ or $\frac{1}{2}$ of a year) = 5,000 (that is 5*l* for half a year. (3) 10,00 (the principal into $\frac{1}{100}$th of the rate, as before) × .24934 (the time. V. lin. 11.) = 2,4934000 (that is £ 2 9 10 2) for 91 days *.———*NB.* (1) This rule may serve for an interest-table in the Head, quite easy to use, and always ready at hand; and therefore preferable to any in Books, be they ever so correct (which yet is a hazard) since in the consulting of them (beside the inconvenience of turning to them, and the trouble of finding the particulars, and the danger of mistakes in copying them) there can be no great satisfaction in the use of them; as it is taking things upon trust, with an implicit faith †.

By the rule of proportion, the last example would stand thus:

thus: If 100*l* (principal) in 365 days, give 5*l* (interest) What will 200*l* (principal) give in 91 days? (Answ.) According to the instructions given under the golden rule, the question will be as in the margin. Then 5 × 200 × 91 = 91000: and 100 × 365 = 36500. Then 91000 ÷ 36500 = £ 2 9 10 1 $\frac{15000}{36500}$.——*NB.* By the directions given under this head of interest, may be known the *provision, commission*, or *factorage* of any sum: as also *insurance, average, storage, brokerage*; and *any thing else, rated at so much per cent.*

Princ.	Days	Inter.
100	365	5
200	91	

† Those, therefore, who are employd in such calculations, ought to understand the rules at large; and so be able to examin, and make tables for themselves. And, in my opinion, it is not fit, in questions of consequence, to trust to any tables; but what one has examind, or made for himself. Malcolm, arithm. 6. 10. p. 614.

c *For example:* [Given p t r to find A] What will 256*l* 10*s amount* to in 3 years, 1 quarter, 2 months, and 18 days; at 6 per cent, per annum?——Answ. [p t r + p = A] 3.46599 (the time) × .06 (the rate) = .2079591 × 256.5 (the principal) = 53.341586 (the interest) + 256.5 (the principal) = 309.841586 (the amount) that is £ 309 16 10.

d *For example:*——[Given a r t (or i r t) to find P] What *principal*, being put to interest, will raise a stock of £ 309 16 10; in 3 years, 1 quarter, 2 months, and 18 days; at 6 per cent, per annum? Or, What is that sum (so much time hence) worth, in ready money; abating, or discounting 6 per cent?——(I) $\left[\frac{a}{rt} + \cdot 1 = P\right]$ (the rate into time; (to-wit) 3.46599 × 06) + 1 (or unit) = 1.2079504. Then 309,841586 (the amount) ÷ 1.2079591 (the time into rate + 1) = 256.5 (that is £ 256 10) for the principal sought. (II) $\left[\frac{i}{rt} = P\right]$ 53.341586 (the interest) ÷ .2079594 (the product of time into rate) = 256.5 (the principal).

e *For example:* [Given a p t, to find R] At what *rate* of-interest, per cent, will £ 256 10 amount to £ 309 16 10, in 3 years, 1 quarter, 2 months, and 18 days? ——Answ. [a—p ÷ t p = R] 309.841586 (the amount)

—256.5 (the principal) = 53.341586 (the amount, less the principal; that is, the interest) ÷ 889 026435 (time into principal, to-wit, 3.46599 × 256.5) = .06, the rate requird.

For example: [Given a p r, to find T] In what *time* will £ 256 10 raise a stock of (or, amount-to) £ 309 16 10, at 6 per cent?——Answ. $\left[\frac{a-p}{rt}=T\right]$ 309 841586 (the amount) — 256.5 (the principal) = 53.341586 (amount, less the principal; that is, the interest) ÷ 15 39 (rate into principal, to-wit, 256.5 × .06) = 3.46599 (the time requird) to-wit, 3 year, 1 quarter, 2 months, and 18 days. V. lin. 11.

For example: [Given p t r, to find A] £ 275 11 3, forborn 4 years, at 6 per cent, per annum, *interest upon interest:* What will it amount-to?——Answ. as follows;

The Principal . . . . . . 275.5625 . . . × .06 $\frac{1}{100}$ o'th' Rate
gives, for Interest . . . . 16.5337* . . . . which + to the Principal
amounts (for the I year) to 292.0962 . . . . which × into the Rate
gives, for Interest . . . . . 17.5257 . . . . which + to the Principal
amounts (for the II year) to 309.6219 . . . . And, in like manner,

proceeding on, the amount (in IV years) will be found 347.8911; that is £ 347 17 10.

To abbreviate the work, the two first places (to the right) are omited in multiplying the principal by .06; 4, or 5 places of decimals, being correct to a farthing, or little more.

For example: In answer to the preceding question [p × r^t = A] 275.5625 (the principal) × 1.26247696 (the power of the rate*) = 347.8903 † that is (nearly) £ 147 17 10.

By the Rate is understood the amount of 1 *l*, and 1 year's simple interest. So, interest being at 5 *l* per cent, the rate (or amount of it) is 1.05 *l*: for, 100 : 105 :: 1 : 1.05.——*The Power of the Rate* is the amount of 1 *l* for the time and rate given; and *is found* by multiplying it into it-self, till the number of multiplications be equal to the time, less 1.

NB. If the rate of interest is determind to any other time than a year, as $\frac{1}{2}$, or $\frac{1}{4}$; the rule is the same: only taking, for $\frac{1}{2}$ a year, continualy divided by the rate, till the quotient be a cipher; the number of divisions will be the time. V. Evolution, and Note [k].

For

For example: [Given a r t, to find P] What principal ſum will amount to 201.9963136*l*, in 4 years, at the rate of 6 per cent, compound intereſt?——Anſw. $\left[\frac{a}{r}=P\right]$ 1 06 (the rate) × into it ſelf 4 times leſs one (for the biquadrate root) = 1.26247696. Then 201.9963136 ÷ 1.26247696 = 160 (the principal ſought).

For example: [Given a p r, to find T] At 5 per cent, compound intereſt, in what time will 50 *l* amount to 60.7753125*l*?——Anſw. $\left[\frac{a}{p}=r^t\right]$ 60.7753125 (the amount) ÷ 50 (the principal) = 1.21550625: which is $\overline{1.05}^4$, or 1.05 × 1.05 × 1.05 × 1.05: which, therefore, divided by 1.05, till the quotient be a cipher; the number of the diviſions will give the time, to-wit, 4 years.

For example: [Given a p t, to find R] At what rate of compound intereſt will 50 *l* amount to 60.7753125 in 4 years?——Anſw. $\left[\frac{a}{p}=r^t\right]$ 60.7753125 (the amount) ÷ 50 (the principal) = 1.21550625: whoſe 4th root (to be found by evolution, or the table of the powers) is 1.05, the rate; or amount of 1 *l* for 1 year.

Note. As the amount of any principal is the ſum of the principal and intereſt: ſo, if (in any of the preceding problems) the intereſt is ſought, or given, inſtead of the amount; the anſwer is eaſily found from the preceding.——For example: (1) Having the principal, rate, and time; to find the intereſt . . Rule: Find the amount (by problem V) The difference of this, and the principal, is the intereſt. (2) Having the intereſt, time, and rate; to find the principal . . Rule. Find the amount of 1 *l* for the given time and rate: then, the difference of 1 *l* and that amount, being the intereſt of 1 *l*; ſay: As that intereſt is to 1 *l*: So is the given intereſt to its principal ſought. (3) Having the principal, intereſt, and rate; to find the time . . Rule: The ſum of principal and intereſt is the amount; by which, with the rate and principal, find the time by Problem VII.

For example: 6.7777 = £ 6 15 6 2. for (1) The *firſt* doubled is 14*s*: and, (2) in the *ſecond* place, 5 out of 7 is 1*s*; in all 15 .. Then (3) the *reſt* of the ſecond figure 7 (to-wit 2) prefixt to the *third* is 27, (bating 1, above 23) 26 *q*, to-wit, 6 *d* 2 *q*.—NB. (I) The Reaſon of this rule is

13

thus: (1) Since 1 shilling is the $\frac{1}{20}$ of a pound; and double any number of 10th parts, makes so many 20th parts; (so $\frac{1}{10}=\frac{2}{20}$) therefore double the figure in the first place (whose denominator is 10th parts) is equal to so many 20th parts, or shillings. Again, (2) Since $\frac{1}{20}=\frac{5}{100}$, therefore 5, in the 2d place (whose denominator is 100th parts) is 1 shilling. Then (3) the figure in the 3d place has 1000th parts for its denominator: and this, with the number over 5 in the 2d place, makes so many 1000th parts; which is little less than so many farthings: because 1 farthing is $\frac{1}{960}$ part of a pound. But, when we make-up a decimal table for farthings from 1 to 47 (which is 11*d* 3*f*) we find this true in fact; that, from 1 to 23 farthings, the figures in the 2d and 3d places of the decimal are the same with the number of farthings: But, from 24 to 47, the figures in the 2d and 3d places make a number one more than the number of farthings. And, though in all these decimals (except that for 6*d* or 24*f*) there are figures after the 3d place; yet their value is not 1 farthing, because they do not make .001, which is less than 1 farthing. (II) These things well considerd, the learner will find that he has little or no occasion for such large tables as are usualy given in books of decimal arithmetic. V. Fractions.

Accordingly, to express (decimaly) the time specified in the margin; the several denominations, added together, give the integer with the decimal fractions.

3 years	3		
1 quarter .	,25	: el. ·	zeitit
2 months .	,16667	to-wit,	2 x ,08333
18 days . . .	,04932	to-wit,	18 x ,00274
	3,46599		yydoio

For example: Suppose I am to receive interest on march 26, 1738, for mony which I lent june 21, 1725 ——What is the time it has been out?——(Answ.) 1725 — 1737 = 12 years (from june 21, 1725; to june 21, 1737) Then, for the days from june 21 (1737) to march 26 (1738) Say: 9 (the number of days from june 21 to the end) + 25 (the number of days from the beginning of march following to the 26th) = 34. (3) Then, 8 (the number of months between june and march) x 31 = 248

= 248 — 2 (for september and november, months of 30 days) + 3 (for february) = 243 (days) + 34 (the days in june and march) = 277; in all 12 years, 277 days.

MEASURING.

1 MEA'SURE *Square:* léngth into breádth: whether by' the Foot, Yard, Square, or Rod [A].

2 Meásure *Cube:* léngth into breádth into dépth: whether by Feet, or Yard [B].

3 *Wrought* .. by Décimals .. by A'liquots .. ór by Crofs-múltiplication [C].

A *That is,* The Content of work, taken in feet, inches, &c. is given—by the *Foot-square,* in Glazing [a], and Masonry [b],—by the *Yard-square,* in Joinery [c], Painting [d], Plastering [e]—by the *Square-of-ten-feet,* in Flooring [f], Partitioning [g], Roofing [h], Slating and Tiling [i]— by the *Rod-square,* in Brick-work [k].

a How-many Feet of *glazing* in a pane of glass, which is 5 feet 73 by 2 feet 54?—Answer (by Decimals) 5.73 × 2.54 = 14.5542, i. e. 14 *f* 7.0504 *i*.

b How-many Feet of *paving* in a yard, which is 22 *f* 4 *i* long, and 19 *f* 7 *i* broad?—Answer (by Crofs-multiplication) 22 4 × 19 7 = 437 *f* 4 *i* 4 *p*.

c How-many Yards of *wainscot* in a room, whose height is 12 *f* 3 *i*, and compass 104 *f* 6 *i*?—Answ. 104 6 × 12 3 = 1280 1 6 ÷ 9 (the inches in a yard) = 142 *y* 2 *f* 1 *i* 6 *p*.

d How-many Yards of *painting* in a room, which is 12 *f* 4 *i* high, and 84 *f* 11 *i* about?—Answ. 84 11 × 12 4 = 1047 3 8 ÷ 9 = 116 *y* 3 *f* 3 *i* 8 *p*.

e How-many Yards of *plastering* in a cieling, which is 47 *f* 4 *i* 8 *p* long, and 18 *f* broad?—Answ. 47 4 8 × 18 = 852 10 6 ÷ 9 = 94 *y* 6 *f* 10 *i* 6 *p*.

f How many Squares in a *floor* 49 *f* 7 *i* 4 *p* long, and 26 *f* 6 *i* broad?—Answ. 49 7 4 × 26 6 = 1314 8 4 ÷ 10 = 13 *S* 14 *f* 8 *i* 4 *p*.

How-

How-many Squares in a *partition* 199 *f* 10 *i* long, and 10 *f* 7 *i* high?——Answ. 199 10 × 10 7 = 21 *ʃ* 14 *f* 10 *i* 10 *p*.

How-many Squares in the *roof* of a house 18 *f* 4 *i* in front, and 37 *f* 10 *i* in depth?——Answ. 37 10 × 18 4 = 693 7 4 + 346 9 8 (half of the ground-plot, in feet) = 1040 5 0, i. e. 10 *ʃ* 40 *f* 5 *i*.

How-many Squares in a *roof coverd with tiles*, whose depth, on both sides (with the usual allowance at the eaves) is 37 *f* 3 *i*, and the length 45 *f*?——Answ. 37 3 × 45 = 1676 3 ÷ 10 = 16 *ʃ* 76 *f* 3 *i*.

How-many Rods of *brick-work* in a wall, 1 $\frac{1}{2}$ brick thick, being 231 *f* about, and 13 *f* 4 *i* high——Answ. 213 × 13 4 = 2840 ÷ 272 (the square feet in a rod*) = 10 *r* 120 *f*.——NB. (1) When the walling is more, or less than 1 $\frac{1}{2}$ brick thick (which is the common standard measure) it must be reduc'd to that thickness; *by subtracting-from, adding-to, or multiplying-by, the* Difference: to-wit, for 1 brick-thick, subtract $\frac{1}{3}$ of the content; for 2 bricks-thick, add $\frac{1}{3}$; for 3 brick-thick, multiply by 2; &c. (2) If the wall be of different thicknesses, as they usualy are in brick-houses (being thickest below, and thinner every story) the best way is to measure every different thickness by it self, and to reduce all to the standard thickness. Then add the several areas into one sum: out of which deduct the doors and windows (measurd by themselves) and the remainder will be the true area of the whole walling.

A rod is (by statute) 16 $\frac{1}{2}$ feet: so that a rod-square is 272 $\frac{1}{4}$ feet. But it being troublesom to divide by the mixt number, it is customary with workmen to divide by 272; which gives the contents something more than truth.——NB. In some places it is the custom to measure by the rod of 18 feet; and, in others, by the rod of 16 feet.. So that, in the former case, the area must be divided by 324; and in the latter, by 256. V. Tables, note [n].

That is, the Content of a thing, taken in feet, inches, &c is given——by the solid *Foot*, in Stone [a], and Timber [b]——by the solid *Yard*, in Diging [c], &c.

How-many solid Feet in a *stone*, whose length is 7 *f* 3 *i*; breadth, 4 *f* 5 *i*; depth 2 *f* 3 *i*?——Answ. 7 3 × 4 5 × 2 3 = 72 *f* 0 *i* 6″ 9‴.

How-many solid Feet in a piece of *timber* * 17 $\frac{1}{2}$ *f* long

long, 23 *i* broad, and 2 *f* 7 *i* deep?——Anſw. 17 ½ × 23 *i* × 2 *f* 7 *i* = 86 *f* 7 *i* 9″ 6‴.

* *The Cuſtom* is—for *Round timber,* To gird the tree about, in the middle of the length; and folding the line twice, to take one length (or a quarter of the whole) and to account that for the true ſide of the ſquare. Then, for the length, it is accounted from the but end of the tree, ſo far up as the tree will hold half a foot girt, as they phraſe it; that is, as long as the line, twice folded, is half a foot.——For *Hewn timber,* To find the middle of the length of the tree; and there, to meaſure its breadth, by clapping two rules to the ſides of the tree, and meaſuring the diſtance between them. If the two are unequal; they add them together, and take half the ſum for the true ſide of the ſquare.

But, both theſe methods are erroneous——by *the Former,* the content being found leſs than the true, in the ratio of 11 to 14; and——by *the Latter,* more than the truth; and the more ſo, as the difference of the ſides is the greater.

C In a *cellar* 25 *f* 4 *i* long, 15 *f* 8 *i* broad, and 7 ½ *f* deep, How-many yards of Diging?——Anſw. 25 4 × 15 8 × 7 6 = 110 *y* 6 *f* 8 *i*.

In a *vault,* Dug 9 *f* deep, 4 ½ *f* long, 3 *f* 9 *i* broad; How many ſolid yards?—Anſw. 4 6 × 9 × 3 9 = 151 *y* 10 *i* 6 *p*: i. e. 5 *y* 16 *f* 10 *i* 6 *p*.

C See Decimals, and compound Multiplication.

MUTIPLICATION.

1 MU′LT. Place the fírſt of the próduct of éach -cator únder it (2) When two;

2 Sét-down the láſt; carry fírſt. (3) Add-up áll for the total product [a].

Compendiums [b].

in Factors with Units, &c.

3 (I) Whén any númber of únits *precédes* any
digits; proceed thus:
4 (1) Múltiply ăs fár as the O'nes: to each-
cánd all the réſt, forward, add (2) Then,
5 Só many ás there are O'nes. (2) Then, by
ſtéps, backward, ádd the remainder [c].
6 (II) Whén any númber of units *fóllows* a dí-
git; proceed thus:
7 (1) A'dd, ſtep-by-ſtép, back the Ones (2)
Then, múltiply; ănd ſó many, back, Add [d].
8 (III) ſkípping for O'ughts interpoſd [e].
9 (IV) Whén other dígits are *intermíxt*; make
a próduct, or two more [f].

Other Digits.

10 (V) Só other dígits, by áccommodátion, are
mánagd as units [g].

Higher Figures.

11 (VI) Whén bigger fáctors approách to a
décimal dénominator;
12 (1) -cand and -cátor ſubtráct from the déci-
mal; (2) Múltiply th' rĕmainder;
13 (3) To their próduct join-báck the altérnate
ſubtrácted remainders [h].
14 (NB) Próduct than -cand—If móre places,
cárry [i]—If féwer, add ciphers [k].

COMPOUND.

15 *Compound Múltiplicátion* ŏf ſéveral námes in-
to ſeveral:
16 I'ntegers ínto ŭppĕr líne mult; add *A'liquots* [l]
.. ŏr *Cróſs*-mult [m] .. and *Mind* [n], that

Int

17 *Int* into primes give primes [o]: *Subdivisions* are known by addition [p].

Fac-tors	Multiplicand	1234
	Multiplicator	2
The Product	.....	2468

II { 1234 / 6 / 7404 }

III { 2234 / 26 / 7404 / 2468 / 32084 }

IV { 1234 / 206 / 7404 / 2468 / 254204 }

V { 1234 / 20 / 24680 }

VI { 5 18 7 3 / 6 / 5 11 10 2 }

a *For example*: To multiply 1234 (I) by 2: Say 2 × 4 = 8 (placing the 8 directly underneath) Then 2 × 3 = 6; and so-on. (II) By 6: Say 6 × 4, or rather, (putting the smaller number first) 4 × 6 = 24. Then, set-down 4 (the last figure) and carrying 2 (the first figure †) to the next row, Say 3 × 6 = 18 + 2 (that I carry) = 20. So, setting-down 0, carry (the first figure) 2 to the next step in the work; and proceed as at first. (III) By 26: Say, as afore; placing the first figure of the product of the 6 (to-wit, 4) under 6; of 2, under 2, and so-on. Then, add-together the products of each figure, for the product of the whole. (IV) By 206: The procedure is the same as in n. III; only removing the first figure of the 2d product one step further; to-wit, under the 2, according to the direction, lin. 1. (V) By Ciphers in the end: the procedure is as afore; only adding the ciphers (of both the factors) to the total product. Thus 200 × 400 = 80000.—Hence it appears that Multiplying (1) by 10, is only adding a cipher; so 1234 × 10 = 12340 (2) by 5, is halving the figures, and adding a cipher: So 1234 × 5 = 6170. (3) And, in like manner, on other occasions.

† The same (or, what is equivalent) is to be done, in multiplying different denominations; as in example (VI). To operate which (1) Say, 3 × 6 *q* = 18 *q*: that is 4 *d* 2 *q*. set-down the 2 *q* (which belong to this row) and carry the 4 *d* to the next row) which is pence (2) Then go-on, and say 6 × 7 *d* = 42 *d* + 4 (that I carry) = 46 *d*: that is 3 *s*. 10 *d*. In like manner, as afore, set-down the 10 *d*; and carry the 3 *s*. (3) Then, proceeding

I

proceeding to the ſhillings, ſay 6 × 8*s* = 48*s* + 3 (that I carry) = 51*s*: Here, the eaſieſt way is to ſet-down (as in integers) the laſt figure, to-wit, 1; and to carry the firſt, to wit, 5. So, proceed, and ſay 6 × 1 = 6 + 5 (that I carry) = 11. Set-down the odd-one; and (as in addition) carry the half of the remainder to the pounds: in which proceed as in integers——*To multiply by Addition.* V. Tabulating.

b Several of the following compendiums were the *invention* of Mr. Hatton (arithm. p. 150) who alſo gives two or three others. But, as the operation of them is pretty difficult, and the caſes occur but ſeldom, and that too out of the courſe of buſineſs; it would not conſiſt with the deſign of this treatiſe to give an account of them here.——It may not, however, be improper, here, to give a hint of *two expedients for the facilitating the operation of large ſums:* to-wit, *Logarithms*, which is made a particular ſcience; and *Neper's bones*, which is only a method of tabulating the multiplicand on ſo many (virgulae) rods, or pieces of ivory, wood, paſte-board, or the like; and may be executed with leſs trouble, and more diſpatch, by the directions here given under the head of Tabulating.

c *For example:* To multiply 652783 by 115 (I) Say, (1) 5 × 3 = 15. (2) Then 5 × 8 = 40 + 1 (that I carry) + 3 (advancing, forward, from 8 in the multiplicand) = 44. (3) Then 5 × 7 = 35 + 4 (that I carry) + 8 + 3 (going forward to the end) = 50. (II) Then, (1) Say 5 × 2 = 10 + 5 (that I carry) + 7 + 8 (going two forward, to wit, ſo many as there are ones) = 30. (2) Then, 5 × 5 = 25 + 3 (that I carry) + 5 + 2 (going 2 forward) = 37. (3) Then 5 × 6 = 30 + 3 (that I carry) + 5 + 2 (ſtill going 2 forward) = 40. (III) Then, (1) The 4 (that I carry) + 5 + 6 (going backward, at each ſtep, ſo many as there are ones from the 2 where I left-off) = 15. (2) Then 1 (that I carry) + 6 (backward again) = 7. (3) So the product turns-out (as in the example) in one line, 75070045. V. Practiſe.

$$\left\{\begin{array}{r} 652783 \\ 115 \\ 75070045 \end{array}\right.$$

d *For example:* To multiply 652783 by 511. (I) Add the places, equal to the number of units, ſtep-by-ſtep, backward:

$$\left\{\begin{array}{r} 652783 \\ 511 \\ 333572113 \end{array}\right.$$

(1) Say

(1) Say 3 (the 1ſt ſtep) = 3 (2) then 3 + 8 = 11, &c. † (II) Then 5 × 3 = 15 + 1 (that I carry) + 8 + 7 (going 2 backward, to-wit, ſo many as there are ones) = 31, and ſo on.

† *Then*——If there were two, more, ones; Say (1) for the Former, 3 + 8 + 7 = 18 (2) for the Latter 3 + 8 + 7 + 2 = 20.——If an ought followd them; Say, (going-back a ſtep, the 4 ones being wrought) 8 + 7 + 2 + 5, &c.

e *For example:* To multiply 652783 by 50011. (I) Having added, by ſteps, backward, the 4 firſt figures of the multiplicand, over 0011, according to the directions of the preceding note, (II) Multiply, and ſay 5 × 3 = 15 + 1 (that I carry) = 16 + 2 [ſkiping-over, 2 places (8 and 7) on account of the 2 ciphers] + 5 (on account of the 2 ones) = 23. and ſo on——And, in like manner, when the units precede.

652783
50011
32646330613

f *For example:* The following ſum may be done ſeveral

Ways	I.	II.	III.
	1842753	1842753	1842753
	9111118	9111118	9111118
	20601978 54	2047630278 54	1678952528583
	167874798 3:By 911	16534777...By 9	By 8...14742024
	16789540027854	16789540027854	16789540027854

In like manner, 26536 × 21415 will give (by 15 14 2, or 15 4 21) 568268440.

g *Thus,*

2783	2783	2783	34567
225	522	5022	6005
626175	1452726	13976226	207574835.

And others, in great variety, may, with great ſaving, and equal eaſe as at large (when the knack is familiariz'd by practiſe) be done in one line: and greater combinations, in two or three.

h *For example:* To multiply 96 into 88 (I) From 100 (the decimal denominator to a number of two figures, as here) ſubtract (1) 96 (the -cand (2) and 88 (the -cator): the remainders will be 4, and 12. (II) Theſe, multiplied, give 48. (III) To this product join-back 84, the remainder of 4 from 88 (the two neareſt) or of 12 from 96 (the two remoteſt) that is, alternately, the remainder of the -cand from the

(I)	
Decimal denom.	100
Multiplicand.	96
Multiplicator.	88
Remaindr. fr. 100	4
	12
Product.	8448

the -cator, &c: and you have the anſwer 8448, as in the margin, n. I.

In the IId example, the product of 919 by 3 (to wit, 2757) being 1 figure *more* than the number of places in the largeſt number to be multiplied; the firſt (to-wit, 2) is to be carried to the ſubtraction of 3 from 81, thus: 3 from 11, remains 8 + 2 (that I carry) = 10: of which ſet-down the 0; and proceed, ſaying: 1 (that I borrowd) from 8, remains 7 + 1 (that I carry) is 8.

(II)	
-cand	997
-cator	81
Remainders . .	3 919
Product . . .	80757

(III)	
-cand	9986
-cator	9994
Remainders . .	14 6
Product :	99800084

In the IIId example, the product 84 being two figures *fewer* than the number of places in the largeſt number to be multiplied; two ciphers muſt be added, or joind back to the ſubtraction of 14 from 9494; which gives the product, as in the margin.

For example: as in the margin: Where the ſeveral denominations in the multiplicand are multiplied by 9, the integers in the multiplicator: to which product are added the quotes of the multiplicand divided by the remainder of the multiplicator, to wit, . . $\frac{1}{3}$ (of a foot) for the 4 inches; and . . $\frac{1}{12}$ of that quote, for the 4 parts; 4 parts, being the $\frac{1}{12}$ of 4 inches.

	feet	*inches*	*parts*
by Aliquots	47 9	8 4	6 4
Mult. *into* 9 *f.*	429	4	6
Divid. *by* 4 *i.* $\frac{1}{3}$	15	10	10
4 *p.* $\frac{1}{12}$	1	3	$10\frac{10}{12}$
The Product . . .	446	7	$2\frac{10}{12}$

For example, as in the margin: Where—The feet, multiplied into the feet, give 423 feet—Then, croſswiſe . . the 9 *f*, into 8 *i*, gives 72 *i*. (i. e. 6 *f*.) . . and 47 *f*, into 4 *i*, gives 188 *i* (i. e. 15 *f* 8 *i*)—Laſtly,

	feet	*inches*	*p.*
by Croſs-mult.	47 9	8 4	— —
9 × 47	423	—	—
9 × 8 . . .	6	—	—
47 × 4 . . .	15	8	—
8 × 4 . . .	—	2	8
The Product . .	444	10	8

the

the inches in both the factors, multiplied one into the other, give 32 parts (i. e. 2 *i* 8 *p*).

*In case of farther subdivisions *, and larger numbers* (that cannot well be computed by the head) the easiest way is to proceed (after the manner of common multiplication) as in the margin; regard being had to the instructions of line 16: by which it appears.. that the products are to be remov'd to the right-hand, so, that the degrees of each part of the operation may fall under the like in the given duodecimals.. and that 2 places given in order (as integers, and primes) to be multiplied into 2 places, produce 3 places; 3 places, into 2, produce 4; and 3, into 3, produce 5: that is, 1 less than the exponents, or places, or names in both the given factors.

	feet	′	″	‴	⁗
	372	11	4	—	—
	25	6	3	—	—
Into 3″			1118	10	—
6′		2232	68	—	—
25		275	100	—	—
Sum of ′	9300	107	1286	—	—
		—	...2		
of ′	217	=2614			
		..10			
Product	9517	10	2	10	—

* The *subdivisions* of an integer, in duodecimal arithmetic —are *distinguisht* by the names of Primes ′, Seconds ″, Thirds ‴, Fourths ⁗, &c.—and may be *applied*.. in Measures, to Inches, Parts, &c... in Mony, to Shillings, Pence, &c —only making *allowance* for the difference, according to the value of the denominations.

That is, The Integer, into ′, gives ′; into ″, gives ″; into ‴, gives ‴; &c.

That is, ′ into ′ [primes into primes] give ″; ′, into ″, give ‴; ″, into ″, give ⁗; &c. the product of the factors being of the denomination that the factors (*added-together*) amount-to.—NB. The great *use* of this operation is in measuring. V. Measuring.

PRACTISE:

Compendiums of the Rule-of-three [a].

IF ONE ?] [b]; The Sóught into príce [c], or its fáctors [d]; or * by' aliquot parts [e];
And by the áliquots ŏf fráctions of fought (if ány) divide price [f].
WHAT'LL ONE ?] [g] Thĕ príce by commódity; ŏr, if too lárge, by its factors [h] †.
ELSEWHERE [i]: Súbftitute thĕ Quótes of two térms by a Cómmon-divifor [k].
[*At* 2 *fhíllings*] [l] The *únit's* place, doúbled, is Shíllings; *the reft*, Pounds [m]: óf which the áliquots gĭve poúnds [n]; taking hálf, when the príce *above* 12*d* [o].
Of even fhill.] into half gives póunds: doubled únits are fhillings? [p].
Réfts (in divíding by fáctors) *to válue*: The laft remainder,
ínto -for láft-but-one, plus reft néxt; into -fór next, plus reft next [q].

For the readier difpatch of Bufinefs, Mr Hatton (arithm. p. 99) gives us 149 rules of practife; and moft Writers fwell the matter into a very large account: but the following 3 verfes will enable one to anfwer any Queftions, oftentimes, more readily and eafily than all his rules, were it poffible for any memory to retain them. ——In effect, after a due acquaintance with thefe few directions, 'Judgment and experience, as Mr Malcolm (ar. p. 542) well obferves, will readily fupply a variety of abridgments, depending on the fame principle, much better than a confusd heap of particular rules.'——It is pretty enough (to give one inftance, out of many) to turn ells englifh into flemifh by adding o, and dividing by 6 not

[10 bearing the same proportion to 6, as 5 to 3] or ells flemish into english, by multiplying into 6, and cuting-off the last figure (as you are directed by Shelley, Ayres, and many of the modern writers) but, if such compendiums as these (of which they give you not a few *) do not offer themselves to your judgment in applying the general rules which you must be acquainted with: it will be very difficult to charge the memory with them; and much more so, to retain them: at the same time, that, without seeing the reason of them (which is not always very obvious) you must always be dissatisfied, and uncertain. Nor, after all, is there much savd by them. For instance: To reduce 622 ells english into flemish, the adding of 0, and dividing by 6 is not much shorter than multiplying into 5, and dividing by 3: which is the high road, and requires no casting-about to find a shorter cut: in which there are frequently greater perplexities. And the same may be observd in all the other cases, where the expedient is but a fanciful devise, to save a few figures.

* The largest collection of the best compendiums of this kind are in *Shelley*'s supplement to *Wingate*'s arithmetic, publisht by *Kersey*, p. 384.

b *That is*, In questions, wherein the conditional-term is 1 (as when we say, '*If one* cost so-much, What will so-much cost' * ?

* Or (which is the same) 'What comes so-much to, at so-much per pound, yard, &c.'——*NB*. The directions, in this case, are as follows in the text . . . *But*, in making, or examining bills by the head, it may perhaps be more obvious, and easy to the generality of people, to halve, or double (and so add, or deduct, as they shall find occasion) the price of the commodity by the number of pounds, yards, &c. . . . *Thus*: (1) 13 pound of beef at 3 *d* 2 *q* per pound: Say, 13 3-pences is 6 six-pences (or 3 *s*) and 3 *d*. And 13 ½-pence are 6 *d* 2 *q*. Then 3 *s* 3 *d*, and 6 ½ *d* makes 3 *s* 9 ½ *d*. (2) 15 yards of silk, at 14 *s* 6 *d* per yard. Say, 15 10 *s* is £ 7-10, and 15-4 *s* is (4 times 10 *s*, and 4 times 5 *s*;) to-wit, 60 *s*, or 3 *l*. In all (to-wit, £ 7-10, and 3 *l*) £ 10 10. Then 15 6-pences are 7 *s* 6 *d*. In all £ 10 17 6. (3) 9 yards of cloth at 18 *s* 6 *d* per yard. Say 9 18 shillings and 6 pence is 9 *l*,

all but 9 *s* and 9 6-pences (or 4 *s* 6 *d*) to-wit, 13 *s* 6 *d*; that is (that being subtracted from 9 *l*) £ 8 6 6.

I. *If the multiplicator be within the compass of the table*; multiply the question-term (or thing-sought) into the price. For example: (I) If one cost 10 *s*; What will 20? Answ. 20 (the thing-sought) × 10 (the price) = 200 *s*; that is 10 *l*. (II) If one cost 12 *s* 3 *d* 2 *q*; What will 134? Answ. Multiply 134 (the commodity) into the *price*, as in the margin.

134 ×	12 *s*	S	1608	—
	3 *d* = 402		33	6
	2 *q* = 268 = 67 *d*		5	7
In all	82 *l*. 7 *s*. 1 *d* =	S.	1647	1

II. *If the multiplicator be a higher number*;——Multiply the thing sought into the factors of the price, or any two numbers, which (multiplied-together) amount to it. For example: If one cost 12 *s* 6 *d*; What will 28? Answ. The factors of 28 being 4 × 7: multiply the price into 4 and 7, as in the margin: the last product is the answer.

£	*s*	*d*
-	12	6
		4
2	10	0
		7
17	10	0

Note. If the multiplicator be not resolvable into factors, take those that come nearest it;——and Add the price for the odd-one: [So, if the number were 29: 17 *l* 10 *s* + 12 *s* 6 *d* = 18 *l* 2 *s* 6 *d*] — or Multiply it into what the factors want of the multiplicator: [So, if the number were 31: 17 *l* 10 *s* + (12 *s* 6 *d* × 3) or 1 *l* 17 *s* 6 *d* = 19 *l* 7 *s* 6 *d*.]

III. *If the multiplicator be still higher*; Divide the thing sought by the even parts of the denomination, in which you would have the answer *. For example:—If one cost 12 *s* 6 *d*; What will 56? Answ. 10 *s* being $\frac{1}{2}$ of a *l*; and 2 *s* 6 *d* (which makes-up the 12 *s* 6 *d*) the $\frac{1}{8}$ of 1 *l*, or the $\frac{1}{4}$ of 10 *s* [for 8 half-crowns make 1 *l*; or 4 half-crowns, 10 *s*] say 2 in 56 = 28 *l*. Then 8 in 56 or 4 in 28 (the quotient of 56 by 2) = 7 *l*. as in the margin, example I: in which the work stands in the most commodious form:

		Aliquots		56 lb, &c.
I.	*s*	10	2	28 -- --
	d	2 6	8	7 -- --
	£			35

form: the mony split into aliquots, with the marks of the denominations prefixt; and the divisors placd against their quotients (not fraction-wise) for the greater dispatch, distinctness, and evidence.

	At 12 *s* 6 *d*.		113 lb, &c.
II *s*	10	2	56 10 -
	2		14 2 6
d	6	4	
£			70 12 6

——In the IId example, [to-wit 113 lb, at 12 *s* 6 *d*] the manner of operation is the same: only it may not be amiss to observe that *The remainder is always of the same name as the dividend* (V. Division) and must be carried-on in lower names, according to the instructions given under the article Reduction, note [a]. Say, therefore, here (according to the directions in the former example) . . . First, 113 lb ÷ 2 (2 10 *s* being 1 *l*) = 56, and 1 over: that is 1 *l*; to be divided, in a lower denomination, by the same divisor, to-wit 2. Say, then, 1 × 20 (*s*, the next name) = 20: then, 20 ÷ 2 = 10 *s* . . . Again 56 *l* 10 *s* (the quotient of 113 by 2 the aliquot of 10 *s*) ÷ 4 (the aliquot of 2 *s* 6 *d*) = £ 14 2 6. for 4 in 56 *l* is 14 *l*: then 4 in 10 *s* is 2 *s*; and 2 *s* over: then 4 in (2 × 12 *d*, the next name, or) 24 *d* is 6 *d*: In all, £ 70 12 6.

* *Tables of Aliquots*, or even-parts of mony, weight, &c. are usualy given, by writers of arithmetic, to the value of above a page; which they tell us must be well understood, and perfectly got-by-heart (V. Fisher, arithm. p. 210, 228)——*But* common sense, with the knowlege of the multiplication-table will enable any one to take the aliquots with readiness.——*So that* it may, perhaps, be thought unnecessary even to hint, that (I) In MEASURE . . 4 *nai* is the 4th of a *yard*; and the 5th of an *Ell* . . 7 *gall.* the 9th of a *Hogshead*, &c. (II) In MONY . . 1 ½ *d* is an 8th of a *Shilling* . . 1 *s* 8 *d*, the 12th: 3 *s*, 4 *d*, the 6th: 6 *s* 8 *d*, the 3d of a *Pound*. (III) In WEIGHT . . 4 lb is a 7th of (28 lb, or) a *Quarter of a cw*, &c. . . 7 lb is an 8th of (56 lb, or) *Half-a-cw*, . . 14 lb is an 8th: 16 lb a 7th of a *Hundred-weight* . . 2 ½ *cw* is an 8th of a *Tun*.

f IV. *If there be fractions (or lower denominations) in the quantity of the thing sought*; Divide the price by

the

the aliquots thereof: proceeding in the rest, according to the instructions already given. The work will stand as in the margin.

		Cw	qr	lb		£	s	d	q
		84	3	11 .. at ..		1	1	10	-
l 1 : 1 *s* =		21	*qr* 2		2	--	10	11	-
×		84	1		2	--	5	5	2
		168	*lb* 7		4	--	1	4	1
d 6	2	42	4		7	--	--	9	1
4	3	28							

Price ...18 6 of the fractions: 18 6 --
Total: 1852 6: The answer; which, being divided by 20, gives £ 92 : 12 : 6, for cw 84 3 11.

g *That is*, In sums, in which the Question-term is one: as when we say: 'If so-much cost so-much; *What'll* one cost?

h I. *For example*: If 12 cost 10 *s* 6 *d*: What will 1 cost? Answ. Divide (I) by 12 (the commodity) or (II) its Factors (2 × 6, or 3 × 4) according to the instructions given in the explication of the 2d example in note [e].

		S. 10 6 --
I. By Commod:	12	-- 10 2
II. † By Factors	2	5 3 --
	6	-- 10 2
	3	3 6 --
	4	-- 10 2

† *NB*. When the quantity of the commodity is greater; a factor (too-big) may be divided.——For example: If 112 cost £ 2 6 8: What will 1?——Answ. Divide by the factors 16 (or 2 × 8) and 7; as in the margin. V. note [¶].

		L. 2 6 8
112	2	1 3 4
	8	-- 2 11
	7	-- -- 5

i *That is*, In any questions of a different nature from the aforementiond, when you can, at sight, or with a small attention, discover the common divisor; that will give lesser numbers to work with.

k *For example*:——If 7 *y* cost 56 *l*; What cost 35 *y*? (*NB*) The question, stated, is: 7 *y* : 56 *l* : : 35 *y*. where it is easily perceivd that 7 divides both the extremes, and the quotes are 1, and 5: So that this question (1 *yd* : 56 *l* : : 5 *yd*) will have the same answer as the former; and is found simply by multiplying 56 *l* by 5; which makes 280 *l*.——If 250 *l*. buy 548 *y*, What will 5 *l* buy?

buy? (*NB*) The extremes being both divided by 5, the quotes are 50 and 1; and the queſtion will have the ſame anſwer as this, 50 *l*: 548 *y*:: 1 *l*: which is ſolvd by dividing 548 *y* by 50: the quote is 10 *y* 3 *qrs*, 3 *nails*, and $\frac{18}{50}$.——If 27 *y* coſt 45 *l*: What coſt 63 *yards?* (NB) Here, the extremes 27 and 63 being divided by 9; the quotes are 3 and 7: and ſo the queſtion has the ſame anſwer as this: 3 *y*: 45 *l*:: 7 *y*. Again, 3 and 45 being both divided by 3; the quotes are 1 and 15: and ſo the queſtion is reduc'd to this: 1 *y*: 15 *l*:: 7 *yds*; and the anſwer 7 times 15, or 105 *l*.

l The following practiſe, by the aliquots of 2 *s*, was publiſht by Mr. *John Jones* of *Briſtol* (in 1720) as his invention; and Mr. *Snow*, in a recommendatory letter, conceives it to be intirely new.——But I find an account of it by Mr. *Mellis*, as ancient as the reign of *Edward* 6th, in Dr. *Record*'s arithmetic, p. 358.——However, as there is ſome advantage in it, I have here given it: though, in effect, there is nothing more in it than a particular application of the general directions in line 1.—— For which reaſon I have added alſo the two following lines, of even ſhillings; as indicating a ſhorter way than might have offerd it ſelf from the general hints in the preceding verſes.

m Thus 748 *lb*, at 2 *s* per *lb*, is 74 *l*: and (8 being doubled) 16 *s*: for, 748 ÷ 10 (2 *s* being the 10th of a *l*) = 74 *l*. 16 *s*.

n *Thus*——For Aliquots (1) 748, at 8 *d*. Set down (as though it were at 2 *s*) 74 *l* 16 *s*; and divide it by 3 (the 8th of 2 *s*) you have the anſwer £ 24 18 8. (2) 721, at $1\frac{1}{2}$ *d*. Say 72 *l* 2 *s* ÷ 8 (the number of $1\frac{1}{2}$ *d* in a ſhilling) = £ 9 0 3 ÷ 2 (the number of 1 *s* in 2 *s*) = £ 4 10 $1\frac{1}{2}$.——for Aliquants (1) When the given price conſiſts of odd farthings, or is under 2 *d*; work it firſt at 3 *d*, and take the parts. Thus 210, at 1 *q*. 21 *l* ÷ 8, the 3 *d* in 2 *s*) = £ 2 12 6 ÷ 12 (the 1 *q* in 3 *d*) = S 4 $4\frac{1}{2}$. (2) When the given price is above 2 *d*, but an aliquant part; you muſt be content to ſplit it into aliquots. Thus 745, at 5 *d*. 74 *l* 10 *s* ÷ 6 (the 4 *d* in 2 *s*) = £ 12 8 4 ÷ 4 (the 1 *d* in 4 *d*) = £ 3 2 1; in all, £ 15 10 5.

o *For example:* 719, at $15\frac{1}{2}$ *d*: For the 12 *d* take half of 71 *l*. 18 *s*; to-wit, 35 *l* 19 *s*: then, of that, for 3 *d*, the 4th; and of that, for 2 *q*, a 6th. The anſwer will be £ 46 8 8 2.

For

For example: 379, at 18*s*. Say 9*d* (the half of the price) × 379 = 3411; that is (the unit place being doubled) 341*l* 2*s*.——In case of *an odd shilling*: a 20th of the commodity added to the price of the Even, gives the total. Thus 379 at 19*s*. To 341*l* 2*s* (the price, at 18*s*) add 18*l* 19*s* (the 20th of 379) the total will be 360*l* 1*s*.

That is: To value the remainders of a division by the factors of any given number——Multiply the last remainder into the last-divisor-but-one; to-wit, that overagainst it, in the position I recommend (V. Reduction note).——To the product add the preceeding remainder.——The sum thereof multiply into the next preceeding divisor: And so on, till you have gone-up, through all the divisors, and remainders, to the first remainder. Thus, in the example annext, the value of the particular fractions, denoted by the three remainders (1 4 5) will be found $\frac{103}{126}$, as against the last dividend.

	Divisors	Dividend	Remrs
	126	3428689	—1
factors	3	1142896	—4
	6	190482	—5
	7	27211	$=\frac{103}{126}$

For 5 (the last remainder) × 6 (the preceding divisor) + 4 (the preceding remainder) × 3 (the preceding divisor) + 1 (the preceding remainder) = 103; for a numerator, to 106 (the product of the factors, or) the denominator.——

NB. This holds-good (I) In all the Changes, or transpositions of the divisors, and varieties of remainders: as will appear .. by dividing the above-sum by the divisors in the margin .. and operating the remainders, as before explaind.

Divisors			Remainders		
3	7	6	1	6	4
6	3	7	1	2	5
6	7	3	1	3	2
7	3	6	5	2	4
7	6	3	5	2	2

(II) In Applicate numbers: as may appear by the solution of the two following questions. (I) In 3476589426 *gr*. How-

factors of 5760		the number of *gr*. in a *lb*.	
		3476589426	*gr*—2
24	4	869147356	—4†
	6	144857892	*dw*—12
	20	7242894	*oz*—6
	12	603574	*lb*—†

many

many *lb* &c? (2) What is the value of 1 yard of cloth, 48 yards of which cost £ 15 10 4? (NB) The value of the remainders, in the abbreviated form, being found by the method aforementiond, appear to agree with the work, at large, as performd by reduction and division, in the margin, underneath the operations by the factors of 5760 and 48.

Gr. 3476589426(5760 *gr* in *lb.*
20509426 603574·*lb.*
337928
4261
—3 12* *oz.* in *lb.*
38232(6 *oz.*
,3672
20 *dw.* in *oz.*
73440(12 *dw.*
15840
,432
24 *gr.* in *dw.*
103680(18 *gr.*
4608,0

factors of 48

£	15	10	4	0	—4
6	2	11	8	2	—2
8	--	6	5	2	—$\frac{16}{48}$

£ .. 15 10 4	
20	14896(48
s. ... 310.	4,1 *q.* 310—2
12.	*d.* ·77—5
d. .. 3724	*s.* ..6—
4	i. e. (by reduction)
q. 14896	S 6 5 2 $\frac{16}{48} = \frac{1}{3}$.

Here, 4 (the last remainder of the division by 6, the latter factor of 24) × 4 (the preceding divisor) + 2 (the first remainder) = 18 *gr.* as in the valuation of the division, at large, underneath.

Here, 6 × 20 + 12 × 6 + 4 × 4 + 2 = 3186: agreeable to what appears from the remainder of the division at the top of the page.

Here, 3186 (the remainder of the division, that reduces *gr* to *lb*) × 12 (the number of (the next inferior denomination, to wit) *oz* that make 1 *lb*) = 38232: which, divided by 5760 (the original divisor) gives 6 *oz.* And so on, according to the directions given in the article Reduction, note [a].

PROGRESSION.

1 PROG. AR: a series of numbers *by equal additions* increasing[a].

Sum

2 *Sum of a séries* is áll into th' súm of the extremes by 2 [b].

3 *Difference of séries* ĭs thát o'th' extrémes, by the terms, lefs unit [c].

4 *Númber of térms:* firft from láft: reft, by dífference, gĭves All-but-unit [d].

5 PR'OG. GE: a féries ŏf númbers *by óne common fáctor* increafing [e].

6 *Láft of a féries* tŏ find, conceíve arithmétical Exponents [f]:

7 twó of which, ádded, denote the próduct o'th' térms correfponding [g].

8 Then for the *fúm of the féries:* thĕ laft term ínto the ratio:

9 ánd, from the próduct, the fírft: the remáinder by th' rátio lefs unit [h].

a *Thus*, 1 2 3 4, or 4 3 2 1 (differing by 1) and 2 4 6 8, or 8 6 4 2 (differing by 2) are faid to be in arithmetical progreffion.——*Note.* In arithmetical progreffion (I) are to be obfervd the two extremes: to-wit, (1) the firft term, *a*. (2) the laft term, *l*. (3) The number of terms, *n*. (4) The common difference, *d*. (5) The fum of all the terms, *s*: (II) any three of which being given, the other two may be found: as may be feen in a feries of 20 propofitions in Oughtred's clavis math. 29. 4. See alfo Malcolm, arithm. p. 233, and p. 243; where he gives feveral problems, wherein two things only are given, to find the other three. (III) The chief and moft ufeful of the problems are thofe which relate to the differences, or the fum of the feries, &c. as follows in the text.

b *For example:* [Given a l n; to find S] How far does he go, that carries, one by-one, into a bafket, 100 ftones, a yard diftant from one another; the firft of 'em a yard from the bafket,——Anfw. $\left[\frac{a + l \times n}{2} = S\right]$ 10100 yards. For 100 (the number of terms) × 202 (the fum of the extremes; to-wit, 1, and 100 doubled, on account

account of going backward and forward) = 20200 ÷ 2 = 10100 *; that is 5 miles and $\frac{3}{4}$, wanting 20 yards.

* Sir *Jonas Moore* makes the distance run but 10000 yards; which is too little by 100 yards. V. Moore's arith. p. 324.

c *For example:* [Given a l n; to find D] One had 12 children, that differd alike in all their ages: the youngest was 9 years old, the eldest was 36 $\frac{1}{2}$: What was the difference of their ages, and the age of each?——Answ. $\left[\frac{l-a}{n-1}=D\right]$ 27.5 (the difference of the extremes; to-wit 36.5 —9) ÷ 11 (the number of the terms less 1) = 2.5, the common difference requird. Consequently, the age of the youngest but one is (9 + 2.5, i. e.) 11.5: of the next (11.5 + 2.5: i. e.) 14: and so of the rest.

d *For example:* [Given a l d; to find N] A man going a journy, his first day's travel was five miles; his last day's travel was 35 miles: he increast his journy, every day, three miles: How-many days did he travel? (Answ.) 11 days. For, 5 (the first term) — 35 (the last term) = 30 ÷ 3 (the difference) = 10 + 1 = 11; the number of days sought.

e *Thus,* 2 4 8 16 (increasing by one common factor, calld the ratio) are said to be in geometrical proportion.

f The *exponents,* or indices, are a series of numbers in arithmetical progression, begining with 1 *, and the common difference 1.

* *NB.* If the series of geometrical proportionals begins with 1, the exponents begin with a cipher.

g *For example:* [To find any term, whose distance from the first is assignd; without producing the whole series] A horse was offerd to be sold at a farthing a-nail, and double it: that is, 1 farthing for the first, 2, for the 2d; 4, for the 3d, &c. in geometrical progression: the number of nails, 7 in each shoe. What would have been the price of the horse at that rate? Answ. (1) First 0 1 2 3 4 5 indices or exponents, in arithm. progr. 1 2 4 8 16 32: farthings in geometrical progression. (2) Then [these leading terms being found with their exponents, say] 5 + 5 = 10: therefore, 32 x 32 = 1024. (3) Then 10 + 10 = 20: therefore, 1024 x 1024 = 1048576. (4) Again, 4 + 3 = 7: therefore, 16 x 8 = 128.

5) And 20 + 7 = 27: therefore, 1048576 x 128 = 134217728: which is here be accounted the 28th, and 1st term; because the 1st term in the series is 1, which does neither multiply, nor divide.

For example: In the preceding series, the last term is 134217728; being the number of farthings to be paid for the last nail. By this, with the 1st term and ratio, is found the sum of all the series, as follows: 134217728 (the last term) x 2 (the ratio) = 268435456 — 1 (the 1st term) = 268435455 ÷ 1 (the ratio, less unit) = 268435455; that is, £279620. 5. 3. 3.

PROOFS.

1. OF THE OPERATIONS:

or, the means of being satisfied that they are rightly performd; are as follows:

PRÓVE by a cáreful reviéw; 'tis the *sáfest*: the *réadiest*, as follows:
SÚB.] *right*; when -hénd and remáinder (together) máke up the compound [a].
ADD MULT DI'V] add the dígits togéther and cást-oút the nines: then
Right; if remáinder of Fácits agreés with remáinder of factors [b],
Múltiplied ĭn Múl [c]: -for and quótient in Dív; to which ádd the remainder [d].

2. OF THE RULES:

RÚLES *Prove* by Várying the wórk in a Dífferent, ór in the Same rule [e].

For example: 234 — 34 = 200.——Proof: 34 (the subtrahend) + 200 (the remainder) = 234; the same as the

the compound number, from which 34 was subtracted: therefore the work is right.

b Note——*In Addition*, the particulars may (not improperly) be calld the factors; and the total, the facit.——*In Division*, the divisor and quotient multiplied, with the remainder added, make the dividend; and may, therefore, be considerd as factors.——To *Exemplify*:

In Addition: 3 + 9 + 15 + 7 + 23 = 57.——Proof: Say (in the factors, or particulars) 3 + 1 + 5 = 9: then 7 + 2 = 9; and 3 remains. Then (in the facit, or total) 5 + 7 = 12: the 9 cast-out, there remains 3; the same as the remainder of the factors: therefore the work is right.——*In case of Different Names* (1) either Add the Columns upward and downward (2) or Divide a long sum into parcels; and, taking the several totals on a bit of paper (laid just underneath each parcel) add them together at the foot of the account.

c *In Multiplication*: 3685723 × 56 = 20640048——Proof: The nines being cast-out of the multiplicand, there remains 7; out of the multiplicator, there remains 2: then 2 × 7 (the remainders of the factors) = 14: out of which the 9 being cast, there remains 5: with which agrees the remainder of the facit, or product, the nines being cast-out: therefore the work is right.

d *In Division*: 3268 ÷ 67 = 48.——Proof: The nines cast out of the divisor, there remains 4; out of the quotient, there remains 3. Then 3 × 4 (the remainders of the factors) = 12: out of which the 9 being cast, there remains 3: then (this) 3 + (the digits in the remainder, to-wit) 5 + 2 = 10; out of which the 9 being cast, there remains 1: with which agrees the remainder of the facit, or dividend, the nines being cast-out: therefore the work is right *.

* Having thus explaind the manner of proof by casting-out the 9 (nines) it may not be improper to show the truth of it. In order hereto, it is to be premisd that the figure, that stands in any place of a number (taken in its simple value) is equal to what will remain, after 9 is taken-out of the complete value, as oft as possible; that is, after all the 9's (containd in it) are taken away. *For example*, If all the 9 (nines) containd in 700 are taken-away, there remains the simple number 7. The demonstration of this lemma stands thus: Any figure,

standing in any place of a number, is equal to ten times the value of the same figure, in the next lower place (by what has been shown in Notation) that is, equal to 9 times, + 1 time that value (because 9 + 1 = 10) But 9 times any number is a precise number of 9 (nines) which being taken-away, there remains once the value of it in that next place: and this, again, is equal to 9 times, + 1 time the value of the same figure in the next lower place; and the 9 times being taken-away, the 1 times remains: and so on till you bring it down to the place of tens; where it is equal to 9 times its simple value, + once the value: and, the 9 times taken-away, there remains the simple value. And thus we have suppos'd all the 9's to be taken out of it; and, consequently, the lemma is true.———But, to this proof it is objected, that a wrong operation may appear to be true. Answ. (1) This must be own'd. for. if we change the places of any two significant figures in the sum, it will still appear to be right; there being the same excess of 9 (nines) where there are the same figures, whatever order they stand in. (2) But, then, consider: a true sum will always appear true by this proof (for that is demonstrated) and, To make a false sum appear true, there must be at least two errors; and these opposit to one another: that is, one figure greater than it ought to be, another as much less: and, if there are more than two errors, they must always balance among themselves: that is, the sum of the figures, that are greater than they ought to be, must always be equal to the sum of the figures that are deficient: else it is plain, a false sum will not appear to be right. But, now, if we consider what an exceeding great chance there is against this particular circumstance of the errors; and how simple the proof-work itself is: we may trust to this proof as safely as to any other.

Thus, Practise may be prov'd by the rule of-three, or by a different working in the rule of practise; as in the following example:

At 5s. 8d. . 756 lb	Or . . . . 756 lb.	Or 1 : 5s. 8d. : : 756
5		12
3780	s4 | 5 | 151 4	68d.
d4 | 3 | 252	1 | 4 | 37 16	756
4 | 3 | 252	d6 | 2 | 18 18	6048
s 4284	2 | 3 | 6 6	4536
£ 214:4	£ 214 4	d. 51408(12
		4284
		£ . . . . . . 214 : 4

Practise — Rule-of three

PROPORTION.

1 PROP.—*Continued*, Progréssion is calld--*Disjúnct*, Rule-of-three—and
2 *Cónjunct*, when (in the same quéstion) are compard Coíns, Weights, and Measures.
3 RULE. *This*: I'nto each óther the I'fs, and the Mákes; for division [a]:
4 *Hów-many Lást* make the gíven o'th' Fírst ? -for, the I'fs ; -dend the Rest make [b].
5 *Hów-many Fírst* make the gíven o'th' Lást ? -dend, the I'fs with the Question [c].

a *To answer questions of this nature* (in the readiest manner, without repeated statings) by *Division* only; the Ifs or (suppositions) are to be enterd in one column; and the Makes (or what they are supposd equal-to) in another. Then, each rank, multiplied continually, give the dividend and divisor, according to the directions in the two following cases.

b *For example*: If 10 *l* at London make 9 at Amsterdam; and 90 at Amsterdam are equal to 112 at Tholouse: How-many at Tholóuse are equal to 50 at London? —Answ. The Ifs 10 × 90 = 900 for the divisor: the Rest (to-wit, the Makes with the question) 9 × 112 × 50

L 3 = 50400

= 50400, for the dividend. Then, 50400 ÷ 900 = 56 *l.* at Tholouse, equal to 50 at London.

c *For example:* If 100 *l* English, make 95 Flemish; and 19 Flemish make 35 at Bologna: How many English are equal to 50 at Bologna?——Answ. the Ifs, with the question, 100 x 19 x 50 = 95000, for the dividend: the Rest 95 x 35 = 2375, for the divisor. Then, 95000 ÷ 2375 = 40 *l* English, equal to 50 at Bologna. V. Exchange.

QUANTITIES.

of goods, &c. nearly (at least) determinate in NUMBER, WEIGHT, MEASURE.

The following list, whatever defects or errors there may be in it (which the curious will be so good as to apprise me of) will not (I presume) be unacceptable: as, thereby, a ready recourse may be had to such notices as frequently occur, in reading, and in the way of business; for the explication whereof little help is to be had from dictionaries, or books of arithmetic.

AEM, *Awme, Awame: Gallons:* (of wine) 35 from Antwerp: 40, from the Rhine: 50, from Dordrecht.

ANKER: ¼th of an aem.

BAG:——*Bushel:* 1, of lime ——*Hundred weight:* 1 ¼ to 1 ¾, of hops: 1 ¼ to 3. of pepper: 2 to 3, of safflower: 2 to 4, of goat's-hair: 2 to 7, of sumach: 2½ to 4 ¼, of cotton-yarn: 3, of almonds: 3 to 4, of aniseeds: 4, of currants.

BALE——*Bolts:* 100, of lyons and paris thread——*Hundred-weight:* 1 to 4, of persia raw silk: 1 ½, of cochineal, indigo: 2, of cardamoms, thrown silk: 2 ¼, of spanish wool: 3, of carraway-seeds: 3 to 4, of cotton-yarn: 6, of safflower: , of feathers: , of cork.——*Pieces:* 3 to 4, of lockrams: 20, of boultels: 22 ½, of bevernix, and holmes fustians ——*Reams:* 10, of paper: 100, of unbound books.

BAND:——*Strikes:* 10, of eels.

BANDLE

Bandle—*Feet:* 2 in length; an irish measure.

Barrel—*Bushels:* 3, of apples, pears—*Dozen:* 10, of candles—*Gallons:* 31 ½, of oil: 32, of herrings [a], ling: 42, of eels [a], mum, salmon [b]—*Hundred-weight:* ⅞ to 2 ½, of figs: 1, of gun-powder, lippora raisins: 1 to 1 ½, of quicksilver: 2 to 3, of spanish-tobacco.—*Number:* 300, of black or white plates: 1200, of stock-fish. V. Hundred.—*Pounds:* 16 (the little) 30 (the great) of anchovies: 100, of gun-pouder for ships: 120, of candles: 200, of barillia, oat-meal: 224, of butter: 240, of soap: ....

[a] By 2 *H.* 6. 11, the barrel of herrings and eels shall contain 30 gallons.

[b] By 2 *H.* 6. 11, the barrel of salmon shall contain 84 gallons.

Basket—*Bushels:* 2 of medlars—*Pounds:* 20 to 50, of asa-fœtida.

Bavin, V. Wood.

Billet: *Feet* (of wood) 3, in length: whereof there should be 3 sorts (1) a Single billet, 7 inches about (2) a Cask, 10 inches (3) a Cask of two, 14 inches. V. Wood.

Bind—*Strikes:* 10, of eels.

Bolt—*Ells:* 28, of pol-davies.—— , of lyons and paris thread.

Box—*Gross:* 2, of rings for keys—*Hundred-weight:* 1 to 2, of quicksilver.—*Pounds:* 14, of prunelloes.

Bunch— , of rhe-nish glass.

Bundle—*Feet:* 3 (about, at the band) of basket-rods.—*Load:* $\frac{1}{60}$, of bulrushes—*Number:* 10, of necklaces, glover's knives, harness plates, bass-ropes: 16, of sets of instruments for barber-surgeons: 100, of laths, 5 foot long: 120, of laths, 4 foot long—*Skains:* 20, of hamburgh yarn.

Burden—*Pounds:* 180, of gad-steel.

Butt—*Gallons:* 84, of salmon—*Hundred-weight:* 15 to 22, of currants.

Cade—*Number:* 500, of red herrings: 1000, of sprats.

Cag, *Kegg*—*Gallons:* 4 to 5, of brandy, sturgeon.

Cane—*Inches:* 12 or 14, of rods of lead for glasiers.

Canister—*Pounds:* 75 to 112, of tea.

Caroteel—*Hundred-weight:* 3, of mace: 4 to 5, of cloves: 5 to 9, of currants: 6 to 7 ½, of nutmegs.

Carrage—*Bushels:* 64, of lime.

Carucata, V. Hide.

Casata, V. Hide.

Case—*Feet:* 120, of normandy-

normandy-glass.—*Number:* 5, of recorders: 120, of window-glasses.——*Pieces:* 21, of hollands linen.—*Tables:* 24, of ratcliff crown-glass: 25, of french-glass: 35, of newcastle-glass.

CASK--*Hundred-weight:* 1 ¾ to 3, of tobacco: 2, of wheat-flour: 3, of almonds: 8 to 11, of sugar.

CHAIN—*Links,* 100; or 4 statute-perch: of which, one in breadth, and 10 in length, make an acre.

CHALDRON, *Chaudron*—*Bolls:* 16, of corn——*Bushels:* 32, of corn: 36, of coals——*Number:* , of grind-stones.

CHEST——*Flasks:* , of florence-wine—*Feet:* 200 to 300, of glass——*Hundred-weight:* 1 ½, of cochineal: 1 ½ to 2, of indigo; 5 score to the *cw:* 2 ½ to 3, of castile-soap: 3 ½, of benjoin, ising-glass: 3 ½ to 4, of myrrh: 10 to 15, of sugar.

CHIEF—*Ells:* 10, of fine linen, silk: 14, of fustian.

CORD—*Feet* (of wood) 8 long, 4 broad, 4 deep. (NB) That, calld the 14-foot cord, is to be 14 feet in length; 3, in breadth; and 3, in depth. V. Wood.

DAKIR (51 H. 3) a Dicker.

DENARIATA—*Acre:* 1, of land.

DISH—*Cubic-inches:* 10 73.52 (near 4 corn-gallons) of lead-ore: which, if pretty good, will yield about 3 *hundred-weight* of lead.

DOZEN——13, of tand calf-skins—14, of rolls.

DUPPER———*Hundred-weight:* 1, of roman vitriol: 1 to 1 ½, of tincal.

FAGOT——*Feet:* 3 (in length) of wood; and, at the band, 24 inches about, beside the knot.—*Pounds:* 120, of steel.

FAMILIA, V. Hide.

FANGOT———*Hundred-weight:* 1 ¼ to 2, of raw-silk of aleppo: 1 ½, of thrown-silk of naples: 1 ¾ to 2, of yarn.

FARDEL—*Yard-land:* ⅛, of land.

FARDING-DEAL, *Farundel* [a], *Acre:* ¼, of land....

[a] In a survey-book of the manor of west-slapton, in com. devon, is enterd thus: *A B* holds 6 *farthings* of land, at 126 *l*, per annum.

FATT, *Vat*——*Bundles:* 210 to 221, of yarn.—*Bushels:* 8, of corn.—*Hundred-weight:* 3 ¼ to 4, of ising-glass: 5, of bristles: 20 to 25, of wire.——*Maunds:* 1 ½, of unbound books——*Pieces:* 200, of narrow germany-linen.

FLOOR—*Feet* (of wood) 18 long, 18 broad, 1 deep.

FOTHER, *Foder*—*Hundred-weight:* 19 ½ (of lead) among the plumbers: 21, at newcastle:

newcastle: 22, at stockholm: 22 ½, at the mines.

FRAIL—*Pounds*, 75 to 100, of raisins.

FURR——*Pains*: 4, of budge-poults.

GOAD—*Ell english*: 1, * of welsh frizes, and frizados.—* 55 inches, Hayes, negot. magaz. p. 206.

GUNNY——*Hundred-weight*: ¾, of cinnamon: 1, of aloes-epatica, benjoin: 1 to 1 ½, of turmeric: 1 ¼, of salt-petre.

HIDE, *Hyde*, *Hyda*, *Carucata*, *Casata*, *Familia*, *Manens*, *Mansum*, *Plough-land*, *Sullinga*—*Acres*: 100, or 120 of land.

HUNDRED—*Bags*: 25, of lime.—*Bundles*: 70, of pipe-hoops: 90, of hogshead hoops: 120, of barrel and kilderkin hoops: 180, of pink or firkin hoops.—*Ells*: 120, of canvas (except quilted, strip'd, and tufted) and linen-cloth—*Inches*: 100 times 72 (or a piece of 12 foot by 6 inches) of wood, in carpentry.—*Number*: 80, of pales six-foot long: 120, of anchor-stocks, balks, barlings, barrel-boards, battens, cabbage-plants, capravens, clapholt, deals, eggs cod-cole- stock fish, handspikes, headings (for barrels, pipes, &c.) red herrings, lathes of three foot long, morkins, oars, pack duck, pales of four foot long, sack-cloths, coney- lamb- sheep-skins, boom-spars, bow-staves, wainscots, walnuts: 124, of haberdine, or ling——*Tuns*: 14, of salt at amsterdam. V. Quintal.

Great HUNDRED—*small-Hundred*: 24, of clap-board.

HYDE, V. Hide,

JARR—*Galions*: 18 to 26, of oil—*Pounds*: 52, of wheat: 100, of green-ginger.

INGOT——*Pounds*: to , of bullion, or melted gold and silver.

KEG, V. Cag.

KINTAL, V. Quintal.

KNIGHT'S FEE—*Hides*: 12, of land: or, so much inheritance as is sufficient to maintain a knight, with suitable retinue: which, in Henry IIId's days, was reckond at 15 *l*: but Sir T. Smith rates it at 40 *l*.

LAST—*Barrels*: 12, of pot-ashes, cod-fish, white-herrings, oat-meal, pitch, tar: 24, of gun powder—*Cades*: 20, of red-herrings—*Dickers*: 2, of leather—*Dozen*: 12, of hides—*Hundred-weight*: 1 ½ to 4, of cotton wool: 17, of flax—*Number*: 100, of stock-fish——*Pair*: 3, of d g-stone.—*Pounds*: 384, of any commodity in scotland: 1700, of feathers, flax.—*Quarters*: 9 of meal: 10, 10, of corn, rape seed—*Tuns*: 12, in estimating the contents of ships.

LIBRATA—*Acres*: 240, of land: or, 20 solidatas.

LOAD—*Bundles*: 60, of bulrushes—*Bushels*: 40, of corn, lime—*Dishes*: 9, of lead-ore.———*Feet-square*: 150, of four-inch plank: 200, of three-inch: 300, of two-inch: 400, of one-inch-and-half: 600, of one inch. —*Number*: 50, of fagots: 100, of bavins: 500, of bricks: 1000, of tiles.——*Pounds*: 175, of lead.——*Trusses*: 36, of hay. V. Fother, Poke, Seam, Tun.

MANENS, *Mansum*, V. Hide.

MANTLE, V. Pain.

MARK—*Ounces* (averd.) 8, of french copper- gold- silver thread: 11 ½ (venice-weight) of french gold- and silver-thread.

MAST——*Pounds* (troy) 2 ½ of amber, cologn gold- and silver thread.

MAUND—*Bales*: 8, of unbound books.

NEST—*Chests*: 3, of cypress-wood coffers.

NOOK, *Nocata*——*Acres*: 12 ½, of land.

OBOLATA—*Acre*: ½, of land.

OX-GANG, *Oskin*—*Acres*: 15, of land: or, as much as an ox can plough in a season.

PACK—*Number*: 52, of cards: 20000, of teasels——*Pounds*: 240, of wool: 480, of irish yarn.

PACKET—*Number*: 250, of needles.

PAIN, *Mantle*—— , of furs.

PEISA, V. Weigh.

PIDDLE—— , of land.

PIECE——*Ells*: 13, of lawns: 106, of lockrams: 120, of most linens.———*Yards*: 2 ½, of carpets of tunis: 4 to 8, of silesia-lawns: 7 ½ of scamoty: 10, of checks: 12 to 13, of devon-dozens (wt. 13 lb) ordinary penistones (wt. 28 lb): 13 to 14, of northern-dozens single (wt. 35 lb. frized) sorting penistones (wt. 35 lb. unfrized): 15, of bassins, bombasins, bustians, carrels, dornix, fustians, rashes, sackcloths, sayes: 17 to 18, of narrow yorkshire kerseys (wt. 22 lb): 24, of broad-cloth (the short piece) frisados, hounscot sayes, newberry-whites, and other kerseys of like make: 25, of spanish-cloth (wt 43 lb): 28, of sorting hampshire kerseys (wt. 32 lb): 30 (the double piece) of fustians, cloth-serges: 32 (the long piece) of broad-cloth: 36, of caddas.

PLOUGH-LAND: so much as may be tilld with a single plough. V. Hide.

POCKET, *Sarplar*, *Ser-*

pliathe—*Pack:* ½, of wool —— , of hops.

POKE—*Hundred-weight:* 20, of wool: calld (in some places) a *load*; being a wagon-load.

POT——*Gallon:* ½, in guernsey and jersey.

PUNCHEON——*Hundred-weight:* 10 to 12, of prunes.

QUADRANTATA—*Acre:* ¼, of land.

QUINTAL, *Kintal*, *Hundred-weight*—*Bushels:* 25, of lime——*Pounds:* 75, at leghorn: 100, of cloves, cochineal, fish (at newfoundland, and in the streights) ginger, indigo, mace, nutmegs, pepper, sugars (in the english settlements in america) brasil- st christopher's- spanish- verinus- tobacco, mohair- raw- linen-yarn: 120 (calld *long-weight*) of cheese (in cheshire, derbyshire, lancashire, leicestershire, shropshire, sturbridge-fair) coarser metals [a], and irish yarn . . . .

[a] It is also calld the *stannary-hundred*; tin being hereby weighd to the king's farmers.

RATION--*Pecks:* 9 ¾: *or*, a days allowance of bread or forage, for man or horse.

RING——*Number:* 240, of clap-boards.

ROD—*Number:* (of Candles) 12, of six in the lb: 16, of eight in the lb: 24, of twelve in the lb.

SACK——*Bushels:* 3, of coals: 4, of corn: 5, of salt——*Hundred-weight:* 1 ½ to 4, of cotton, wool——*Stone:* 26, of sheep's wool (14 lb. to the stone: but, in Scotland 24, of 16 lb. to the stone).

SARPLAR, V. Pocket.

SAUME——*Pounds:* 315, of quicksilver.

SCORE—*Chaldrons:* 21, of coals.

SEAM——*Bushels:* 8, of malt——*Horse-load:* 1, of wood——*Pounds:* 120, of glass.

SEMIBOLE——*Pipe:* 1, of wine.

SERON————*Hundred-weight:* 2, of almonds: 2 ½ to 3 ¾, of castile-soap: 3, of barillia: 3 to 4, of aniseeds.

SET——*Number:* 5, of recorders: 24, of alphabets.

SERPLIATHE, V. Pocket.

SHID *of wood*——*Feet:* 4 in length: and in girth, according as they are mar .t. If they have but 1 notch, they are to be 16 inches about: if they have two notches, they are to be 23: if 3, 28: if 4, 33: if 5, 38.

SHOCK——*Ells:* 13, of lawn——*Number:* 60, of soap-boxes, canes, trays——*Yards:* 4 to 8, of silesia-lawns.

SKIN—*Hundred-weight:* ¾ of cinamon.

of

SOLIDATA—*Acres*: 12, of land: or 12 denariatas. V. Farding-deal, Obolata.

SORT—*Dozen*: 4, of balances—*Ells*: 106, of lockrams: 120, of several linens.

STACK—*Feet* (of wood) 3 long, 3 broad, 12 high.

STAND—*Hundred-weight*: $2\frac{1}{2}$ to 3, of burgundy-pitch.

STICK—*Rods*: 30, of candles.

STOOK—*Sheaves*: 12, of corn.

STRIKE—*Number*: 25, of eels.

SULLINGA, V. Hide.

SUM—*Number*: 10000, copper- harness- rose- sadlers sprig nails.

THRAVE—*Sheaves*: 24, of corn.

TRUG— , of corn.

TRUSS—*Pounds*: 56, * of hay: , of forage, as much as a trooper can carry on his horse's crupper.... * 60, in july and august.

TUB—*Hundred-weight* 3 to 4, of vermillion—*Pounds*: 56 to 86, of camphor: 60, of tea.

TUN—*Bales*: 5, of feathers: 8, of paper: 10, of cork—*Barrels*: $2\frac{1}{2}$, of brandy: 3, of syrop: 4, of prunes—*Bushels*: 20, of chestnuts, wheat, and other grain: 42, of salt. V. Bushel, in Tables, note [n].—*Dozen*: 1, of planks: 2, of walnut-tree tables—*Feet-square*: of timber. V. Load. —*Gallons*: 236, of sweet oil: 252, of whale oil.—*Pounds*: 1709, of barley: 2100 to 2240, of rye: 2200 to 2500, of wheat: 2000, the sea-tun, by which the contents of a ship are estimated...... Corn is usually sold, in England, by the *quarter*: and 5 quarters is commonly reckond to a tun in freight.

VAGA, V. Weigh.

VAT, V. Fatt.

WEIGH, *Wey*, *Waga*, *Vaga*, *Peisa*.—*Bunches*: 60, of rhenish glass—*Cases*: 60, of window glass —*Pounds*: 224, (of cheese) by 9 *H* 6. 8: 248, in essex: 256, in : 300, in : 336, in suffolk (of bay salt)—*Quarters*: 6, of barley and malt: 5, of other grain.

WINCH— : , of cable-yarn.

WOOD, is assizd into Shids, Billets, Fagots, Falwood, and Cord wood. V. Shid, &c.

YARD LAND—*Acres*: 15, at wimbledon in surry: 20, in most other places: 24, 30, 40, in some.

REBATE.

REBATE.

1 DIscount [a]: *Dividend* gives the Ráte into Príncipal and Time.
2 And the Tíme into Rate, more Yéar into ág, the *Divisor* [b].
3 *Present Wórth* is the Príncipal léss the Rebáte; to be paid-down [c].

a *Rebate*, or *Discount* of mony is the allowance made by the creditor out of a sum of mony, due to him at the end of some certain time, in consideration of the prompt payment of the remainder by the debtor——That sum, payd-down instead of the principal, due hereafter, may be calld the *Present-worth*: in regard that, if it were put-out to interest for the time that the discount is computed; it would amount to the principal, due at the end of that time. V. Interest.

b *For example:* Sold goods for £ 795 11 2: to be paid at 2 3 months: that is, one half at 3 months; and the other half at 3 months after that. If all the mony be payd-down; what must be discounted? (Answ.)

For the 1*st* 3 *months:*——for the *Dividend:* 6 *l.* (the rate) x 3 mo. (the time) = 18 x 397, 779 *l.* (half the mony to be paid-down) = 7160,022. Then——for the *Divisor:* 3 months (the time) x 6 (the rate) = 18 + 1200 [the year; to-wit, 12 months (to correspond with the species of time aforementiond) into ag = 1218 ——Then, 7160,022 (the dividend) ÷ 1218 (the divisor) = 5,878; that is £ 5 17 6 3.

For the 6 *months:*——for the *Dividend:* 6 x 6 x 397, 779 = 14320044——for the *Divisor:* 6 x 6 + 100 x.12 = 1236.——Then, 14320044 ÷ 1236 = 11, 585 that is £ 11 11 8 2.

c For the *Present-worth:* 5,878 (the 3 month's-rebate) + 11,585 (the 6 month's rebate) = 17,463 (the whole discount) which, deducted from 795,558 (the whole sum) leaves 777,095 (that is £ 777 1 10 3) for prompt payment.

R E D U C T I O N.

R'ED. By the númber of one name, that makes óne of another,
Upwards to Gréater DIVIDE: to Leſſer MÚLTIPLY *Downwards*.[a]
Different Námes to the léaſt of the lóweſt redúce, add, and value.[b]

To *Reduce*, or bring to a different denomination of equal value*,

1. *Upwards* (e.g.) 12014 farthings to pounds (a Greater name) Divide —— either by 960 (the number of farthings that make one pound) the quotient will be 12 (viz. pounds) the remainder, 494: which, multiplied into 20 (*s*, the number of the next inferior denomination that makes 1 pound) gives 9880. This, divided by 960 (the common diviſor throughout all the operation) gives = 10 *s*: the remainder 280. Then 280 x 12 (*d*, the number of the next denomination that makes 1 ſhilling) = 3360 ÷ 960 = 3 d: the remainder 480. Then 480 x 4 (*q*, the next name) = 1920 ÷ 960 = 2 q. So, the work will ſtand, as in the margin, n. I.——— or (proceeding by ſteps) divide by 4, to bring it to pence: that, by 12; to bring it to ſhillings: that, by 20 (or halving all but the laſt) to bring it to pounds. So the work will ſtand (moſt commodiouſly) as in the margin, n. II; in working of which, I ſay: 4 in 12: 3, which I ſet underneath (V. Diviſion, line 7). Then 4 in 0 (the next figure) 0 (to be ſet down). Then 4 in 1 (the next figure) 0 (to be ſet

(I)

12014	960
2414	12 l.
.49	
20†	
9880	10 s.
.28	
12†	
3360	3 d.
.480	
4†	
1920	2 q.

(II)

q.	12014*	— 2†
d.	3003	— 3
s.	250	— 10
l.	12	———

* Divided by 4 *q*, gives the quotient as underneath, &c.

† Remainders, plac'd againſt their proper denominations.

† NB. The *multiplicators* need not be ſet-down: nor the *diviſors*, within the compaſs of the multiplication-table. V. n. II.

down

down alſo. Then 4 in 14 [the next figure, with 1 (the preceding remainder) prefixt] 3, &c.———(NB) *In different denominations* the method is the ſame: Thus, The work, in the margin, may be wrought as follows: 3 in 11: 3, and 2 over; which being prefixt to the next figure (in the value of its place) will make 22. Then, 3 in 22: 7, and 1 over; which prefixt to the next figure (viz. 12 s) and reduc'd to the ſame name, will make 32 s. Then, 3 in 32: 10, and 2 over; which reduc'd to the next name (viz. pence) will be 24; and 7, added, makes 31. Then, 3 in 31: 10, and 1 over; which (in the next name) is 4 q; to which the 2 q, being added, will make 6. Then 3 in 6: 2. So that the work is finiſht. V. Practiſe, note [c].

	£ 112	12	7	2
3)	37	10	10	2

2. *Downwards* (e. g.) £ 12 10 3 2 to farthings (a Leſſer name) Multiply 12 *l* into 20 (the number of *s* in a *l*) taking in the 10 *s* (viz adding units to units; tens, to tens). Then, multiply the ſhillings into 12 (the number of pence in a ſhilling) to bring them to pence; adding the 3 *d:* and ſo on, to the loweſt denomination: The work will ſtand as in the margin. —— NB. *Remember always* to mark the denominations, as you advance; to prevent confuſion and miſtakes; which, without ſuch caution, will be apt to creep into the operation

l. . .	12	10	3 2
	20		
s.	250 . . +	10	
	12		
d.	3003 . . +		3
	4		
q.	12014 . . +		2

To divide the value of any ſpecies into different denominations, the number of which ſhall be equal; Reduce the denominations to the loweſt name, by which divide the ſpecies, reduc'd to the ſame name.——*Exa.* In a moidore, how many nobles, crowns, ſhillings, groats, 3-pences, 2-pences and pence; of each an equal number?——*Anſw.* 2 of each. For, 6 *s* 8 *d* (a noble) + 5 *s* (a crown) + 1 *s* + 4 *d* + 3 *d* + 2 *d* + 1 *d* = 162 *d.* Then 324 *d* (a moidore) ÷ 162 *d*, the (ſum of the particulars, in the loweſt name) = 2.

A Diagonal Circular INSTRUMENT, consisting of 7 concentrical circles (of mony, weights, and measures) beside the two outermost, which are lines of numbers; was contrivd, and publisht in 1721, by Mr Hatton, for reduction of mony, weights, and measures into decimals; or for finding (with ease and speed) the value of those fractions, and for multiplication, division, and evolution. ——But, as all instrumental arithmetic is of little use, except to those who are unacquainted with the doctrin of numbers; which is the business of this treatise: it may suffice just to have mentiond it. Those who have a mind to see an account of it, will find it in his system of arithmetic, p. 282.

Different names (e. g.) 4 guineas, 3 half-guineas, 2 nobles, 1 livre, To reduce to the value in English mony ——The least name of the lowest particular being pence, all the particulars are to be reduc'd to pence, as afore directed (note [a] 2). Then, being added-together, the sum total is to be valued, or reduc'd to the highest name of our mony, viz. pounds.——Thus

			s	d			d			
4 guineas	*gradually reduc'd*	will be	84	-	*that is, in the lowest name*		1008	*which being reduc'd (by n. * 1) give*		*as, here, underneath.*
3 half guineas			31	6			378			
2 nobles			13	4			160			
1 livre			1	6			18			
		s.	130	4	=	*d.*	1564	——	4	
						s.	130	——	10	
						l.	6	——		

RULE OF THREE.

RULE-OF-THRE'E[a] to perfórm; State, Prepare, Work, ánd Value . . quote, rest.[b]

Sta] *Quéstion*-term, LÁST, correspónds to the FÍRST: to the MÍDDLE, the *Answer*.

Pre] DÍFFERENT námes to the *Least* redúce; to the *Sáme*, CORRESPONDING.

Wor]

4 *Wor*] Láſt into Mi'ddle by Fírſt: the *Reverſe*: if Móre, leſs; or Leſs, more.
5 *Val*] QUÓTIENT redúce: the REMÁINDER's the nūm. of denóm. the diviſor.[c]
6 DÚPLICATE, by rátios of *Squares*[d]; and TRÍPLICATE, by rátios of *Cubes*[e], work:
7 SESQUIPLICA'TE, by the rátios of *ſquáres to cubes*; ánd vice verſa[f]:

a *NB*. Under this head of Proportion (in regard to the name of the rule*) I have given the doctrin of the *ſingle* rule; or the method of finding a 4th proportional to 3 numbers given †: the *double* rule (or the method of finding, by two ſtatings, a 6th proportional to 5 numbers given) is better explaind under the article Golden rule; in a manner, that I do not find any where elſe deliverd. V. Golden rule.

* *The Name* of the Rule-of-three imports but 3 terms in a queſtion propoſd to be ſolvd by it. But it may not be improper to caution the learner, that (NB) Queſtions, belonging to this rule, may be propoſd in ſuch manner as that— There ſhall be *a ſuperfluous term*; which, though it makes a circumſtance in the queſtion, yet is not concernd in the proportion; becauſe it is equally ſo in both the ſuppoſition, and demand. The ſuperfluous term is always known by being twice mentiond; either directly, or by ſome word that refers to it. For example: If 3 men ſpend 20 *l* in 10 days; how much, at that rate, will they ſpend in 25 days? Here the 3 men, though not directly mentiond a ſecond time, being referd-to by the term 'they', appears to be a ſuperfluous term; the proportion being among the other 3 given terms, with the number ſought: ſo that any number of men may be as well ſuppoſd, as three.—— Sometimes there are *two ſuperfluous terms*; as in the following example. When wheat is at 12 *s* per buſhel, the 6-penny loaf of bread is (by ſtatute) to weigh 1 *lb* 4 *oz* (troy-weight). What ought it, then, to weigh, when wheat is at 9 *s* 6 *d* the buſhel? Here are, plainly, two ſuperfluous terms; to-wit, 1 buſhel, and 6-pence. Theſe, therefore, being caſt-out, the ſtating will be as follows: As 12 *s* to 1 *lb* 4 *oz*: So 9 *s* 6 *d* to 16 *oz* 14$\frac{2}{57}$ *dw*.

A Caution is neceſſary to be here given; leſt the learner be deceivd, and take thoſe things to be proportional, which are not ſo. E G —— Suppoſe a weight, moving by its own gravity, deſcends 20 feet in 2 ſeconds of time; and it be requird to find how many feet it will fall in 10 ſeconds? The ſtating will ſtand thus: 2 : 20 :: 10 : and 100 would be the anſwer But, this number does by no means anſwer the queſtion: becauſe a falling weight does not proceed with an equable motion, but with an accelerated one; its motion being ſo much the ſwifter, by how much the longer it is in motion.——Again, If a veſſel, that will hold (ſuppoſe) 12 gallons, be filld with water, and a hole be made at the bottom; and, through it, there runs-out 3 gallons in 2 minutes of time; and it be demanded in what time all the water will run-out. According to the tenor of the rule of three, it will be anſwer'd in 8 minutes. And, indeed, this would be the true anſwer, ſhould the water continue to run-out with the ſame velocity, with which it began to run. But it is quite otherwiſe: for the celerity of the water runing-out continually decreaſes: and, by how much the leſs remains of water to run-out, by ſo much the ſlower it runs-out; that is, It runs-out with a greater velocity when it is near full (for inſtance) than it does, when it is but half-full: becauſe the inferior water runing out, is (in the former caſe) preſt by a greater weight of the ſuperior water, than it is in the latter.

This is the *whole work* of this excellent rule in miniature: and a little attention hereto (as explaind in the 4 following verſes) will enable a learner to diſembroil the perplexity of the moſt complex queſtions——*More particular directions*, for the application of this rule, in all the variety of circumſtances where proportions ariſe, *it is*, as Mr Malcolm (arithm. p. 536) obſerves, *impoſſible to give.* For, Queſtions may be leſs, or more complex; comprehending various queſtions of proportion connected in their circumſtances; either to bring-out ſeveral numbers requird, or as ſo many neceſſary ſteps towards the finding of one number requird: and, beſides the proportions containd in a queſtion, there may be other operations of addition and ſubtraction, ſimple multiplication or diviſion, neceſſary either to make-out the terms of a proportion; or, after the proportions are ſolvd, to find-out ſome numbers ſought:

or

or a number to be further applied towards finding numbers sought: in short, to satisfy some condition of the question in the progress of the work. The managing of such questions depends upon the arithmetician's judgment in distinguishing all the parts of the question; and knowing what each requires according to the true sense and import of it; and of the several operations of arithmetic, and particularly of proportion: of all which he must have a clear and ready idea. And, as there is no other general direction, that can reach all cases; the only thing more, that can be done to help one to acquire the necessary capacity for all useful questions, is to make the application particularly to such variety, in all the common subjects and branches of business; that he, who understands these, may be supposd capable to do any other of the same, or any other useful kind. To this purpose are all the other common rules that are generally brought-in after the rule of three; and are but applications of it: a full account of which is to be found under the proper heads. And I have added (in the latter part) for exercising herein (with a hint, where necessary, for the solution of them) a list of complex questions, which come not so well under any of those titles, that generally make-up the subsequent part of the system, in common arithmetics.——*In case of Fractions*, you reduce the extremes to one denominator; and, that being neglected, you work by the numerators only: since that denominator would be a multiplier both in the numerator and denominator of the quote, as it comes out first in fractional form: and therefore, both being divided by it (or, which is the same, neglect it in the operation) the quote will still be the same. So, to multiply by $\frac{5}{8}$, and divide the product by $\frac{3}{8}$, is the same as multiplying by 5, and dividing by 3. And, thus, with regard to the rule of three (1) If $\frac{3}{8}$ of a yard cost 8*s* what will $\frac{5}{8}$ of a yard cost? The answer will be the same as in this stating 3 : 8 : : 5. (2) If 4 $\frac{3}{5}$ ounces cost 14*s*; what will be the price of 9 *lb*, or 2304*oz*. For answer, The first reducd is $\frac{23}{5}$, and you may turn either 14 or 2304 into the form of a fraction, whose denominator is 5; and then work with the numerator only: and so it will be either 23 : 70 : : 2304; or 23 : 14 : : 11520. The answer is 7012 $\frac{4}{23}$.

C *To Exemplify:* What will the carriage of cw 17 3 11 come-to, at the rate of 7*s* 6 *d* per cw?——*Answ.* Here, as in all other queſtions in this rule, there are 3 terms: one of which an inquiry is made-about, on the proportion ſpecified by the other two: Then,

I. *To State:* Place —— cw 17 3 11 (the term, which moves the queſtion; or, about which the inquiry is made) Laſt —— cw 1 (the term, which correſponds to it, as being of the ſame name, or nature) Firſt —— *s* 7 6 (the other term) in the Middle [1]. This done,

II. *To Prepare:* Reduce —— the Different names of the Middle term (viz. 7*s* 6*d*) to the *leaſt*: And thoſe of —— the Correſponding terms (viz. cw 1, and cw 17 3 11) to the *ſame*: viz. by reducing the greater to the leſſer; that is cw 1 to 112 *lb*; that being the leaſt name of the other term, when reduc'd[2]. Then,

III. *To Operate:* —— In *direct* proportion[3] (1) Multiplie 1999 (the laſt term) into 90 (the middle term) And (2) Divide the product (viz. 179910) by 112 (the firſt term)[4] ...The Quotient (1606) will be the Anſwer (viz. 1606 *d*; as correſponding to the middle term, which is *d*.)... The Remainder will be the numerator of the fraction of the anſwer; and the diviſor, the denominator (viz. $\frac{38}{112}$, or 38 parts of a penny divided into 112) —— In *reciprocal* proportion[5] (1) Multiply the firſt into the middle term; and (2) Divide by the laſt ... The Quotient and Remainder will be, as afore.

IV. *To Value* —— the Quotient; reduce the name to the higheſt denomination; as is taught in the article Reduction. To value —— the Remainder; bring it to the next Lower name, as is taught in the article Fractions.

So, the work —— will Stand thus: cw 1 : 7*s* 6*d* : : cw 17 3 11 —— to be Read thus (1) As 1 to 7 6: So 17 3 11 to &c. (2) Or (accommodated) thus: If the carriage of 1 *cw* coſt 7*s* 6*d*; What will that of *cw* 17 3 11 come-to?

So, the work will Stand thus: 112 *lb* : 90 *d* : : 1999 *lb*.

When More (for inſtance, weight, as in the caſe) requires More (for inſtance, mony-to-be-paid, as here): or, contrariwiſe, Leſs requires Leſs; the queſtion is ſaid to be in *direct* proportion, or the rule-of-three direct. In this caſe the rule for operation is as follows, n. III.

If the dividend be Leſs than the diviſor; reduce it to a lower denomination, that ſhall (at leaſt) be equal to the diviſor. —— *For example:* What are 5 yards of ribon worth;

worth; 63 ½ yards of which cost 5 *l*? Here 20 (*qrs*, the last term) × 5 (*l*, the middle term) = 100: which, being less than the first term reduc'd to quarters, to-wit 254, by which it should be divided; I bring the 5 *l* to *s*, to-wit 100; and, having multiplied it into 20 (the last term) I find it comes to 2000: which, being divided by 254, gives 7 *s* for the answer; with a remainder, to be valued according to the directions, n. IV.

5 When More requires Less; or Less, More: the question is said to be in *reciprocal* proportion, or the rule-of-three *inverse*; or, according to the ancients, the *backer* rule. In this case, the Reverse of the rule takes place——For example, If a penny-white-loaf ought to weigh 8 *oz*, troy-weight, when wheat is sold for 6 *s* the bushel: What should it weigh, when wheat is sold for 4 *s* the bushel? (In answer) The question being stated [6 *s* : 8 *oz* : : 4 *s*] it will appear (on consideration) that Less (viz. price of wheat) will require More (viz. weight of bread). The rule of operation, therefore, is the reverse of the other, viz. 'First into Middle by Last': which will show that the penny-white-loaf, when wheat is sold for 4 *s* the bushel, ought to weigh 12 *oz*.

d *For example:*——in Direct proportion (1) What is the area, or superficial content of a circle, whose diameter is 8; when the diameter of a circle being 2, the area is 3.1416, Answ. 50.2656. for, As 4 (the square of the diameter of the circle given) to 3. 1416 (the area): So is 64 (the square of the diameter of the circle sought) to 50.2656. (2) What is the diameter of a circle, whose area is 50.2656? supposing the diameter of a circle, whose area is 3.1416, be 2, as it really is. Answ. 8. for, as 3.1416 (the area of a circle) is to 4 (the square of that circle's diameter): So 50.2656 (the area of any other circle) to 64, the square of the diameter of that circle; the square root of which is 8.——in Reverse proportion (1) Suppose the length of the pendulum of our common clocks to be 39 inches, as it is very little more. We know that such clocks vibrate seconds, or 60 times in a minute. What, then, will be the length of a pendulum that vibrates half-seconds, or 120 times in a minute? Answ. 9 ¾ inches. for, As 3600 (the square of 60 vibrations) to 39 (inches of pendulum): So are 14400 (the square of 120 vibrations, which are More than 60*) to 9 ¾. (2) Supposing a pendu-

pendulum of 39 inches vibrates 60 times in a minute; How many times does that pendulum vibrate in a minute, whose length is 9 $\frac{3}{4}$ inches? Answ. 120. for, As 39 (inches) to 3600 (the square of 60 vibrations) So is 9 $\frac{3}{4}$ (inches; which are Fewer†) to 14400 vibrations; of which the square-root is 120.

And, therefore, require fewer inches of the pendulum: for, the longer the pendulum, the fewer the vibrations in a minute; † and the contrary.

For example —— in Weight (1) If a sphere, or ball, which is 8 inches diameter, weigh 48 *lb*; what will another sphere of the same species of matter weigh, whose diameter is 4 inches? Answ. 6 *lb*. for, As 512 (the cube of the diameter 8) is to 48 *lb*: So is 64 (the cube of the diameter 4) to 6 *lb*, the weight requird. (2) If a sphere, weighing 48 *lb*, be 8 inches in diameter; What is the diameter of another sphere of the same matter, whose weight is 6 *lb*? Answ. 4. for, As 48 *lb* is to 512 (the cube of the diameter 8): So is 6 *lb* to 64 (the cube of the diameter sought) whose root is 4.———in Solidity. (1) Suppose the solid content of a sphere be 4.1888, whose diameter is 2: What is the solidity of another sphere, whose diameter is 4? Answ. 33.5104. for, As 8 (the cube of the diameter 2) to 4.1888 (the solidity of the sphere given): So is 64 (the cube of the diameter 4) to 33.5104, the solid content of the sphere sought. (2) The diameter of a sphere being 2, whose solidity is 4.1888, what is the diameter of another sphere, whose solidity is 33.5104? Answ. 4, the cube-root of 64. for, as 4.1888 : 8 :: 33.5104 : 64.

For example: The earth finishes its period in 365 $\frac{1}{4}$ days; and its distance from the sun is 86,000,000 miles. What, then, is the distance of mars from the sun, supposing its period to be 625 days? Answ. 130.000,000 miles. for, As the square of the time, in which any planet finishes its periodical revolution, is to the cube of its distance from the sun: So is the square of any other planet's time, to the cube of its distance.

SUB-

SUBTRACTION.

1 SUB. (1) Place the -tractor únder -trahénd, as in adding (2) Then take
2 'Units from únits, and so on (3) Write the Dífference, the Réſt or Remainder[a].
3 *Nóte* (I) When from Léſs: take from óne of the néxt in that náme; add the leſs; pay[b]:
4 And (II) When from Séveral, óne; or Revérſe: make them óne by addition[c].

a *For the Manner of operation*, having plac'd the ſubtrahend and ſubtractor,* as in the margin (according to the inſtructions given under the article Addition)——— The *common* way is this: Begining at the right hand, or units; Say, 2 from 6, and there remains 4. Then, 3 from 5, &c.———More *commodiouſly*, addition-wiſe, thus: 2 and (and as much as will make 6, viz.) 4 (which ſet down as you pronounce it) is 6. Then, 3 and 2 is 5 &c.

Subtrahend . . .	4 2 5 6
Subtractor . . .	2 1 3 2
Remainder . . .	2 1 2 4

* Thus, in ſubmiſſion to Mr Malcolm's authority, and by way of alluſion to the terms of dividend and diviſor; I am content to call the factors of this operation: though, in propriety, the Subtrahend is the number to be ſubtracted; and that, from which it is to be ſubtracted, ſhould be calld the Compound number; as being compoſd of the leſſer number, and the difference———Some, with more propriety, call them the *minorand*, and the *ſubducend*.

For

b *For example:* To operate the examples in the margin:
In the I*ſt*—Say: 2 from 1, I cannot: but 2 from (one of the next row, in the name of this, viz. units; that is, from) 10: there remains 8; and 1 (the leſs number) is 9. Then (going-on to the next ſtep, ſay) 1 (that I borrow'd) and 4 is 5: 5 from 2 I cannot; but &c. as afore —— Or rather (addition-wiſe) ſay: 2 and (as much as will make the amount to the next row, viz. 10, with the 1 added, viz. 11) 9 (ſeting it down, as you pronounce it) is 11. Then 11, being the laſt found, admoniſhes what is to be paid in proceeding. So, looking on 4 (the next ſtep) ſay (paying the 1, you carry) 5, and (ſo much as will make 10 and 2, that is 12; viz.) 7, is 12. Then 7 and 7 is 14; &c. *NB.* This method is vaſtly advantageous in the operating of diviſion. V. Diviſion.

I	From ..	12365421			
	Take ...	3578642			
	Reſts ...	8786779			
II	S^d. 12 *l.*	5 *s.*	6 *d.*	2 *q.*	
	S^r. 6	3	7	3	
	R^r. 6	2	3	3	

In the II*d* ——— Say: 3 *q* from 2 *q*, I cannot: but 3 *q* from (1 of the next row, viz. 1 *d*, that is) 4 *q*; and there remains 1 *q*; and 2 *q* (viz. the leſs, from which 3 could not be ſubtracted without borrowing) is 3 *q*; which ſet-down; and, proceeding to the next row, ſay 1 (that I borrowd) and 6 is 7: 7 from (1 of the next row, viz. 1 *s*; that is) 12 *d*; there remains 5, and 6 is 11. And ſo on. (*NB*) 'I cannot' 'and there remains' &c. after ſome practiſe, may be omited; as rather embaraſſing, than expediting or explaining the operation. Thus, the laſt explication will run thus: $3 - 4 = 1 + 2 = 3$. Then $7 - 12 = 5 + 6 = 11$. And ſo on.——The other method (addition-wiſe) is not, here, ſo commodious.

c *For example:* Let it be propoſd to ſubtract 560 from 467 + 235; or 345 + 432 from 978: the work of the former will ſtand, as in the margin, n. I; of the latter, as in n. II. ——— And the ſame is to be done,

I		467	II	Sub^d.	978
		235			
					345
	Sub^d.	702			432
	Sub^r.	560		Sub^r.	777
	Rem^r.	142		Rem^r.	201

when

when two or more severals are to be subtracted from two or more severals.

TABLES* OF COINS, MEASURES, WEIGHTS:

I. British.

1 *How many This make That*: From thís to that múltiply the numbers[a].

2 *Míxt numbers* Bríng to the Léast name: To válue 'em, Dĭvíde by the same name[b].

Coins & Mony.

3 Farthing - o . pén - be . shil - ez . *Pound* . .

Measures.

4 Ale, Beer:[c] gal-k, re (beer-ou: ale-k) fir-d. kil-d. bár-a,re . ho-d . *Butt*.

5 Ci'rcular: mínutes (with múltiples[d]) -auz. deg-ïy . sign-ad . *Circ*.

6 Cloth: inch-d,ró . nail-o . Quar-Yard = *Ells*: eng-ú . flem-i . french-au.

7 Dry': gal-e . péck-o . bush-e . strike-e . coomb-é . quar-u . wey-d . *Last*.

8 Liquid: gíll-o . mutch-é . chop-e . pint-e . quárt-o . gal-as . *Hog*.[e]—V. Ale, Wine.

9 Lóng: line-be . ínch-be . foot-i . yar-d . fáth-e,tro . r-óz . fur-ei . m-i . *League*.

10 Númb:[f] dicker-az . kip-üy . quire-el . ream-úg . timber-öy.

11 Quántity:[g] *Róll* = dozen-u Skins . . élls-bazy M, 'Oz . . hun-ro . Barb-tob.

N Squáre

SQUÁRE : in-aso . foo-n . yár-ty,ro . p-oz . rood-ó . acre-soz . *Mile.*

TÍMBER : inch-boídei . foot-ép . *Yard* . . Foot-óz round, foot-úl hewn. : a *Load*, *Tun.*

TÍME : second-áuz . minute-auz . hour-ef. day-tául, u, fei, up[h] . *Year.*

WÍNE : gal-ak . rún-a,tro . b-á,rt . ti-b,re . hog-a,rt . púnch-b,re . pipe-e . *Tun.*

Gallons[i] = bár-ta,re. tierce-od . hóg-si . pun-eíf . pipe-adau . T-eld.

WEIGHTS.

A'VERDUPOIS [a]: dram-as . ounce-as . pound-ábe . hun-ez . *Tun.*

TROY . . *Gold:* [b] grain-ef . pénw-ez . Ounce . . *Pot* : gr-ez . scr-i . dr-ei . oun-ad . *Pound.*

Wool : pound-oí . clove-e . stóne-e . tod-au, re . wey'-e . sack-ad . *Last.*

Mint-monyers : blank-éf . periot-ez . droíte-do . mite-ez. *Grain.*

Proportions & Distinctions.

FOOT : *British*, áth . *Greek* azyp . *Rome* (coss) naup (st) oúpe (ves) oukau.

Par, azáuk . *Rhin*, azít . *Venice*, abse [k]. *Ams*, nod . *Cópenhag*, nául.

GÁLLON *cube-ínches* contaíns . . *Dry* : esei, fru . . *Beer* : éke . . *Wine* : eta[l].

GRAINS . . *English*-bif, re make . . *French*-alei . . *Dutch*-apou.

OÚNCE *Aver* Lighter than *tróy* (near a 12th) as úa to uau, 26 Pound *Aver* Heavier than *troy* (near a 6th) as áoi to ao . . . Equal, in troy-weight, to ounce-so, pén-ba, grain-al,re [m].

29 Stone = *Pounds*: Beéf-k (heref-ad, pemb-ak, north-ás) Glass-u . Wax-ei . . . Wool: her-be, gloce-bu . Spice cin nu pép sugar-at, re. The *rest* af [n].

Observations on sundry Particulars*.

A Abbreviatures: Barrel. Bushel. Carat. Chopin. Circle. Degree. Dram. Fathom. Firkin. Foot. Furlong. Gallon. Grain. Hogs-head. Hundred-weight. Inch. Kilderkin. Line. Mile. Mutchkin. Ounce. Penny. Penny-weight. Perch. Punchion. Quarter. Rod. Runlet. Scruple. Shilling. Tierce. Tun. Yard.

E Equivalents: Broad-piece, carolus, jacobus. Butt (of malmsey, sack, &c.) pipe. Carnock, Cornock, coomb. Digit, inch. Laureat, carolus. Lundress, silver-penny. Perch, rod. Pieces, guineas. Pole, rod. Prime, minute. Quintal, hundred-weight. Seam, quarter. Sterling, penny, penny-weight. Tertian, tierce. Tun, wey. Twelve-month, year.

O Omitted — *Coins*: Achison, .20 *q*. Angel 10 *s*. Angelet 4 *s*. Bawbee, .15 *q*. Bezant, 3 *l*. 15 *s*. Bodle, .05 *q*. Cardecue, 19.50 *d*. Carolus, 23 *s*. Cross-dagger, 11 *s*. Crown, 5 *s*. Florence, 6 *s*. Guinea, 21 *s*. Groat, 4 *d*. Harper, 9 *d*. Jacobus, 25 *s*. Maile, $\frac{1}{2}$ *q*. Mark 13 *s*. 4 *d*. Mony, 4 *s*. 6 *d*. Noble 6 *s*. 8 *d*. Plack, 10 *q*. Rial 10 *s*. Salute, 6.96 *s*. Sexling, 15 *s*. Sovereign, 22.50 *s*. Testoon, 18.84 *d*. Thryling, .07 *q*. Unicorn, 6 *s*. Unite, 22 *s*. Urchin, 12 *q*. — *Measures*: Barley-corn, $\frac{1}{3}$ of an inch. Cubit, $\frac{1}{2}$ a yard. Firlot, 31 pints. Fortnight, 2 weeks. Gill, $\frac{1}{4}$ of a pint. Hair's-breadth, $\frac{1}{48}$ of an inch. Hand, 4 inches. Month, 4 weeks, or $\frac{1}{12}$ of a year. Pace, 5 foot. Palm, 3 inches. Pottle, 2 quarts. Scruple, $\frac{1}{1080}$th of an hour. Span, 9 inches. Week, 7 days. — *Weights*: Clove, 8 *lb*. Pack, 120 pounds. Pig, 21$\frac{1}{2}$ stone. Prime, $\frac{1}{24}$ of a grain.

* The *ancient* coins, weights, and measures; and the proportion they bear to each other; may be learnt in my

Mnemonics: where, by getting a few lines, a child may treasure up (in his head) all the large tables of Dr. Arbuthnot. V. Pref. paragr. 6.

For example: How many farthings make a pound? —V. line, 3. (Answ.) $4 \times 12 = 48 \times 20 = 960$.

For example: How many gallons of wine in a barrel? —V. line, 15. (Answ.) $18 \times 1\frac{3}{4} = 31\frac{1}{2}$ (V. Fractions, l. 17) Or —— Bring $1\frac{3}{4}$ to the least name, viz. quarters, thus: 4×1 (the integer) $= 4 + 3$ (quarters) $= 7$ ——Then $18 \times 7 = 126$ —— Then $126 \div 4$ (the least name) $= 31\frac{2}{4}$ or $\frac{1}{2}$. V. note [1].

That is: $8\frac{1}{2}$ gallons [but (about London) 9 of beer, and 8 of ale] make a *firkin* . . 2 firkins make a *kilderkin* . . 2 kilderkins, a *barrel* . . . And so in the rest.

That is: The subdivisions of minutes are seconds, 60′; thirds, 60‴; &c.

In Scotland these are their common denominations of liquid measure —— But it is to be observd that (1) A scotch mutchkin is almost an english pint; and that (2) The excise in Scotland, since the union of the two nations, is calculated upon english measure.

Collective names of Numbers (for goods accounted by the *Tale*) are—Such as are us'd in General: as *Brace*, *Couple*, 2: *Dozen*, 12: *Gross*, 144 (i. e. 12 dozen) *Great-gross*, 1728 (i. e. 144×12): *Leash*, 3: *Score*, 20. —— Such as are us'd in speaking of Particular things: *Dicker*: of hides, knives, iron-bars, bundles of necklaces. *Kip*: of goat-skins. *Quire*, *Ream*: of paper. *Timber*: of skins of fitches, grays, genits, martens, minks, sables.

Collective names of Quantities are what frequently occur; and which to be quite ignorant-of is a little unsatisfactory—— I have, therefore, here, given a specimen of them; as being the proper head, under which they were to be considerd: and, but one*; because an alphabetical list of 'em in prose will be full as much as any one would wish-for. V. Quantities.

Roll = *Dozen*: 5, of Skins of parchment ——*Ells*: 1100, of Minsters and Ozenbrigs. ——*Quintals*: $\frac{1}{4}$, of barbadoes-Tobacco.

That is (taking the denominations backward) 365 days, 5 hours, 48 minutes, 57 seconds, &c.——NB. (1) In the royal Navy, the men are payd their wages by the following table: a Year = 13 months, or 52 weeks, or

364 days: a Month = 4 weeks, or 28 days. (2) For sums, where no great exactness is requir'd, they say: a Year = 12 months, or 365 days: a Month = 30 days. (3) But to be more exact, the Year should be reckond 365¼ days. V. Time, in note [o].

i Multiplication of fractions in *Wine-measure* being somewhat operose (V. note [b]) I have here given the contents of each in gallons; which, by an easy division, will give the contents of any, in any. For example: How-many tierce in a tun? Ans. 252 ÷ 42 = 6.

k *That is:* The British *foot* being divided into 1000 parts: those of the following places are, in proportion thereto, as in the rule: to-wit, the old Grecian foot 1007: the Roman, as found on the monument of Cossutius, on that of Statilius, and on a congius of Vespasian; as specified by the numeral letters ——— NB. Hereby, also, may be found the proportion of the english *inch* to those of the other places here mentiond, thus: As 1000 (the supposd parts of an english foot) to 1068 (for the french foot) So 12 (the number of inches in an english foot) to 12.816 (for the length of the french foot) i. e. 12 inches, and something more than ¾. And, consequently, there being 12 lines in an inch, the french inch is ¾ of a line longer than the english.

l These are the contents, according as they are now computed, and practisd in the art of gauging——But (1) The *Wine-gallon*, kept seald at Guildhall in London, according to act-of-parliament (11 H. 7. c. 4.) by which all wines, brandies, strong-waters, mead, perry, cider, vinegar, oil, and hony are measurd; was found, by a nice experiment (in 1688) to contain but 224 cubic-inches. However, for several reasons, it was, at that time, found convenient to continue the former supposd content of 231; and that all computations in gauging should be made from thence. V. Wybard, tectometr. p. 289. (2) The common receivd content of the *Corn-gallon* (before the year 1697; when the legal winchester-bushel was settled by an act of parliament, according to a standard in his majesty's exchequer) was 272¼ cubic-inches; in a mean (as it were) between the wine-, and beer-gallon. V. Ward, arithm. p. 36.

So Mr Ward (arithm. p. 33) tells us, he found it by very nice experiment. V. note °.

That is: A stone —— of Beef is 8 *lb.* [but in Herefordshire and parts adjacent, 12: in Pembrokeshire, &c. 8: in the Northern counties, 16] —— of Glass, 5 *lb.* &c. —— in Racing Hay, Iron, Shot, &c. 14 *lb.* (NB) What other differences there are, in this or other denominations, will be given, with more propriety, under the article Quantities.

Weights and Measures. The original of all weights, usd in England, is suppos'd to have been a corn of wheat, gatherd out of the middle of the ear, and well dried (V. Yard) 32 of which were to make 1 penny-weight; and 8 pound of them (or 61440 grains) were to fill 1 gallon of wine measure. V. 9 H 3. 51 H 3. 31 E 1. 12 H 7. ——And, by statute (14 E 3) there was to be but *one weight*, throughout this realm; viz. troy: by which are (now) weighd jewels, gold, silver, corn, bread, and all liquors; and by which the proportion of gravity, which any two bodies have to each other, is usually tried in philosophical experiments. Averdupois, therefore, seems to have been introduc'd and settled by custom, viz. from giving good weight to such commodities as are usually weighd by it; which are such as are either very coarse and drossy, or very subject to waste; as all kind of grocery-wares, and physical drugs; as also, baser metals, and minerals; and flesh, butter, cheese, soap, tallow, &c. to which it was thought convenient to allow a greater weight than what the law had provided. Mr Ward (introd. to mathem. p. 33) by a very nice experiment, found that one pound averdupois is equal to 14 *oz.* 11 *dw.* 15½ *gr.* troy. V. Proportion of weights, art. Tables, l. 27. —— By the same statute it was also orderd that there should be but *one liquid measure* throughout the kingdom. Yet custom has prevaild; and, there having been introduc'd a new weight (viz. the averdupois) we have, now, a second standard-gallon (viz. the winchester, for ale and beer) adjusted thereto; and therefore exceeding the former, in proportion of the averdupois to the troy-weight.

Bushel of *Salt*, † and

Sea-coal, is 5 ſtricken, or 4 heapt pecks. 11 H. 7.4 —— † Salt (formerly) uſd to be bought and ſold by meaſure, as corn now is. But it is (now) ſold, from the pits, only by weight; reckoning 7*lb* averdupois to a gallon; 56*lb*, to the buſhel; and 42 buſhels, to the tun; for freight: and 5 buſhels is one ſack; and 4 cw is 1 quarter.

Carat. By *jewellers* the ounce is divided into 152 parts, calld carats: which are divided into grains, or $\frac{1}{4}$ and $\frac{1}{8}$ $\frac{1}{16}$ $\frac{1}{32}$ $\frac{1}{64}$ &c. parts.——NB. (1) The *Carat*-Fine is the 24th part of the goodneſs of a piece of gold. (2) The *Carat*-Price is the 24th part of the value of a piece of gold: as, if the piece be 384, the carat-price is 16 pound. (3) The *Carat*-Weight is the 24th part of the weight of the piece, or 192 grains.

Corn-*Meaſure* (ſcotch) are Peck-o, Búſhel o, Bollas, Chaldron —— But they are different meaſures from the engliſh of the ſame name.

Cubic *Meaſure* is eaſily found from the ſquare, by multiplying the ſquare into its root. Thus 144 (ſquare inches) × 12 (the root of 144) = 1728 ∴ 9 (ſquare feet) × 3 (the root of 9) = 27.

Firkin = *pounds*: 56, of butter: 60, of ſoap.

Foot (in the foreſt of Sherwood) is 18 inches.

Gallon —— of Ale and Beer ought to hold 10 *lb*, 3.426 *oz* of pure, or rain-water. —— of Wine, 8 *lb*, 1 *oz*, 11 *dr*.

Grains, uſd in weighing *diamonds*, are ſomewhat lighter than thoſe uſd in gold, &c.

Hogshead. The *diſtillers* weigh their veſſels, when full: and, for a hogſhead allow cw 4 2 22, caſk and liquor. —— Of virginia-*tobacco*, a hogſhead contains from 2 to 5 cw, and upward.

Noble. Half-nobles were calld *half-pennies* of gold: Quarter-nobles, *farthings* of gold.

Peck. The legal winchester peck, according to the ſtandard-buſhel in the exchequer, contains 2 gallons: But, beſide this, there are *local* pecks; containing, ſome more, ſome leſs. The ——Lancaſter peck is 6 gallons.

Penny-weight (ſcots) are grains-ep, drops-noid, oúnces-alule.

Pipe is computed to weigh about cw 9 2 17. V. Hogſhead.

Pound.

POUND. From Persia and Turkey (1) *raw silk* is sold by the averdupois pound: but the pound is accounted 24 ounces. (2) but *ferret*, *filosella*, *sleeve silk*, *&c.* by the common pound of 16 *oz.* —— To Reduce (1) *Great pounds* to Common; multiply by 3, and divide by 2. (2) *Common pounds* to Great; multiply by 2, and divide by 3.

RIAL = Shill. Hen-s, az†. Hen-k, baro El, al. Jáme-b, spur-al, rose-iz —— † i. e. The rial (in Henry, the 6th's reign) was 10 *s.*

ROD. By the custom of several counties, there is a difference in this measure —— in *Herefordshire*, a Perch (1) of Denshird ground is 12 foot (2) of Ditching, 21 —— the *Scotch* perch is $18\frac{3}{4}$ —— in the forest of *Sherwood*, 25 —— in *Staffordshire*, 24.

RUNLET of *wine* and *oil* (by 1 R. 3. c. 13) was to hold $18\frac{1}{2}$ gallons.

TIME —— In Astronomical calculations, Days ought to be made the greatest denomination: and then any number of days may be again reduc'd to years, by dividing them by 365 days, 5 hours, 48 minutes, 57 seconds —— In Compound interest, it is best to make 365 days = 1 year; and use ... denomination between year and day —— On Common occasions, months and weeks make a convenient division of time; though they cannot conveniently be mixt in accounts. V. note [b].

TUN is reckond to weigh about 1890 *lb* averd. 2016 *lb* troy. V. Hogshead. —— In *oil*, by the custom of London, 236 gallons (calld, by merchants, the civil-gauge) is ordinarily sold for a tun: except whale-oil (or oil from Greenland) which has 252 gallons to the tun.

WOOL is commonly bought by the *tod*: but when it is stapled, or sorted; it is sold by the *pack*.

YARD. It is highly probable, that the various measures of lengths were (at first) deduc'd, by the dictates of nature, from the different dimensions of the parts of the human body, whose names they still retain. Thus, from thence were taken the digit or finger's breadth; a hand; a span; a foot; a pace; and several others. But, because the dimension of the human body is various and uncertain; and the proportion (in measures) must necessarily be fixt and certain: hence every nation has pitcht upon some settled and determind extension, to use in their measures of lengths. Upon this consideration our english

english laws have determind the extent of the measure; which is kept (for a standard-one) in Guildhall in London, calld the yard standard. And, to this, all the other english measures of lengths ought to observe their prescribd proportions. Thus, An english foot is a third part of the measure just mentiond. Thus, also, an inch is the 36th part of the same. Therefore, those, who deduce the dimension of an english inch from three grains of barley, are not altogether right: since our inch has not any respect (at least any immediate one) to those grains (or any other) but to the forementiond standard-measure.

2. Foreign.

COINS and MONY*.

1. *Accounts are kept*

in DENMARK	*by*
Rixdollar = *q*	216
Hor	54
Schelling	2.25
FRANCE	
Livre	72
Sol	3.60
Denier	.30
GERMANY	
Florin	144
Kreuxer	2.40
Pfenin[a]	.30
Rixdollar	216
Kreuxer	2.24
Pfenin[b]	.28
Rixdollar	216
Marc-lub	72
Schelling	4.50
Pfenin[c]	.37
Dollar	216
Kreuxer[d]	2.40
Rixdollar	216
Groch	6
Pfenin[e]	.50
Rixdollar	216
Florin	120

* The reader will be pleasd to observe that —— In the *first* table, the monies are all exprest in the lowest denomination of ours: so that it will answer all the purposes of the largest tables (1) the difference of any two terms being found by subtraction (2) and how many of any make one of another, by division. —— In the *second* table (1) the Gold coins are exprest in shillings (3) the Silver, in pence: for the readier estimation of them in the head: (3) the Rest, in farthings, for the greater accuracy —— In *all* of them, the fractions are decimals; because they are full as easy to be conceivd as the vulgar, and more ready for calculation.

a In *Switzerland, and most of the chief cities.* b In *Basil, Francfort, Noremberg, Strasburg, &c.* c In *Berlin, Hamburg, &c.* d In *Augsburg, and Bolzamont.* e In *Leipsic, & Naumburg.*

Kreuzer	2
Hellert	25
IRELAND.	
Pound	720
Shilling	36
Penny	3
Farthing	.75
ITALY	
Ducat[f]	240
Gros di banco[g]	10
Florin	156
Soldi[h]	26
Livre	28.80
Sol	1.44
Denier[i]	.12
Crown	240.28
Julio	24.03
Grain	3.01
Quatrine[k]	.60
Ducat	240
Tarin	48
Grain[l]	2.40
Ounce	600
Tarin	20
Carlin	10
Grain	1
Piccoli[m] (fere)	.17
MUSCOVY	
Ducat	408
Ruble	204
Grif	20.40
Altin	6.12
NETHERLANDS	
Pundt	518.40
Schelling	25.92
Penning	2.16
Pundt	540
Schelling	27
Penning[n]	2.25
Florin	86.62
Stuyver	4.33
Penning[o]	2.16
POLAND	
Rixdollar	216
Groch	2.40
Pfenin	.12
PORTUGAL	
Milrea	360
Rea	.36
PRUSSIA	
Florin	72
Groch	2.40
Pfenin	.12
SCOTLAND	
Pound	80
Shilling	4
Penny	.33
SPAIN	
Real de vellon	13.6
Maravedi	.40
SWEDEN	
Rixdollar	216
Copper-dollar	36
Roustique	1.12
TURKEY	
Abouquel	49.50
Meidein	1.50
Aspre	.50
Purse	112*l* 10*s*
— *of Gold*	6750*l*

f In *Zurich*. g In *Candia*, *Venice*, *&c*. h In *Geneva*. i In *Bergamo*, *Bologna*, *Genoa*, *Mantua*, *Milan*, *Modena*, *Novi*, *Placentia*. k In *Ancona*, *Ferrara*, *Rome*. l In *Naples*. m In *Malta*, *and Sicily*. n In *Flanders*, *&c*. o In *Holland*, *&c*.

The

2. *Coins their Value.*

GOLD	
Albert = *s*	13
Caſtellano	6.16
Copec	1.75
Doblon	18.03
Ducatoon	39.17
Hongre	9.25
Imperial	11.25
Joannes (port)	36
Lewidor	20.32
Lis	10.50
Manca	7.50
Moidore	27
Piſtole	16.50
Ride	3.75
Rider	6.50
Rixgould	2
Sol	25
Zecchin	9.45
SILVER	
Abra = *d*	12.20
Batze	4.75
Blanc	2.55
Carline	6.25
Caroline	17.25
Chavelet	1.44
Chriſtine	13.50
Copec	1.25
Croutac	5.29
Danſch	18
Derlingue	14.25
Drittle	36
Ducatoon	56
Dutgen	5.62
Ebrew	48
Gluckſtadt	7.65
Hongre	30.62
Izelotte	33
Lis	18
Marc	6.75
Monaco	52
Obolus	26.67
Ort	10.80
Patagon	54
Petite Piece	3.60
Polpoltin	12.75
Poltin	25.50
Ponti	5.28
Real de plata	27.20
Rix-gould	13
Rix-marc	21.50
Rix-ort	27
Roup	4.75
Scheſdale	36
Shakee	3.50
Vintain	7.28
BILLON	
Blaze = *q.*	3.45
Cavalot	1.80
Pignatelle	.40
Ratze	3.45
Vintain	6
COPPER	
Albus	2.78
Alleuvre	.56
Bayoco	2.42
Blanca	.34
Blaphace	7.20
Brummer	3.60
Carolus	3
Cornado	.10
Dollar	36
Double	.60
Dreyer	.90
Liard	.90
Maille	.15
Marc	9
Muſkofske	1.25
Negenmaniken	60
Ochavo	.80
Oortje	1.20
Ore	3.37
Patac	.60
Pite	.08
Plappert	2.82
Polchen	1.20
Poluſke	2.50
Quarto	1.60
Rappen	.47
Stooter	4.19
Swaar	.60
Vintain	6
Vording	20.16
Whitten	3.36
TIN, &c.	
V. *Annotations, at the end of these* Tables.	

The following it may be convenient to know-by-heart, reduc'd to ſhillings & pence, *as follows:*

GOLD: Ducat (holl.) ou í . Lewidore : ez o . Moidore : ɛp .

Piſtole

Piſtole (ítal.) as au . John (pórtugal) ís . Zechin : ou au.

Silver : Crówn, Patagón, Piece-of-eight, Dollar, Rix-dollar : o au .

Crúſade : o ei,re . Dúcat : u o,re . Dúcatoon : o ei.

Flórin : a az,re . Lívre : a . Márc : e i . Réal : e i,ru .

3. *Countries their Coins.*

Denmark. *Silver :* Danſch, Ebrew, Gluckſtadt, Hor, Rix-mark, Rix-ort, Scheſdale.

France. *Gold :* Crown, Lewidore, Lis, Sol. *Silver :* Crown, Gros, Lis, Petite Piece, Teſton. *Billon :* Cavalot, Denier, Douzain, Sol. *Copper :* Blank, Carolus, Denier, Double, Liard, Maille, Patac, Pite.

Germany. *Gold :* Ducat, Florin, Obolus, Rixgould. *Silver :* Florin, Hongre, Izelotte, Rixdollar. — *Billon :* Blaze, Ratze. *Copper :* Albus, Kreuxer, Pfenin, Plappert, Sexling, Rappen, Swaar, Tryling. V. *Netherlands.*

Italy. *Gold :* Piſtole. *Silver :* Carline, Croiſate, Derlingue, Ducatoon, Florin, Julio, Philip, Scudi, Teſtoon, Zecchin. *Billon :* Cavale, Papirole, Pignatelle. .. *Copper :* Bayoco, Quatrine.

Muscovy. *Gold :* Copec. *Silver :* Copec. *Copper :* Muſkoſſke, Poluſke.

Netherlands. *Gold :* Albert, Crown, Ducat, Ducatoon, Florin, Imperial, Ride, Soverain. *Silver :* Florin, Gulden, Patagon, Philip, Schelling. *Billon :* Stuyver. *Copper :* Blanc, Duyt, Grooch, Penning, Stooter.

Poland. *Silver :* Abra, Groch, Ort, Roup.

Portugal. *Gold :* Joannes, Milrea, Moidore, Three-pound-twelvers. *Silver :* Cruzada, Pataca, Vintain. *Billon :* Vintain. *Copper :* Rez, Vintain.

Spain. *Gold :* Caſtellan, Doblon, Piſtole. *Silver :* Dollar, Piaſtre, Real. *Copper :* Blanca, Cornado, Ochavo, Quarto, Real.

Sweden. *Silver :* Caroline, Cavaliere, Chriſtin, Marc. *Copper :* Alleuvre, Dollar, Farthing, Marc, Mony, Rouſtique, Whitten.

DIF-

DIFFERENCES

In the British and Foreign Coins.

	s	d	dec.
ANGEL			
1 Henry VI	6	8	
1 Henry VII	7	6	
34 Henry VIII & 6 Edw. VI	8		
ANGELET			
1 Henry VI	3	4	
CROWN			
British, 10 *James I*	5	6	
English. (V. *Thistle*)	5		
Florence	5	3	
France: *New*	4	10	.79
Old	4	6	
Genoa	6	6	.74
Milan	4	9	.08
Portugal	5	5	
Rome	5	3	.75
Thistle: 2 *Ja. I.*	4		
10 *Ja.* I.	4	4	.75
Venice	4	7	.50
of Cosmo III.	4	3	.73
DOLLAR			
Campen	2	7	
Dantzic	4	6	.29
Denmark: *Sletch*	6		
Embden	2	3	
Hamburgh	4	6	.78
Holland: *Leg*	4	4	.27
Lion	3	7	.72
Koningsburgh: *Bank*	1	—	—
Cross	—	9	.72
Spain: *Cross*	4	4	.75
Mexico	4	5	.79
Peru	4	5	
Pillar	4	5	.78
New Sevile	3	7	.80
Old Sevile	4	6	.15
Specie	2		
Sweden:			
Copper-plate	4	6	
Stuyver	2	2	.78
Thick	5		
Zeland	2	8	
DRITTLE			
Brandenb. & Lunenb. *New*	2	7	
Old	2	9	
DUCAT			
Gold. Arragon	6	6	
Barbary	9	4	.75
Hanover	9	2	.13
Hungary	6	4	
Poland	9	1	.55
Transylvania	8	11	.50
Silver. Naples	3	4	.44
Portugal	2	10	.33
Venice: *New, or Bank*	4	2	
Old, of Picoli, or Current	3	4	.50
DUCATOON			
Barcelona, Hamburgh	6		
Bergen	4	4	
Cadiz, Saragossa	5	6	
Cologn	5	5	.20
Flanders	5	6	.15
Holland	5	5	.59
Naples	5		
Valencia	5	3	
FLORIN			
Dry	5	4	

Geneva		6	.50
Genoa		8	.25
Liege	2	3	
Norimberg	6	1	
Savoy		11	
Sicily	2	6	
Strasburg	1	8	
Venice	1	9	.60
GROAT			
Basil			.88
Bremen			.50
Flemish			.56
French		1	.80
White		1	.75
GUILDER			
Basil	4	8	.98
Brandenburg: $\frac{1}{3}$	1	1	.90
Gout (*Holland*)	2	2	.26
Hanover: $\frac{2}{3}$	1	2	.70
Hildesheim	2	6	.21
Leopold	4	6	.28
Milan	2	3	.25
Norimberg	7	1	
Saxony: $\frac{2}{3}$	2	4	.12
Sigismund III.	4	6	.45
Thorn	4	5	.78
Uladislaus IV.	4	6	.48
Zell	2	3	.06
Zuric	4	4	.56
MARC			
Denmark: 4-*marc-piece*	2	8	.28
flat marc	1	6	—
Italy	2	10	—
Lub, or Lubec	1	8	—
Saxon	6	—	—
Scotch	1	1	.50
Sweden: 4-*marc piece*	2	6	.29
NOBLE			
England: *George*	9	9	.50
Ferling	1	8	—
Flanders	12	—	—

Maille	3	4	—
PATAGON			
Cologn	4	4	.53
Flanders	4	4	.91
Holland: *Leg*	4	4	.28
Liege	4	7	.48
PISTOLE.			
Italian, *Old*	16	7	.56
Spanish, *Old*	16	9	.30
RIAL			
Rose	30	—	—
Speer	15	—	—
RIXDOLLAR			
Basil	4	8	.24
Bavaria and Palatine	4	5	.78
Brandenburg, *Old*	4	7	.17
Cologn	4	4	.53
Dantzic, or Thorn	4	5	.85
Ferdinand, Duk of Austria	4	5	.78
Francfort	4	6	.53
Hamburg	4	6	.92
Hanover	4	7	.30
Leopold, and Ferdinand III.	4	6	.27
Liege	4	4	.20
Lubec	4	7	.54
Lunenburg	4	6	.65
Magdeburg	4	6	.27
Mentz	4	7	.27
Nuremberg	4	7	.55
Zurich	4	2	.65
SHILLING			
Lubeck	—	—	.37
Lucern	—	—	.57
Riga: *Black*	—	—	.05
Zercher, or Zurich	—	—	.75
SOVEREIGN			
England: 34 *H. VIII.*	20	—	—
2 *El.*	30	—	—
Great	33	—	—
Holland	2	3	—

TESTON

TESTOON.				UNITE.			
Portugal	—	9	—	10 James I.	22	—	—
Rome	1	6	.84				

DIVISIONS.

$\frac{1}{2}$ $\frac{1}{4}$ Angel. $\frac{1}{4}$ Angelet. $\frac{1}{2}$ Bayoco. $\frac{1}{2}$ (english) Crown. $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{12}$ $\frac{1}{16}$ (french) Crown. $\frac{1}{2}$ $\frac{1}{4}$ Dollar. $\frac{1}{2}$ Douzain. $\frac{1}{2}$ $\frac{1}{4}$ (gold) Ducatoon. $\frac{1}{2}$ $\frac{1}{4}$ Florence. $\frac{1}{2}$ $\frac{1}{4}$ Guinea. $\frac{1}{2}$ $\frac{1}{4}$ Lewidore. $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{10}$ $\frac{1}{12}$ Moidore. $\frac{1}{2}$ $\frac{1}{4}$ Noble. $\frac{1}{2}$ Ochavo. $\frac{1}{2}$ $\frac{1}{4}$ Pistole. $\frac{1}{2}$ Pite. $\frac{1}{2}$ Real. $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{12}$ $\frac{1}{24}$ $\frac{1}{48}$ Shilling. $\frac{1}{2}$ Soverain. $\frac{1}{2}$ Sterling. $\frac{1}{2}$ Testoon. $\frac{1}{2}$ $\frac{1}{4}$ Vintain.

MULTIPLES.

2 (i. e. *Double*) british Crown-piece (&c.) 2, 4, 6, 15, 30 Deniers. 2 Ducat. 1 $\frac{1}{4}$, 1 $\frac{1}{2}$, 2, 4, 8 (german) Groat. 2, 4 Lewidore. 2 Livre. 2, 2 $\frac{1}{2}$, 4 Moidore. 2 (elizabeth) Noble. 3, 4, 6, 8, 9 (german) Penning. 2, 4 Pistole. 2, 2 $\frac{1}{2}$, 4, 5, 10, 250, 400, 500 Rea. 2, 4, 6, 10, 20, 25 Sol. 2 Soverain. 10 Tarin. 2 $\frac{1}{2}$, 5, 12 Vintain.

SYNONYMS

Of Coins and Mony.

Alphonsi	*Maravedi*
Abras	*Brummer*
Aslani	*Abouquel*
Bolognies	*Bayoco*
Byzantine	*Bezant*
Cassa	*Rixdollar*
Castillian	*Castellano*
Cecchin	*Zecchin*
Cheffin, Chequin	*Zecchin*
Craca	*Grain*
Creux	*Kreuxer*
Croisate	*genoa-Crown*
Cruisade :	*spanish Crown, or Castillan*
Cruitser	*Kreuxer*
Cruzada	*portugal Ducat*
Cuento (in Annotat.)	*V. Maravedi*
Dalle, Daller	*Dollar*
Demi-Angel	$\frac{1}{2}$ *Angel*
Demi bayoco	$\frac{1}{2}$ *Bayoco*
Demi-Maille	*Pite*
Dieci Tarini	10 *Tarins*
Denain	*silver Copec*

 Denier

Denier gros	*Penning*
Doublon	*Doblon*
stuyver-Dollar:	*Swedish Rix-* [*dollar*
turkish-Dollar	*Abouquel*
Douzain	*Sol*
gold-Ducat	*Hongre*
Duyt	*flemish Penny*
Easterling	*Sterling*
Ecu, Escu	*Crown*
Escalin	*Shilling*
Fenin	*Penny*
Franc	*Livre*
Genouin	*genoa Crown*
George-noble	*Noble*
Gilder	*Florin*
Gludstadt	*Gluckstadt*
Gould	*german Florin*
Grievener, Grieve	*Grif*
Gr-os, -och, -osch	*Groat*
bohemia Gros	*Blaphace*
Guilder, Gulden	*Florin*
Harper	*irish Shilling*
Justine	*venice Ducatoon*
Justus judex	*Ebrew*
Kapeke	*Copec*
Laureat	*Carolus*
white Lewis	*french Crown*
Livre de gros	*dutch Pundt*
Louis-d'or	*Lewidor*
Lub	*Stuyver*
Lundress	*Sterling*
Malvedis	*Maravedis*
Manc-os, -usa	*Mark*
Marabitini	*Maravedi*
Mearc	*Marc*
Mite	*Farthing*
Moeda d'oro	*Moidore*
Niquet	*Double*
new Noble	*Rial*
Obole	*Maille*
Obolus (in Annotat.)	V. *Penny*
Octavo	*Ochavo*

Par-a, -asi, -at	*Meidein*
Pat-ar, -rd	*Stuyver*
Paullo	*Julio*
Penny	*Pfenin*
Peso	*spanish Dollar*
Peso d'oro	*Castellano*
Pezz-a, -o	*Dollar*
Pfenin	*Penny*
Philip	*Ride*
Philip of Milan	*Crown*
Piastre	*Dollar*
spanish Pistole	*Doblon*
Piece of 8 (reals)	*Dollar*
Pogeria, Poitevin	*Pite*
Pougeoise	*Pite*
Poy	*flemish Penny*
Pundt	*Pound*
Quadrans (in Annot.)	V. *Penny*
Quadrine, Quartrin	*Quartile*
double Quarto	*Ochavo*
Quento (in Annot.)	V. *Ma-* [*ravedi*
Quilo	*Julio*
Ree, Rez	*Rea*
Real	*Rial*
Real of 8	*Dollar*
double Rial	*Sovereign*
Riser	*half Purse*
Royal	*Riall*
Runstick	*Roustique*
Scalin, Schelling	*Shilling*
Sceptre	*Unite*
Scherif	*Zecchin*
Scudi	*Crown*
Seguin, Sequin	*Zecchin*
Sheckeen	*Zecchin*
Semipite	$\frac{1}{2}$ *Pite*
Seventeener	*german Florin*
Sixain	$\frac{1}{2}$ *Douzain*
Sol	*Bayoco*
Sol de gros	*dutch Schelling*
Sol-lub	*Schelling*
St. Stephen	*Millrea*

Sultanin

Sultanin	*Zecchin*	Tostao	*Teston*
Thaler	*Dollar*	Xerif	*Zecchin*

ANNOTATIONS
Upon the whole.

CASTELLANO—formerly, when it was standard, and weigh'd 90 grains, was worth 598 $\frac{2}{3}$ maravedis——Since the year 1652, it has been raisd to 739 maravedis.

CROWN (english) goes—at Amsterdam, for 58 stuyvers, or f 5 2 3 .04——at Rotterdam, for 58 $\frac{1}{2}$ stuyvers, or f 5 3 1 .20. V. Shilling.

DENIERS are only current in the Southern part of France, there being none of them to be seen on this side Poitiers.

DOUBLES (that is, 2 deniers) sometimes pass for *liards*.

FLORINS *of Gold* are (most of them) of a very coarse alloy; some of them not exceeding 13 or 14 carats; and none 17 $\frac{1}{2}$: they weigh about 2 dw. 13 gr.

In FRANCE, among traders, it is usual (to save the trouble of telling their mony) to put it into bags. These, in great dealings, they only weigh: and, if the receiver finds bad mony in the bag when he comes to open it, the payer makes it good: but, in case of a deficiency in the Sum, it must be challeng'd at the scale; otherwise it is not recoverable.

GOLD *Coins* (9 Jam. I) were raisd by proclamation, 2 s. in every 20 s.

GROAT. In the Saxon times we had no silver mony bigger than a penny; nor, after the conquest, till Edward III: who, about the year 1351, coin'd *grosses* (that is, groats, or great pieces) which went for 4 d. a piece. And so the matter stood till the reign of Henry VII; who, in 1504, first coin'd Shillings.

GUINEAS were *first coin'd* by K. Charles II (ann. 1663) on the footing of 20s: though they never went for so little. (V. Alloy). They have since advanc'd to 21s. 6d: and, in the reign of K. William, were current at 30s; people being willing to take them at any rate, rather than run the hazard of the silver-mony; which was then so exceedingly clipt, and counterfeited—— But, in 1696 (after the clipt mony was recoind) they came to settle at the price of 21s. 6d, and, at that rate, they continued to pass, till they were brought down to their present value of 21s. by the proclamation of dec. 22. 1717.

In ITALY, the current mony (calld *imperial*, and *piccoli*) is 20 per cent worse than bank-money (calld *di ova*).

LOUISD'ORS were first coin'd in 1640, under the reign of Louis XIII; and were valued at 10 livres; afterwards at 11, 12, 14. In the latter end of Louis XIV, they rose to 20; and in the beginning of Louis XV, to 30, 36, and even to 40, and upwards; with this difference however, that, in the last coinings the weight was augmented in some proportion to the price; which, in the former reign, was never regarded.——The new louid'or is now valued at 20s 3d 3q.

MARAVEDIS have been of *different Values* in different ages. (1) In 1401, a maravedi was the $\frac{1}{3}$ of a real. (2) Under Alonço XI, it was worth 17 times as much as now. (3) Under Henry II, and John I, 10 times the present value. (4) Under Henry III, 5 times. (5) Under John II, 2 $\frac{1}{2}$ of the present. Mariana.——Anciently, *in Castile*, they reckoned by maravedis, and quentos. A *cuento* (or quento) of maravedis was 1.000,000 of them. Vayrac.

MARK *Scotish*, in K. Henry VIII's time, was valued at 3s 4d.

PENNY *(Denarius)* in our ancient histories, is a term frequently usd to denote an Integer: of which the *obolus* was half; the *quadrans*, a fourth.

PESO——of 10 reals, at Madrid, is 41 $\frac{7}{8}$ d——of 6 livres, at Leghorn, is 50 $\frac{1}{4}$ d. ——of 7 livres, at Genoa, is 53 $\frac{1}{2}$ d.

PIASTRES, struck in *Mexico*, are something heavier than those struck in *Potosi*: But, in return, they are not quite so fine.

PURSE (without any addition) is to be understood of *silver*; those of *gold* being seldom usd, but for presents to favorites.

SHILLING (english) goes —in Holland, but for 10 $\frac{1}{2}$ (d 11 1 .36) or 11 stuyvers (d 11 3 .63). V. Crown.

In SICILY, *Malta*, &c. their money is made, the one of *silver*, the other of *copper* or brass; the latter being their current mony: and, in buying or selling of any commodities of value, it is always said whether of silver,

silver, or brass-mony; the former being counted 50 per cent better than the latter.

SOL——*of gold*, in the time of the salique law, was 40 deniers——*of billon*: was first struck on the foot of 12 deniers tournois; whence it was also calld douzain; though it went (afterwards) for 15; and, in 1709, was raisd to 18.

In SPAIN they have new and old money: The *old* (current in Andalusia, Cadiz, Seville, and some other places) is worth 25 per cent more than the *new*.

TESTONS were *first struck* under Louis XII, in 1513; their value 10 sols. Afterwards they rose from 15 sols, 6 den. to 19 sols 6 den.

TIN *Farthings*, and *Halfpennies* were coind by K. James II, in 1685; and, in 1689, about 1.000,000*l*, in half-crowns, shillings, and six-pences of old *Brass guns, and utensils of the most Refuse metals*; when he landed, with french forces, at Kingsale in Ireland, on the 12th of march; the greatest part of that kingdom (then) submitting to him. And, before he left Ireland, a proclamation was preparing for the currency of *Pewter*-mony, and even of *Lead*; of which were coin'd some pence, and half-pence.

MEASURES.[a]

i. APPLICATORY.

Arscheen, Brace, Cane, Cavado, Dersch, Ell, Pico, Ras, Shock, Toise, Vara, Veschcove, Yard. V. *Proportions of measures*, p.

ii. CUBIC.

a *The business of measures, the great* Mr Chambers *observes, has been so confusedly, and (withal) so imperfectly deliverd by our English writers, that his readers, he presumd, would not be displeasd with the pains he had taken to disembroil what was perplext, and to supply what was wanting—How-many* particulars *I have addrd to his account, and how-much more light I have derivd on the subject by the* disposition *of them; I leave to the observation of the curious: and only pray them (as, in the view, in which I have here presented the doctrin, it will be much easier than ever to see what is erroneous, or defective) to assist me with such hints as may occur to them, for the improvement of this article: which (after all) I am sensible is short of the perfection it is capable of.——* *NB.* The proportion *of the foreign measures* to those of Britain, *when not specified in the Notes, may be found under the head of proportions of measures, p.*

ii. Cubic.

1. Dry [b].

Almud 11. Alquie 8. Asnée 3. Bochel 6. Boisseau 3. Charge 3. Chetweric 7. Chetwert 7. Corbe 6. Emine 3. Fanega 11. Halfter 5. Hoedt 5. Killow 12. Last 4 5 9. Litron 3. Load 3. Mesurette 3. Mina 6. Mine 3. Minot 3. Moggio 6. Mouver 5. Moy 6. Mude 5. Muid 3. Muken 5. Picotin 3. Pipe 3. Quartier 3. Quartillo 11. Raiser 5. Rugio 6. Sac 3 5 6. Salma 11. Salmo 6. Scheppel 4 5 9. Setier 3. Staro 6. Stax 6. Tun 3 5 10. Viertel 2. Voye 3.

1. Denmark, V. Scandinavia.——Morea, V. Italy. Norway, V. Scandinavia.——Sicily, V. Italy.—— Sweden, V. Scandinavia.

2. Flanders: Viertel. V. Proportions.

3. France: [*Corn, &c.*] Quarte 2 Litron [c] 4 Picotin 4 Boisseau [d] 3 Minot [e] 2 Mine [f] 2 Setier [g] 12 Muid [h]. ——Differences (1) *Char-coal:* Litron 2 Picotin 4 Boisseau 8 Minot 2 Mine 16 [i] Muid. (2) *Lime:* Boisseau 3 Sac 36 Muid [k]. (3) *Oats:* Bushel = double that of any other grain. (4) *Plaster:* Boisseau 12 Sac 36 Muid.

(5)

b *The following alphabetical* indexes *of measures and weights are here given (for the readier recourse) with references, by figures, to the account given of them in the subsequent paragraphs; which are, therefore, distinguisht by numbers prefixt.*

c *By ordonnance, the* litron *is divided into 2 demi-litrons, and 4 quarter-litrons; and contains 36 cubic inches of Paris.*

d *By ordonnance, the Paris* bushel *is to be 8 inches, 2 lines, and a half high; and 10 inches broad (or, in diameter) within-side.—But it is different, in different jurisdictions. V. Oats.* (3)

e *By ordonnance, The* minot *is to be 11 inches 9 lines high; and 14 inches 8 lines in diameter.—It commonly weighs* 240 lb, *marc-weight.*

f *The* mine *is no real vessel; but an estimation of several others.*

g *A* setier *of good wheat weighs betwixt* 244 *and* 248 lb, *marc-weight.——In Berri the setier consists of 16 boisseaux.*

h *The* muid *of Paris is to weigh* 2640 lb: *that of Orleans* 600 lb.—*That of Berri is 21 boisseaux.—That of Rouen is 12 setiers, which makes 14 of Paris; and weighs* 3360 lb.——*And is divided into mines: but those mines only contain* $2\frac{1}{2}$ *paris-setiers.*

i *Instead of 16 mines to the* muid, *the city-measure gives 20.*

k Or 3 *boisseaux is* 1 *Minot; and 48 minots,* 1 *Muid.*

(5) *Salt* [l]: Mesurette 16 Litron [m] 16 Quartier 4 Minot [n] 4 Setier 10 Muid. (6) *Sea-coal:* Litron 4 Picotin 4 Boisseau 6 Minot 15 Voye. (7) *Wood:* Boisseau 8 Minot 2 Mine 20 Muid——VARIATIONS (1) *Asnée* (of Maçon = 1 $\frac{1}{3}$ setier. (2) *Emine* (of Castres) = $\frac{1}{2}$ a setier [o]. (3) *Load* of Tarschoon = lb 352. 80: of Arles, 360: of Beaucaire, 367. 20: of St. Gilles, 428. (4) *Pipe* (in Bretagne) = 10 charges, each of 4 boisseaux; and weighs 600 lb. (5) *Tun* [p] of Auray = lb 2200: of Brest, Port-louis, Quinpercorentin, 2240: of Audierne, 2300.

4. GERMANY: Scheppel [q] 90 Last.

5. HOLLAND: Scheppel 4 Mude 27 Last [r]——DIFFERENCES: *Oats:* Last (at Berg-op-zoom) 28. 25 viertels. (at Bruges) 14. 50 hoedts. (at Dixmuyde) 24 raisers. (at Ghent) 19 sacs, or 38 halsters. (at Gravelin) 18 raisers. (at Lisle) 30 raisers. (at Steenberge) 29 viertels. (at Tongres) 14 muids.——VARIATIONS: (1) *Halster* = [muid] $\frac{1}{8}$ in Louvain. [sac] $\frac{1}{2}$ at Ghent. (2) *Hoedt* = [mouvers] 8, in Bois-le-duc, Cleves, and Guelderland. [muids] 9 in Overyssel, Zwell. [raisers] 18, at Dunkirk. [sacs] 10. 50, at Utrecht. 10.66, at Delf, Rotterdam. [viertels] 13 at Amsterdam. (3) *Last* = [hoedts] 17.50, at Bruges. [mouvers] 20.50, at Bois-le-duc. 22, in Guelderland. [muids] 8, in Liege [s]. 15, at Tongres. 25, at Utrecht. 33, in Friesland. 36, at Deventer. 37, at Louvain. [raisers] 22.58, at Gravelin, St.

l Salt *is sold, all over France, by the muid; which is greater, or lesser, according to the custom of the provinces, where it is made, and where it is sold.—In Marenne in the isle of Rhé, and other places in France, where salt is made, they sell it by the* hundred; *which they divide into 28 muids, and every muid into 24 bushels: and the hundred commonly makes, in Amsterdam,* 11 $\frac{1}{2}$ *lasts, or 23 tuns.*

m *The* litron *for salt is larger than that for corn; and is divided into 2 halves, 4 quarters, and 16 mesurettes.*

n *The* minot *of salt commonly weighs* 240 lb, *marc-weight.*

o *The* setier *of Castres weighs about* 200 lb *weight of that place; which is about* 170 lb *marc-weight.*

p *The* tun *of Nantes consists of* 10 *setiers; the setier, of* 10 *bushels. The measure . . being heapt, it weighs between* 2200 *and* 2250 lb.. *when stricken, it weighs* 18 *or* 20, *per cent, less.*

q *Of the* scheppels *of Hamburg,* 83 *make about* 10 *quarters in London.*

r *The* last *commonly weighs* 4000lb *weight—At Amsterdam, and in North holland, a Last .. of Barley, commonly weighs between* 3200 *and* 3400 lb . . *of Rye:* 400 *and* 4200 . . *of Wheat:* 42000 *and* 4800.

s *Where they reckon* 12 *setier to a* muid, *and* 8 *muids to a last.*

St. Omers. 30.50, at Dixmuyde. 41, at Lisle. [sacs] 4 50, at Middleburg [t], in Zeeland. 25, at Brussels, Utrecht. 26, at Alcmaer. 28, at Tergou. 29, at Delf, Rotterdam, Schedam [u], and Ghent. 33, at Haerlem. 36, at Amsterdam, Montfort, Vianen, Yselstein [w]. 44 [x], at Enchuysen, Hoorn, Muyden, Naarden, Wesop. [scheppels] 33, at Thiel. 68, at Ruremond. 90, at Hamburg. [viertels] 28, at Mechlin. 33.50, at Breda, Steenberge. 34, at Berg-op-zoom. 37.50, at Amsterdam. 38, at Antwerp. (4) *Mouver* = 4 Scheppel. (5) *Muken* = $\frac{1}{4}$ of a viertel. (6) *Raiser* = [scheppels] 2, at St. Omers. (7) *Sac* [muid] $\frac{1}{6}$, at Ghent. [scheppels] 2, at Enchysen. 2.25, in Zeeland. 2.50, at Brill, Flushing, Zuricksee. 3, at Amsterdam. 8, at Leyden. [viertels] 32, at Antwerp.

6. ITALY: *Bologna:* Corbe [y]. *Florence:* Staro [z] 24 Moggio. *Genoa:* Mina 20 Tun [a]. *Leghorn:* Stax 3 Sac [b] 8 Moggio. *Morea:* Bochel [c]. *Rome:* Rugio [d]. *Sicily:* Salmo [e]. *Venice:* Staro [f].

7. MUSCOVY: Chetweric 8 Chetwert [g].

8. PORTUGAL: Alquie 60 Moy [h].

9. PRUSSIA: Scheppel 60 Last [i].

10. SCANDINAVIA: Tun [k].

11. SPAIN: *Biscany:* Fanega [l]. *Catalonia:* Quartillo [m] 4 Salma.

t *Where the* sac *is little more than* 2 *scheppels.*

u *The* last *of these places is* 2, *per cent, more than the last of Amsterdam.*

w *Where they reckon* 2 *sacs to a muid.*

x *Each* sac *containing* 2 *scheppels.*

y *Of the* corbes, 100 *make about* 92 *setiers of Paris.*

z *The* staro *weighs about* 50 lb. —*Salt is sold by the stare of* 72 lb.

a *The* tun *of Genoa is about* 40 *bushels of winchester measure.*

b *At Leghorn* 5 *sacs is accounted to make little less than* 10 *english bushels.*

c *Of the* bochels, 9 $\frac{2}{3}$ *make about* 8 *bushels winchester-measure.*

d *The* rugio *weighs about* 412lb; *and makes, in Florence,* 2 $\frac{1}{2}$ *staros.*

e *Of the* salmo, *they have* 2 *sorts; viz. a great one, and a small one; which is the common one: and is about* 7 $\frac{1}{6}$ *bushels, winchester-measure; and about* 17, *per cent, less than the great one.*

f *The* staro *of Venice is about* 1 *setier of Paris.*

g *The* chetwert *holds about* 5$\frac{3}{10}$ *bushels of winchester-measure.*

h *A* moy *contains about* 3 *english quarters.*

i *Of the Prussia* scheppels, 4 *make a muid; which is a stone of* 34 lb.

k *The* tun *of Denmark and Norway is about* 4 *London-bushels.*

l *Of the* fanegas *of Biscany and Valencia,* 5 *make an english quarter.*

m *The* quarter *of Catalonia is the same as the english quarter: and* 2 $\frac{1}{2}$ *of them is a cargo, or load, of* 360 lb *weight.*

4 Salma. *Granada:* Almude [n] 2 Fanega. *Valencia:* Fanega [o].

12. TURKEY: Killow [p].

2. *Liquid.*

Aem 1 3 4. Achtelin 3. Açumbre 9. Amphora 5. Anker 4. Arroba 9. Asnée 2. Barile 5. Barique 2. Bassee 5. Beson 3. Bigorza 5. Boccale 5. Botte 2. Brenta 5. Bussard 2. Cantar 9. Cavada 6. Chopine 2. Cogno 5. Demi-setier 2. Driolinck 3. Fat 7. Feoder 3 4. Feuillette 2. Fiasco 5. Heemer 3. Je 3. Kan 8. Lera 5. Levor 5. Loder 5. Massem 3. Mastilli 5. Mero 5. Meter 20. Millerole 2. Miserole 5. Mittidel 5. Mizaro 5. Muid 2. Mussie 4. Oke 10. Oxio 5. Pignatoli 5. Pinte 2 4. Pipe 1 2 9. Poinçon 2. Poisson 2. Pot 2 6 8. Quarta 5. Quartillo 9. Queuë 2. Reoder 3. Rubbia 5. Sachie 5. Salma 5. Scandale 2. Schreve 3. Sechys 5. Seiltin 3. Setier 2. Somar 9. Staio 5. Steckan 4. Stoop 1 4 7. Tomolo 5. Tun 2 4 5. Viertel 3 4. Urna 5. Yune 3.

1. FLANDERS: Stoop [q] 50 Aem [r] 3.04 Pipe.——DIFFERENCES: *Beer* is sold by the barrel of 52 stoops. The Stoop contains 7 pints: and the Aem is about 42 gallons wine-measure, in London.

2. FRANCE: Poisson [s] 2 Demisetier 2 Chopine [t] 2 Pinte [u] 2 Pot 4 Setier [w] 36 Muid [x] 3 Tonneau.——DIFFERENCES: *Brandy*

n *An* almude *is about* 1 ½ *english bushels: in weight* . . *by heap,* 144 lb . . *by strike,* 99 lb *english.*—NB. 100 facs *of Granada make* . . 3 *lasts* 10 *muids of Amsterdam* . . 64 *setiers of Paris* . . 128 *bushels of Bourdeaux.*

o *The* fanega *of Valencia makes about* 2 *english bushels.*

p *The* killow *weighs about* 20 *okes: and* 8 ⅔ *of them make about* 1 *english quarter.*

q *The* stoop, *they reckon, weighs* 6 lb *of their weight.*

r *Six* aems *make a tun of* 252 *gallons, winchester-measure.*

s *The* poisson *contains* 6 *cubic inches.*

t *The* chopine *of common water weighs* 1 lb *of Paris.*

u *The* pinte . . *of Paris is about the* 6*th part of the roman congius; and contains* 2 lb *of common water. That* . . *of St Denis is bigger—In several places it is called a* pot.

w *The* setier, *among gaugers, is an estimation of* 8 *pintes.*

x *The* muid—*at Bourdeaux, contains* 110 *pots with the lee, or* 100 *pots clear measure; the pot containing about* 2 *mingles of Amsterdam.*—*of Champaign* = 48 *setiers.*—*of Montpelier and several other places in Languedoc,* = 18 *setiers; the setier* 32 *pots, equal to* 35 *steckans of Amsterdam.*—*of Paris, according to an ordonnance of Henry IV,* 300 *pintes; according to the regulation of Louis XIII,* 280 *pintes.*

Brandy (at Montpelier, Tholouſe, &c.) is ſold by the quintal of 100 *lb* weight with the caſk——VARIATIONS: (1) *Aſnée* (at Lion) 80 pots. (2) *Barique* (at Bourdeaux) $\frac{1}{4}$th of a tonneau, or 3 paris-muids. (3) *Botte* (in the Southern provinces) a veſſel containing about a muid. (4) *Buſſard* (in Anjou and Poitou) half a pipe. (5) *Feuillette* (in Burgundy) 120 pintes (in Some provinces 1 $\frac{1}{2}$ a pinte.) (6) *Millerole* (in Provence) about 66 pintes of Paris. (7) *Pipe* [y] (in Anjou and Poitou) a muid and half of Paris, or 432 pintes. (8) *Poinçon* (at Paris) a demi-queue, or half a queue. (in Blaiſois and Touraine) half the orleans-tun, or 288 pintes. (at Rouën) 13 boiſſeaux. (9) *Queuë* (in Champagne, and at Orleans) 54 ſetiers. (10) *Scandale* (in Provence) 4 $\frac{1}{2}$ gallons wincheſter-meaſure. (11) *Tonneau* (at Bayonne and Bourdeaux) 3 paris muids, or 864 chopines. (at Berri, and Orleans) near 2 paris muids, or 576 chopines.

3. GERMANY: Maſſem 4 Viertel 20 Aem 6 Feoder [z] 2.50 Reoder——VARIATIONS.. *Augſburg:* Maſſem 8 Beſon 12 Je [a] 8 Feoder.. *Heidelberg:* Maſſem 4 Viertel 12 Aem 10 Feoder.. *Nuremberg:* Maſſem 64 Heemer 12 Feoder.. *Vienna:* Seiltin 4 Achtelin 32 Heemer 32 Feoder.. *Wirtemberg:* Máſſem 10 Yune 16 Aem 6 Feoder.— *NB.* (1) *Driolinck* (of Vienna) = 24 heemers. (2) *Schreve* (of Vienna) = 4 maſſems.

4. HOLLAND: Muſſie 4 Pint 2 Mingle 2 Stoop 8 Steckan 2 Anker 4 Aem 14 Feoder.——DIFFERENCES: (1) *Hony* (at Amſterdam) is ſold at ſo-many pounds flemiſh per tun; conſiſting of ſix aems.. or by ſo-many florins per barrel.. or by the hundred-weight. (2) *Oils* are ſold by the tun; which contains 6 aems, equal to 1600 paris pintes... Coarſe fiſh-oil they commonly keep in barrels, containing from 15 to 20 ſteckans.——VARIATIONS: (1) *Viertel*, or *Virge* [b]: 5 $\frac{1}{6}$ mingles.. that of Wine, 6 mingles.. that for Brandy, 6 $\frac{1}{4}$. (2) Tun, V. Differences: Hony, Oil.

5. ITALY:

y *The* pipe *goes by the name of* tun *in the provinces beyond the Loire.*

z *The* feoder *is ſuppoſ'd the load of a wagon with 2 horſes.*

a *The* je *is 12 beſons, or 3 muids.*

b *At Bruges they call the* virges *Seſtiers; reckoning* 16 *ſtoops to a ſeſtier.*—NB. *It is common to put French, Spaniſh, and Portugal wines into pipes, butts, and other* [illegible]*; ſome of which will contain, at Amſterdam, 60 to 90 virges. It is uſual, therefore, with the Hollanders, to reduce thoſe meaſures into butts by the following reckoning:* For one Butt, *Virges.. 27, at Cognac, Embden, Monguion, Rhé, Rochelle.. 29, at Nantes, and other places in Bretagne and Anjou.. 30, at Hamburgh, and Lubeck.. 32, at Amſterdam, and other places in Holland; and at Bourdeaux, and other places in Guienne.*

5. ITALY: *Calabria:* Pignatoli[c] 32 Staio 10 Salma. *Ferrara:* Sechys 8 Maſtilli. *Florence, & Leghorn:* Mittidel 2 Fiaſco 20 Barile 10 Cogno. *Genoa:* Barile 2 Miſerole 5 Botte[d]. *Iſtria:* Sechys 6 Urna. *Morea:* Lodere. *Rome:* Boccale[e] 7.50 Rubbia 13.50 Brenta. *Venice:* Lera 4 Sachie 4 Quart 4 Bigorza 4 Amphora[ee]. *Verona:* Baſſee 16 Brenta.—— DIFFERENCES: (1) *Corn* (at Venice) is ſold by the ſtaio; and is, in quantity, about 1 ſetier of Paris. (2) *Oil* (at Genoa) Barile 14 Tun[f]. (at Leghorn) Mittidel 32 Oxio. (in Morea) Levor[g] 10 Barile. (at Naples) Tomolo 16 Salma[h]. (at Venice) Mero[i] 40 Mizaro.

6. PORTUGAL: Cavada 12 Almuda[k].——VARIATIONS: *Pots* are alſo uſd, holding . . ſome $\frac{1}{2}$ a gallon . . others $\frac{1}{4}$ of a gallon.

7. PRUSSIA: Stoop 180 Fat[l].

8. SCANDINAVIA: Pot 4 Kan[m].

9. SPAIN: Quartillo 4 Açumbre[n] 8 Arroba[o]. *Andaluſia:* Quartillo 4 Somar 8 Arroba. *Valencia:* Cantar[p]. ——DIFFERENCES: *Oil*[q]: Pipe 40.50 Arroba.

10. TURKEY: Oke 8 Meter[r].

WEIGHTS[s].

Ace 4. Arrata 7. Arroba 5, 7, 10. Baleman 11. Barquit 6. Cantar 5, 11. Carat 2, 4. Cargo 10. Caſtillan

c *The* pignatoli *is equal to the french* pinte.

d *The* botte *is about* 100 *pints—The Venetian botte is divided into muſtaches; 76 whereof make the amphora.*

e *The* boccale *contains ſomewhat more than a paris pinte.*

ee *By wholeſale, the* amphora *is* 14 *quarts; and the* bigorza, 3 $\frac{1}{2}$ *quarts.*

f *The* tun *of Genoa makes* 236 *London-gallons.*

g *The* levor *weighs* 7 $\frac{1}{2}$ lb: 10 *whereof fill a candia-barile; which ſhould hold* 15 *engliſh* gallons, *and weigh* 112 $\frac{1}{2}$ lb *averdupois.*

h 5 $\frac{1}{2}$ ſalmas *are accounted to a tun of* 236 *gallons of oil in London.*

i *The* mero *is about* 3 $\frac{1}{2}$ *pints by meaſure: but, by weight, it is more.*

k *The* almuda *holds* 4 $\frac{1}{2}$ *gallons wincheſter meaſure.*

l *The* fat *is about* 80 *ſtoops antwerp-meaſure.*

m *The* kan *holds near* 1 *gallon wincheſter-meaſure.*

n *An* açumbre *is about* 3 *pints engliſh.*

o 81 arrobas *in Andaluſia, make* 252 *gallons engliſh . . but, upon the Seville-gauge,* 236.

p *The* cantar *holds about* 2 *gallons wincheſter-meaſure.*

q *The meaſure for* oil *is the arroba of* 25 lb. *Hayes, negotiator's magazine, p.* 350.

r *The* meter *is about* 2 *thirds of a wincheſter-gallon.*

s *In moſt parts of Europe the weights for coarſer commodities are* different *from thoſe, with which they weigh gold, ſilver, jewels, &c.*

Milan 10. Centner 3, 8, 9. Denier 5. Dram 2, 4, 5, 7, 10, 11. Engel 4. Grain 1, 2, 4, 5, 10, 11. Gros 4, 5. Killet 11. Last 8, 9. Lispound 3, 4, 8, 9. Livre 2. Load 4. Loodt 3, 4. Marc 2, 4, 5, 10. Medical 11. Millier 2. Numile 3. Obolo 5. Ochavo 7. Octave 5. Oke 5, 11. Ounce 1, 2, 3, 5, 7, 10, 11. Penny-weight 1. Pood 6. Pound 1, 3, 4, 5, 7, 8. Primi 5. Quarta 5. Quint 3. Quintal 1, 2, 5, 7, 10. Quirat 11. Rota 11. Rotello 5. Rugio 5. Saliqua 5. Schippound 3, 4, 8, 9. Sestertia 3. Scruple 2, 5. Shock 8. Stone 3, 4, 8. Tomine 10. Tun 3. Vicomté 2. Wage 4. Zollotnic 6.

1. Flanders: Ounce 16 Pound 100 Quintal.—Troy: Grain 32 Penny-weight 20 Ounce 8 Pound [t].

2. France: Livre 100 Quintal [u] 10 Millier.—Troy [w]: Karat 24 Grain 24 Scrupule 3 Drachme 8 Once [x] 8 Marc 2 Livre [y].—— Differences ... *At Calais* they have three sorts of weights: (1) The first is the *town-weight*; 100 lb of

These latter I shall take-notice of under the title of troy-weight.— In the mean time it must be observd that there are in some places, still further distinctions of weights: Thus . . at Genoa *they have* 5 *kinds of weights:* (1) *Large weights, by which all merchandizes are weighd at the custom-house* (2) *Cash-weights, for piastres, and other species.* (3) *The Cantara or quintal, for the coarsest commodities.* (4) *The Large balance, for raw silks;* and (5) *The Small balance, for finer commodities.*

t 112 *flemish*-pounds *make about* (100 lb) *troy-weight of London.*

u *In some places a difference is made between a* quintal *and a* hundred-pound weight: *so that the buyer and seller are obligd to explain themselves on this head in making of bargains.*

w *Beside* (1) *The* poids de Marc, *generally usd by merchants for things in little compass;* (2) *In Provence and Languedoc they have the* poids de Table; *which is found to differ, in several places, from the marc-weight,* 18, 20, *or* 25 *per cent:* 16 *ounces of the table being scarce* 14 *of the marc.* (3) *At Rouën they have another sort of weight, calld the* poids de Vicomté; 100 lb *of which is reckond to make about* 108, *or* 110 lb *marc, or paris-weight; especially in weighing of wool: but, in weighing other things, the said* 100 lb *is counted* 104 lb *marc-weight* *. (4) *In Languedoc, they have also another sort of weight, calld the* Roman *or* Statera-weight; *which is much the same as the table-weight.*

* *Of the Vicount-weight, they have no less a weight than* 13 lb: *so that all goods, weighing under that weight, are weighd by the marc-weight.*

x *The* ounce—*with Goldsmiths and Monyers, is divided as follows, viz. Grain* 7.20 *Felin* 2 *Maille* 2 *Estelin* 20 *Once.*———*with Physicians, is the* 12th *part of the livre. V. Livre* y.

y *The* livre—*of Avignon, Lions, Montpelier, and Toulouse, is* 13 *ounces: that—of Rouën,* 14: *that —of Marseille, and Rochelle,* 19. *V. Ounce* x.

of which makes about 92 lb in London. (2) The second is the *merchant's weight*; of which 100 lb makes 113 in London. (3) The third is calld the *english wool-weight*; and is about 3 per cent lighter than the town-weight . . . *At Lions*, the weights are of two sorts: (1) The *city-weight*, which weighs 14 ounces of the pound de marc, for common use; and (2) The *other* of 15 ounces, for silk. NB. 100 lb silk-weight makes 108 of the city-weight: and 100 lb of the city-weight is about 94 lb avoirdupois english . . . *At Rouen*, they have two sorts of weight: viz. *de vicomté*, and *de marc*. 108 lb of the former makes 100 of the latter, or 110lb of paris-weight [z].

3. Germany: Loodt 2 Ounce 16 Pound [a] 14 Lispound [b].——Troy: Sestertia 4 Numile 4 Quint 4 Loodt 16 Marc [c].——Variations: (1) *Centner* [d] = 8 lispound. (2) *Schippound* of feathers and wool is 20 lispound. (3) *Stone* . . of flax, 20 lb . . of wool and feathers, 10 lb. (4) *Tun* of butter and tallow is 16 lispound.

4. Holland: Grain 4 Dram 3 Gros 2.50 Engel 10 Loodt 16 Marc 2 Pound 8 Stone.——Troy: (1) *For weighing Gross gold:* Ace 32 Engel 20 Ounce 8 Marc. (2) *For Fining of gold:* Parts 24 Grain 12 Carats 24 Marc [e].——Differences: *Salt* (at Amsterdam) is sold by a great hundred of 404 scheppels; which is reckoned 7 lasts, or 14 tuns, or 28000 lb: which is also counted 208 facs; and is sold by the pound flemish: and 11 ½ lasts of Amsterdam make about the great hundred in the isle of Rhé in France.——Variations: (1) *Lispound* = 15 pounds. (2) *Load* = 400 lb. (3) *Schippound* = 20 lispound. (4) *Wage* = 165 lb.

5. Italy: Ounce 12 Pound 25 Arroba 6 Quintal. *Morea:* Dram 11.11 Ounce [f] 12 Pound 3 Oke 44 Quintal

z *This last is only to be understood in the weighing of wool: or else* 100 lb *marc-weight weighs but* 104 lb *of the viscount-weight. V. rete* w.—*And* 100 lb *de vicomté is about* 113 ⅓ lb *avoirdupois english.*

a *The* pound *of Vienna* . . *in some commodities, is divided into* 32 *loodts* . . *in others, into* 28 *pints.*

b *A* Lispound *of feathers, or wool, is* 16 lb.

c 116 marcs *make* 100 lb *troy-weight in London.*

d *A* centner *makes about* 120 lb *avoirdupois in London.—The centner of tin, at Dantzic (which consists of* 120 lb*) makes, in London, about* 112 lb.

e *The* marc-weights *of Holland are about* 1 *per cent lighter than the troy-weight of London.*

f *In weighing* raw-silk, *they reckon* 15 *ounces to the pound.*

tal. *Sicily:* Ounce 12 Pound 2.50 Rotello 100 Cantar [g]. *Venice:* Pound 100 Quintal [h].——TROY: *Genoa, Florence, & Legborn:* Grain 24 Denier 3 Grofs 8 Ounce 8 Marc [i]. *Naples:* Octave 8 Ounce 12 Pound [k]. *Rome:* Primi 4 Saliqua 3 Obolo 2 Scruple 3 Dram 8 Ounce 8 Marc [l]. *Venice:* Grain 4 Saliqua 9 Quarta 4 Ounce 8 Marc [l].—DIFFERENCES: *Corn,* or Grain (at Florence) is fold by the Moggio of 24 ftaios, of 50 lb weight, each.———VARIATIONS: (1) *Quintal* (at Leghorn) is of 4 forts: that of .. 100 lb, for Alum, 150 lb, for Sugar .. 151 lb, for Fifh .. 160 lb, for Wool. (at Rome) of 2 forts: that of .. 160 lb, for Spices, and other choice goods .. 250 lb, for heavy Bulky goods; about 200 lb, avoirdupois in London. (2) *Rotello* (at Genoa) is 18 ounces. (3) *Rugio* (at Rome) is 412 lb of their weight; and makes (in Florence) 3 ½ ftaios.

6. MUSCOVY: Zollotnic 96 Pound [m] 40 Pood 10 Barquit.

7. PORTUGAL: Dram 2 Ochavo 8 Ounce [n] 16 Arrata 32 Arroba 4 Quintal [o].

8. PRUSSIA: (1) *Grofs or bulky goods:* Pound 34 Stone [p] 10 Schippound. (2) *Fine goods:* Pound 16 Lifpound 20 Schippound.——VARIATIONS: (1) *Centner* of Tin (at Dantzic, 120 lb; at Koningfberg, 128 lb) makes, in London

g *The* cantar *is about* 176 lb *avoirdupois in London.*

h *The* Venice weights *are diftinguifht into grofs and futtle.* (1) *By the* grofs *they weigh coarfer metals, feathers, and other lumbering commodities.* (2) *By the* futtle *they weigh filk, fpices, drugs, &c.* —*And* (1) 100 lb *grofs-weight, make* 158 lb *futtle; or* 106 lb *avoirdupois in London.* (2) 100 lb *futtle, make* 63.66 *grofs; or about* 65.75 *avoirdupois in London.*

i *Of the Italian* marcs, 100 lb *troy-weight, in London, make about* .. 130, *at Genoa* .. 158.50, *at Florence*—NB. 100 lb *troy-weight, is equal to* 86.50 lb *of their weight for filver; wherein they reckon* 12 *ounces to the pound.*

k 86.50 *Naples*-pounds *make about* 100 lb *troy-weight, in London.*

l 116.50 *Roman, Venetian, and Verona*-marcs *make* 100 lb *troy-weight, in London.*

m *The Ruffia pound is counted equal to* 13 *oz* 3 *dw* 6 *gr. troy-weight; or* 14.15 *oz avoirdupois.*

n *The Portugal* ounce *is alfo divided into penny-weights and grains; the fame parts the ounce troy is divided into, in London.*

o *The Portugal* weights *are between* 3 *and* 4, *per cent. heavier than the London avoirdupois.*

p *The little Pruffia, and Dantzic*-ftone *(for pepper, fpices, and other fine goods) is* 24 lb.

q *The* laft .. *of Dantzic, makes, in London, about* 17 cw 7 lb .. *of Koningfberg, a fmall matter above* 18 cwt don, 112 lb. (2) *Last* . . of hemp, flax, and such light goods is 6 schippound, or 60 stone, viz. at Dantzic, 2040 lb; at Koningsberg, 2400 lb. ¶. But . . for Pot-ashes, the lastage is reckond double; viz. 12 schippound of them take-up no more room, in a ship, than 6 schippound of hemp or flax. (3) *Shock* is 60 pieces of any commodity sold by tale [r].

9. SCANDINAVIA: Pound 20 Lispound 20 Schippound [s]. ——VARIATIONS: (1) *Centner* of gun-powder is 120 lb. (2) *Last* of flax, hemp, cordage, and tallow, is 6 schippound.

10. SPAIN: Dram 8 Ounce 8 Marc 2 Pound 25 Arroba 4 Quintal. *Castile:* Grain 28 Dram 16 Ounce 16 Pound 25 Arroba 4 Quintal. *Catalonia:* Quintal [t] 3 Cargo. *Valencia:* Pound 24 Arroba 4 Quintal 2.50 Cargo ——TROY: *Gold:* Grain 12 Tomine 8 Castillan 6.25 Ounce 8 Marc. *Silver:* Grain 75 Dram 8 Ounce 8 Marc [u] ——DIFFERENCES: *Wool* is sold by the arroba of 30 lb. And 100 lb of London makes about 102 lb in Catalonia: but it makes about 92 lb of their wool-weight.

11. TURKEY: Grain 4 Quirat 16 Dram 12 Ounce 12 Rota 150 Cantar [w].———TROY: Killet 24 Medical [x]. ——DIFFERENCES: *Silk* is sold by the baleman, containing 6 okes [y].

SYNONYMS.

Aschnee, V. *asnée*. Aum, *aem*. Barrel, *brenta*. Bottle, *boccale*, *mingle*. Brante, *brenta*. Bushel, *boisseau*, *staio*. Butt, *pipe*. Carat, *saliqua*. Denier, *scrupule*. Dram, *medical*. Fat, *pipe*. Feillette, *feuillette*. Fertel, *viertel*. Flask, *fiasco*. Fuillet, *feuillette*. Gallon, *setier*. Grain, *primi*. Gros, *drachme*. Hemine, *chopine*. Hogshead, *muid*. Karat, *carat*. Letcht, Leth, *last*. Load, *cargo*, *salma*, *voye*.

Mill-

r *Thus, a* shock . . *of wood is 60 pieces*; . . *of linen, 60 auns*— *But, when linen is very narrow, and not creast or folded double; 2 auns of such linens is reckond but 1 aun.*

s 7.50 *of the Swedish* schippound *make, in London,* 20 cw.

t Wool *is sold by the arroba of* 30 lb.

u *Their weight* for gold and silver, in dust, or in bars, in the *Indies, is as follows: a tomine is worth 2 rials; and the tomine weighs 16 grains: a castillan is 16 tomine 4 grains: 6 castillan and 2 tomines make 1 ounce marc-weight; and 8 ounces to 1 marc.*

w *The Turkey*-cantar *makes about* 120 lb *in London.*

x 20 medical *of gold is 3 ounces, troy-weight, in London.*

y *If the* baleman *be weighd with the lodera; it will weigh 13 loderas, and 112 drams.*

Milr-oe, owl, *millerolle*. Mingeeble, *mingle*. Mui, *muid*. Oak, *oke*. Peché, *pot*. Penny, *numile*. Pinte, *pot*. Poſſon, *poiſſon*. Punchion, *poinçon*. Pound, *arrata*. Quarte, *pot*. Robe, Rove, *arroba*. Roquille, *poiſſon*. Schreve, *viertel*. Septier, *ſetier*. Setier, *chopine*. Somme, *ſomar*. Staro, *ſtaio*. Stekamen, *ſteckan*. Tierce, *aem*. Tiſchauſera, *ſachie*. Toiſe, *fathom*. Tun, *tonneau*. Verge, *viertel*. Vertel, *viertel*. Virge, *viertel*. Virtule, *viertel*. Voedar, *feuder*. Zambre, *açumbre*.

Proportions of Meaſures.*

(Applicatory.)

Feet.

an Engliſh foot divided into 1000 *parts, Others will be as follows:* at Amſterdam, 942. Antwerp, 946. Bononia, 1204. Bremen, 964. Cairo [a], 1824. Cologn, 954. Conſtantinople [b], 2314. Copenhagen, 965. Dantzic, 944. Dort, 1184. Florence [c], 1913. Francfort, 948. Greek, 1007. Leyden, 1033. Lorrain, 958. Mantua, 1569. Mechlin, 919. Middleburg, 991. Naples [c], 2100. Paris [d], 1068. Prague, 1026. Rhinland [e], 1033. Riga, 1831. Roman: *pes colotianus*, 967: *on the monument of Coſſutius*, 970: *on that of Statilius*, 972: *on a congius of Veſpaſian*, 986. Spain, 1001. Straſburg, 920. Toledo, 899. Turin, 1062. Venice, 1162.

YARDS,

* The Proportions *being ſixt as underneath, it will be eaſy (thereby) to find an anſwer to other queſtions relating to the following articles: e. g.* — *What is the value of* 1 vara *of Spain?* (Anſw.) 3.70 *qrs of a yard. for, As* 108 *varas, to* 100 *yards; So* 1 *vara, to* 3.70 *qrs yd.* —*What number of Engliſh* yards *anſwers to* 100 *varas of Spain?* (Anſw.) 92.59 *yards. for, As* 108 *varas, to* 100 *yards; So* 100 *varas, to* 92.59 *yards.*—*What is the value of one* ell *of England?* (Anſw.) 1.25 *yards. for, As* 80 *ells, to* 100 *yards; So* 1 *ell, to* 1.25 *yards.*

a *calld the* Derſch.

b *calld the* Pike, *or* Pico.

c *calld the* Brace, *or* Braccio.

d *a* Toiſe *is* 6 *feet.*

e *or* Leyden *foot; by which moſt of the Northern nations go.*

Yards

100 *Yards of England* make

Arſcheens——140.35, *of* Ruſſia.

Braces——80, *of* Ferrara——104.33, *of* Bergamo, Bologna——130.90, of Ancona——136, *of* Mantua, Modena, Venice: *for ſilk.*——136.26, *of* Milan: *for cloth.*——154.75, *of* Florence, Leghorn, Lucca——171.33, *of* Milan: *for ſilk.*

Canes——38.69, *of* Leghorn——40, *of* Naples, Sicily——40.66, *of* Genoa——44, *of* Rome——46.66, *of* Marſeilles, Montpelier——50, *of* Guienne, Tholouſe——55.66, *of* Barcelona——57.33, *of* Andaluſia——61.19, *of* Avignon, Dauphiné, Provence——97.33, *of* Valencia.

Cavados——133.33, *of* Portugal.

Ells——77.22 *of* Lions——78, *of* France——80, *of* Ferrara, Geneva, London, Oſnabrug——114.60, *of* St Gall *for woollen*——125, *of* Cambray, Douay——126, *of* Bruges——130, *of* Ypres——131, *of* Artois——131.66, *of* Brabant, Narva——132, *of* Ruremond——133.33, *of* Holland, Norimberg——134, *of* Antwep——135, *of* Dunkirk, Middleburg——139, *of* Guelderland, Maeſtricht——144, *of* Biſcany (for ſilk) Tournay——146, *of* Denmark——148.66 *of* Norway——149 33, *of* St Gall *for linen*——150, *of* Dantzick——151, *of* Liege——153.85, *of* Pruſſia——156, *of* Sweden——156.25, *of* Naumberg——160, *of* Baſil, Bern, Cologn, Francfort, Hamburg, Koningſberg, Leipſic, Lubec, Riga.——166.60, *of* Breſlaw.

Picos——*of* Candia *(for Silk)* 162.68 *(for Cloth)* 152.68 ——*of* Turkey *(for Camlets and Grograms)* 150 *(for Linen)* 66.66 *(for Woolen)* 133.33.

Ras——16.30, *of* Piedmont.

Shocks——1.40, *of* Poland.

Varas——81.33, *of* Portugal——108, *of* Spain——109, *of* Granada.

Veſcoves——8.77, *of* Ruſſia.

(CUBIC)

Corn

Corn

10.25 *Quarters of England* make

Acklings——27, *of* Delf and Rotterdam——88, *of* Schoonhoven.
Asnées——14.72, *of* Lions.
Bushels——38, *of* Bourdeaux.
Fanegas——157, *of* Spain.
Hoedts——7.50, *of* Bruges.
Last——1, *of* Amsterdam.
Muids——10.50, *of* Bruxelles——4.58, *of* Ghent——27, *of* Amsterdam——33, *of* Groeningen.
Raisers——18, *of* Dunkirk.
Sacks——28, *of* Dort——40, *of* Middleburg.
Scheppels——30.75, *of* Dantzic——56, *of* Prussia——83, *of* Hamburg.
Setiers——17.53, *of* Calais——19, *of* Paris.
Viertels——37.50, *of* Antwerp.

(ITINERARY)

A Mile [f] *contains Rhinland feet*

in Arabia, 6187. Britain, 5454. Burgundy, 6000. Egypt, 25000. Flanders, 6666. France, 5250. Germany, *small*, 20000: *middle*, 22500: *largest*, 25000. Holland, 8000. Lithuania, 18500. Muscovy, 3750. Persia, 18750. Poland, 19850. Scotland, 6000. Spain, 7090. Sweden, 30000.

Proportions of Weights.

100 lb *averdupois of England* make

at Amsterdam, 91 lb 8 oz. Ancona, 136. Andalusia, 102: *of wool weight* 92. Antwerp, 96 8. Biscany, 90

[f] *Or, such distinction of distances, as has been made by several nations, for the use of travelling; by whatever names they are call'd:* leagues, parasangs, versts, &c.

90 (of iron) 78 (of other things). Bologna, 125. Bremen, 94 4. Candia *(gross)* 84 12. *(suttle)* 131 9. Castile, 103 8. Catalonia, 102. Dantzic, 106 12. Denmark, 92. Ferrara, 133 5. Florence, 138 14. Francfort, 89 7. Geneva, 81 7. Genoa, 137 4. Granada, 104 2. Hamburgh, 93 5. Leghorn, 132 11. Leipsic, 96 1. Liege, 96 5. Lions, 106. Mantua, 138 12. Milan, 153 11. Modena, 138 12. Naples, 154 10. Norway, 92 Paris, 90 8. Poland, 114 5. Portugal, 104 13. Provence, 113 Prussia, 116. Rochelle, 90 9. Rouen, 88 Russia, 90. Savoy, 121 13. Spain, 97 4. Tholouse, 107 11. Valencia, 92 12. Venice, 152. Vienna, 81 7.

for Brabant, V. *Antwerp*. Hall, Leipsic, Holland, *Amsterdam*: Marseilles, *Provence*. Naumberg, *Leipsic*. Norimberg, *Francfort*. Seville, *Spain*.

TABULATING.

to Subtract, Multiply, Divide, *by Addition.*

1. Twíce-double-Multiplicánd facits †, évery múltiplicator. † *gives the facit of* [a]
2. Tábulate Dĭvísor: Quote néxt-Digit-únder: Subtráct by Addition [b].

a In the Multiplication-sum (I) The facits of the multiplicand *twice doubled*, are, as they stand against the digits 2 and 4. Then, To multiply the multiplicand—into 8 (the last figure of the multiplicator) double the facit of the digit 4—into 6 (the 2d figure &c.) add the facit of 4 to that of 2 (=6)—into 7 (the next figure &c.) add-together the facits of 1, 2, 4 (=7) placing each of them, as in the common method of multiplication.

Multipli-cand	*cator*	
Digits. 1	98765×768	
2	197530 (I)	
4	395060	
	by	
Facits.	790120	8
	592590	6
	691355	7
	75851520 × 768	

In.

b In the Division-sum, here indented, (1) *Tabulate the divisor*, as in the example, viz. against the digit 2, by adding the divisor to itself; against 3, by adding together the totals of 2 and 1; against 4, by adding the total of 2 to itself, or that of 3 to that of 1; and, in like manner, in the rest, by adding together the totals of any 2 or more digits, equal to the digit whose total is sought. Then, (2) *Quote* (or, for the quotient, take) the *digit* against the total *next* less, or *under* the first corresponding figures of the dividend, viz. 7585.. Then, instead of subtracting, according to the common method, the facit of the divisor by 9 (viz. 6912) from (7585) the corresponding figures of the dividend (3) *Substract by addition*, and say [not, 2 from 5, and there remains 3; but] 2, and (so much as will make 5, viz.) 3 is 5: then 1, and (as much as will make 8, viz.) 7 is 8: then 9, and [what will make 15 (since 9 cannot be taken from 5) viz.] 6 is 15 *, then 1, that I borrow, and 6 is 7: and so on.

Divi-dend	*-sor.*	*Tabulated*
75851520 ÷	768	1
673794	1536	2
5898	2304	3
43.	3072	4
	3840	5
Remainders	4608	6
	5376	7
	6144	8
Quotient: 98765	6912	9

In the Division-sum, in the margin, it appears that——All the tabulating necessary to find the quotient, is only to double the divisor: for, the total next less than (the 1st dividend) 987, is 968; therefore quote 1: then (the 2d dividend) 196 has no total less; therefore quote 0: then the next total less than (the 3d dividend) 1965, is (the 2d total viz.) 1936; therefore quote 2.——And, in like manner, may be tabulated any sum, by steps, as there shall be occasion.

98765 ÷	968	1
19.29	1936	2
——		
102 *Quotient*.		

* See Division, note d †.

in Fellowship, &c.

Fell. *Tarif*:] Stóck by Loss-Gain: and ínto the Quótient, each Claimant a.

a *For Example*——I. Two or three hundred persons having *gaind* (or *lost*) 8 per cent; it is required to know

How

How this must be shar'd among them, in proportion to the interests each-one has in the stock? (Answ.) Having found (according to Fellowship, note b) What 1 l will gain, at the rate of 8 l per cent, [100 : 8 : : 1 : .0800] viz. .0800 l; and, consequently, What 1 s will gain [.0800 ÷ 20 = .040] viz. .040 s: a tarif may thence be drawn-up to any number; or found occasionally, as in the following example: Suppose any-one had put-in £ 19978 10 3; he must have

.0800	x	10000 l:	viz. - - - - -	0800.0000
		9000	- - - - - - - - -	720.0000
		900	- - - - - - - - -	72.0000
		70	- - - - - - - - -	5.6000
		8	- - - - - - - - -	.6400
.040	x -	10 s	- - - - - - - - -	.400
.003	x -	3 d	- - - - - - - - -	.90
				1598.2890

that is £ 1598 5 10 1.——II. A man turns *bankrupt* for 80000 l; and his effects are valued at no more than 9000 l. The question is, How-much each creditor is to have in proportion to his debt? (Answ.) Having found, as in the preceding example, that, for 1 l, a creditor is to have but .1125: If his debt was 566 l;

Then	.1125 x 500 l	=	56.2500
he must	60	-	6.7500
have but	6	-	.6750

——III. Suppose a district, which payd, last year, 8426 l; is to pay, this year, 12864 l, for *taxes:* and it is requird to find How-much each inhabitant is to pay, in proportion to what he payd the year before? (Answ.) Say, 12864 : 8426 : : 1 : .6500. Then, He, that payd 36 l (last year) must

pay	.6500 x 30 l, viz.	-	19.5000
(this	—— x 6 - -	,	3 9000
year)			
£ 23 8	- - - - - - -		23.4000

V. Fisher's concise arithmetic p. 244—258.

Tare,

TARE, TRET, CLOUGH.

TARE, TRET, CLÓUGH, when from *Gróss*-weight [a] dedúcted; remains the *Net*-weight.

Táre's pounds for package [b]. *Trét*, o in azo [c]. *Clóugh*, e in azy [d].

I'nto. allówance by quántity; ŏr, by' aliquóts of allowance,
Grofs gives *tare* [e]: Tare-net gives *tret* [f]: and Trét-net the *clough* gives [g].

Grofs-weight is that of goods with their duft, drofs, &c; as alfo with the bag, box, &c, they are in.

Tare is the allowance given for the weight of the bag, box, cheft, or other package of a commodity. This allowance is fo much in the hundred-weight, more or lefs, according to the nature of the package.

Commonly there is an allowance (*in* 112 *lb*) of — 4, in feathers, hops, wool——6, in iron and latten-wire—8, in brimftone, copper—10, in copperas—12, in alum, falt petre, tallow—14, in almonds, argol, figs, &c.—16, of currants, prunes &c; in caroteels, butts, &c.—18, of oil, in uncertain cafks, &c.

By the book of Rates, in feveral commodities, the allowance for tare is not reckond per cent: but fo-much of the grofs, calld *invoice tare*. Thus—in *Madder*: When the tare is to be deducted; the rule is: 28 lb per Bale.—in *Oil* (1) from Candia: 29 lb per Barrel (2) from New-England: 50 lb per Barrel *—in Silk: per Bale (1) 16 lb, for 3 cw, and upward (2) 14 lb, from 2 cw weight to 3 (3) 12, from 2 cw downwards. ——in *Raifins*: 14 lb per Frail.——in *Sugar*, from India, in cafks and canifters, $\frac{1}{6}$: in chefts and cafks, $\frac{1}{5}$—in Virginia-*Tobacco*, all hogfheads (1) under 3 cw, allow 70 lb tare (2) from 3 to 4 cw, 80 lb (3) from 4 to 5 cw, 90 lb (4) from 5 cw, upward, 100 lb.

In Uncertain cafks it is weighd; and the tare allowd is 18 lb per cw: which, being deducted, is computed at 7 $\frac{1}{2}$ lb per gallon.

c *Tret* is an allowance of 4 lb in 104 (viz. $\frac{1}{26}$) for réfuse of dust, dirt, &c. in some sorts of goods,

d *Clough*, or *Draught*, is an allowance of 2 lb in 100 lb (viz. $\frac{1}{50}$) * for the turn of the scale; that the commodity may hold-out weight, when sold by retail †.

* At every 300 weight, in the port of London, 2 lb is usually allowd for argol, cinamon, cloves, galls, mace, madder, sumach, tobacco, cotton-yarn, cotton-wool, and other things that have waste.

† *All these Allowances*, beyond sea, are calld the Courtesies of London; because they are not practisd in any other place.——*Beside these allowances* there are also others, not so common: as (1) Break, at so-much per bag, barrel, &c. and (2) Damage, at so-much in the whole.

e *For example:* Cw 45 3 15 = 5139 *l* × 16 (the allowance) = 82224 ÷ 112 (the quantity, out of which the allowance is made) = 734 lb; that is cw 6 2 6 $\frac{16}{112}$ or $\frac{1}{7}$: Or, cw 45 3 15 ÷ 7 (the $\frac{1}{16}$th of 112) = cw 6 2 6 $\frac{1}{7}$.

f *For example:* Cw 45 3 15 — 6 2 6 (tare) = 39 1 9 (the tare-net; calld also suttle) ——Then 39 1 9 (tare-net) ÷ $\frac{1}{26}$ (or, its factors 2 × 13) of 104 = 1 2 1 (tret) which subtracted from 39 1 9 (the tare-net) gives 37 3 8 (the tret-net.)

g *Thus* Cw 37 3 8 (the tret-net) ÷ $\frac{1}{50}$ (or, its factors, 5 × 10) of 100 = 3 lb: which subtracted from 37 3 8 (the tret-net) gives 37 0 8 (the clough-net.)

Operations of this nature will stand, most commodiously, thus:

	Cw:	45	3	15	Grofs
[a] 16	7	6	2	6	Tare
		39	1	9	net [d]
[b] 26	2	19	2	18	
	13	1	2	1	Tret
		37	3	8	net [e]
[c] 50	5	7	2	7	
	10	0	3	0	Clough
Aliquots	Div.	37	0	8	net [f]

[a] 16 is the $\frac{1}{7}$ of 112.

[b] 26 (or, its factors, 2 × 13) is $\frac{1}{4}$ of 104.

[c] 50 (or, its factors, 5 × 10) is $\frac{1}{2}$ of 100.

[d] Tare-net is the remainder of grofs, after tare is deducted.

[e] Tret-net is the remainder of tare-net, afte tret is deducted.

[f] Clough-net is the remainder of tret-net, after clough is deducted.

APPENDIX.

A PRACTISE TABLE

Commodity, &c.	Farthings			Pence									Shillings									Commodity, &c.
PRICE:				1			2			4			1			2			4			
	s	d	q	L	s	d	L	s	d	L	s	d	L	s	d	L	s	d	L	s	d	
2			2			2			4			8		2			4			8		2
3			3			3			6		1			3			6			12		3
4		1				4			8		1	4		4			8			16		4
5		1	1			5			10		1	8		5			10		1			5
6		1	2			6		1			2			6			12		1	4		6
7		1	3			7		1	2		2	4		7			14		1	8		7
8		2				8		1	4		2	8		8			16		1	12		8
9		2	1			9		1	6		3			9			18		1	16		9
10		2	2			10		1	8		3	4		10		1			2			10
20		5			1	8		3	4		6	8	1			2			4			20
30		7	2		2	6		5			10		1	10		3			6			30
40		10			3	4		6	8		13	4	2			4			8			40
50	1		2		4	2		8	4		16	8	2	10		5			10			50
60	1	3			5			10		1			3			6			12			60
70	1	5	2		5	10		11	8	1	3	4	3	10		7			14			70
80	1	8			6	8		13	4	1	6	8	4			8			16			80
90	1	10	2		7	6		15		1	10		4	10		9			18			90
100	2	1			8	4		16	8	1	13	4	5			10			20			100
COL-	1			2			3			4			5			6			7			-UMN

Here

Here WITHOUT DIVISION you have

by . . . . *Inspection* . . . . only

PENCE-TABLES, *Groat-tables, &c:* Thus, from the margin (1) in column 2, you read 20d is 1 s 8d, &c. (2) in column 4, 20 groats is 6 s 8d &c. V. p. 8*

PRACTISE: Thus——*If one* lb of beef cost 4 d; What will 40 lb come-to? Carry your eye from 40, in the margin, to the 4th column that has 4 d at the top; and you will find the answer, s 13 4*. ——*What'll one* lb of beef cost? or, At what rate per pound is the beef sold, for 30 lb of which the butcher charges me 10 s? Go-up from the price, found (as afore) in the 4th column, to the price of 1 at the top: That is the answer; viz. 4 d.——*In the same manner* are found answers in

PROPORTION, or the *Rule-of-three:* Thus, If 20 cost 6 s 8 d, 70 will come to L 1 3 4.

by . . . . *Accommodation* . . . . thus:

Lay a blank paper (or slate) across the table, under the quantity in the margin; and set-down the several answers as given by *Inspection only*. The Total you will have (I) either *by Addition only:* e. g. (1) The price of 50 oz, at s 1 4 1 an ounce, is (by inspection) l 2 10 and s 16 8, and s 1 0 2: in all l 3 7 8 2. (2) The price of 50 oz, at s 3 6 2 an ounce, is (by the rates, a top, 2 and 1, viz. 3 s) 5 l, and l 2 10; (by the rates 4 and 2, viz 6 d) s 16 8, and s 8 4; (by the rate of 1 q, doubled) s 2 1: in all l 8 17 1. (3) The price of 100 lb, at the rate of s 4 2 3, for 7 lb (by the rates of 4 d 2 d 1 d, and 1 q, against 7 in the margin) will be (at the rates in the same columns, against 100 in the margin) l 3 0 5. (II) or *by Multiplication and Addition:* e. g. The price of 220 cw, at l 2 7 7 3 per cw, is (by multiplying the prices of 100 by 2) 440 l; and (by adding the prices of 20) l 84 2 1: in all l 524 2 1.

* *NB.* The term, that corresponds to the question-term, is to be of the same name. V. Rule-of-three, line 3.——Therefore, If the question-above were propounded thus: What is the price of 5 stone, at 4 d a pound; the higher name [stone] must be reduc'd, by multiplication, to the lower, viz pounds; and the question will be as above.—So likewise, If 1 lb cost l 12 13 7; 1 cw 6 lb (or 118 lb) will be found to come to l 1496 2 10.

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LONDON: MDCCXLVIII.

Advertiſement.

THE *Uſe* of the following collection being ſpecified in the title,———I need not inform maſters, who (under the tyranny of cuſtom) are obligd to ſpend themſelves, dayly, in the drudgery of ſeting a number of boys their ſums; how much trouble they may ſave themſelves, for much better purpoſes, by means of ſuch a proviſion as this: from which their pupils may be directed to take what they want; either to work on their ſlates, or to enter (with the operation) in their books, in due form, as they ſhall judge moſt convenient.———A great part of the time, they thus loſe in mere pains-taking, they cannot but be ſenſible they might (much more pleaſurably, and uſefully) employ, to the advantage of their ſcholars, in forming their hands; and in opening their underſtandings, by explaining the rules, by examining their operations, by directing their entries, and (on every exigency) by removing ſuch difficulties, and rectifying ſuch miſtakes, as might retard their progreſs, by diſguſting their minds, and abating their inclinations. V. Addition, note 1 2———Nor will it be any difficult matter for the ingenious in the profeſſion, to ſupply, in proper place, whatever may be wanting, for the better elucidation of any part of the ſyſtem: eſpecially as I have diſpoſd the queſtions under proper heads; and, where the nature of the thing admited it, in alphabetical order. V. Addition, Allegation, Barter, Exchange, Gain, Proportion, Tare, &c. 1

For the Furniſhing a good quantity of theſe exerciſes, it will not, I preſume, be reckond a fault, that I have ranſackt moſt of the modern arithmetics: the rather, as I have ſelected ſuch as ſeemd to be beſt calculated to anſwer the purpoſes ſpecified in the title-page. A variety of good examples, from a variety of authors (with various views, conceptions, and contrivances) in the order they are here diſposd; cannot fail, I think, of being pleaſing to the authors themſelves; as well as profitable to the public. 2

As to the Promiſcuous diſpoſition of a number of queſtions, deſignd for the ſeverer trial of learners (which are introduc'd after a copious detail under each particular head) the maſter will readily ſee the uſe of them. A good arithmetician, as Mr Malcolm (arith. p. 82) obſerves, muſt be capable of ſomething more than barely to perform any rules or operations, with given numbers, when the queſtion is ſimply propoſd to add, ſubtract, reduce, &c. that is, when he knows what operation is to be applied, in what rules, and to what numbers. The great art of application lies in the ſolution of queſtions, wherein no rule or operation is namd; but we are left to find the proper work from the nature and circumſtances of the queſtion. For this, there are not any determinate and general rules, or directions: the ſolution, in ſuch caſe, depends upon the good ſenſe and judgment of the arithmetician, whereby he can diſtinctly and perfectly comprehend the nature and circumſtances of a queſtion; and ſuppoſes him to underſtand the true general import and effect of the ſeveral operations of arithmetic, by which means he may know when the reaſon of the queſtion requires ſuch an operation. The more ſimple the circumſtances of a queſtion are, it will be the more eaſy; and, where there is but one operation to be applied, it will be always obvious: but, where a variety of circumſtances occur, and ſeveral operations become thereby neceſſary; the difficulty encreaſes; which experience only can make eaſy. And, therefore,

fore, as a proper introduction to that experience, I have given this ſecond ſet of queſtions: which by that time a learner has gone-through, by the help of a hint (now-and-then) from his maſter; he will have had all the aſſiſtance that books can give him; and may look upon himſelf as a good accountant. 3

To account for what ſome may look-upon as an Over-ſight, it may not be improper to add that I have purpoſely omited ſuch queſtions as relate to calculations in geometry, gauging, aſtronomy, muſic, &c. which ſome writers overcharge their ſyſtems with; more particularly under the heads of proportion, and evolution. This I choſe to do, partly becauſe ſuch queſtions are of no uſe to the generality of thoſe, who learn arithmetic: but, chiefly, becauſe things of that nature are learnt more eaſily, and to much better purpoſe, in their proper ſciences; wherein a regular account is given of the definitions, and the data, that are neceſſary to be known for the ſolution of ſuch queſtions. It looks extremely odd, and muſt be very edifying, to aſk ſuch a queſtion as this: 'If the conjugate diameter of an ellipſis be 4 feet, and its tranſverſe 6 feet; and the content of the circle (deſcrib'd upon the conjugate diameter) be 12.566 ſquare feet: What is the content of the ellipſis?' and, at the ſame time, by way of preparation to the anſwer, to be told only that 'The area of an ellipſis, is to a circle deſcrib'd on its conjugate diameter, as the tranſverſe diameter is to the conjugate.' V. *Weſton*, p. 380. See alſo *Hill*, p. 229. *Royer*, p. 524. *Clare*, p. 117, &c. 4

How to Initiate children, and acquaint them with the fundamental operations, is all (I think) that remains to be conſiderd with regard to the praxis of arithmetic; which is the deſign of this part. In my opinion, then——*Addition and Subtraction* may be managd with the greateſt eaſe, and to the beſt advantage, as follows: Inſtead of a long train of ſums, to be ſet-down (with infinit drudgery) in the children's ciphering-books ing-books, to the loss of time that might be much better employd, and without any advantage; the best way to acquire a readiness and certainty in these operations, seems to be to practise occasionally, at proper intervals, under the master's direction. For this purpose, let an example (from the sketch of the sums offerd under the head of Addition) be enterd at the top of a slate; and, under it, any sum that is less in every particular. Then, let as many of the scholars as can conveniently see on each side of the master, begin to subtract, and proceed in turns (still deducting the under from the upper, without drawing a line between) till the sum is carried-down to a proper depth to be added-up. After the doing of which by any one (the rest attending) a memorandum of the total (which is to be effac'd on the slate) may be taken by the master; and those of them that are able may cast-up the sum, each of them (separately) by themselves: and, by thus repeating the same exercise (every now and then) in the several particulars of mony, weights, and measures (in order to refresh their memories, and rivet the practise) they will be ready and expert in what they might otherwise have forgot. As for—— *Multiplication and Division*, they cannot be made familiar to young folks but by a great deal of practise. After they have, therefore, been duly instructed in the way of working, by four (or, by six) at a time, as in addition and subtraction; variety of sums may very easily be set them (beside what are proposd under the head of Division) and very readily be examind by the short proof: in the working of which they may be employd (by way of penalty in play-time, or of diversion in the intervals of other business) from day to day, and for a considerable time, till they can multiply and divide by any figures, as readily as by the least. and, thus, they will be well qualified to proceed to the rules; which they will be able to perform with pleasure, as their judgment ripens, without either harassing the master, or perplexing themselves.

1 { EXAMPLES ALPHABETICALLY DISPOSD. } 1

ADDITION

I. SUMS [1]

1. Measure

Ale and Beer

Ale					Beer				
Buts	hh.	kild.	firkins	gall.	Buts	hh.	kild.	firkins	gall.
999	1	2	1	7	999	1	2	1	8
123	0	1	0	3	321	0	1	0	2

1 *The following Sums are set in such manner as to serve for examples, not only in addition, but in subtraction also; the two lines, in each (more especially in mony and weight) may be drawn-out to what depth the master pleases, without his*

Circles	ſigns	minutes	Degrees	minutes	ſeconds
999999999	11	59	999999999	59	59
987654321	2	6	123456789	4	3

Cloth

Yards	qrs	nails	Ells eng.	qrs Yd	nails	Ells flem.	qrs Yd	nails
99999	3	3	99999	4	3	99999	2	3
12345	1	2	54321	2	1	12345	1	2

*his trouble. for, the learner, having copied (on his ſlate) the two lines of any denomination, may be directed to ſubtract them down to any number of lines; and, then, to add them up: in order to acquire a readineſs, and certainty, in theſe operations *; which are of moſt uſe on the ordinary occaſions of buſineſs.*——NB. (1) *To examin each ſtep, without trouble, or loſs of time; the maſter may have, in manuſcript, the anſwers to each, both in ſubtraction and addition; and, thereby, may eaſily convict the ſcholar of any miſtakes; and, when neceſſary, put him in the way of rectifying them.* (2) *It may be further obſervd to the learner, that, in the upper line, every figure is the higheſt it could be ſet: ſo that, without regard had to the tables, a child may conceive that he is to borrow in ſubtraction (and to dot, in addition, at) the number above. Thus, in the article of mony,* 99 l 19 s 11 d 3 q *(the upper line) intimates that no number higher than theſe can be enterd under any of theſe denominations: ſince the next number above them would amount to one of the next denomination;* 4 q *being equal to* 1 d: *and* 12 d *to* 1 s: *and* 20 s *to* 1 l: *and* 10 l *(viz. the next number above* 9) *equal to one in the next row. V. Numeration, line* 5.

* *Had I ſet-down long ſums (as is uſual) to ſwell the work; the copying of them on a ſlate, in order to operate, would be pure drudgery, not without great danger of miſtakes: whereas the ſubtracting them downwards, line by line, is an uſeful entertainment, that engages the mind; ſo as to ſave time, and to take-off the irkſomneſs of mere labor. V. Pref. paragr.* 1.

Dry

Lasts	weys	qrs.	strikes	bushels	pecks	gallons	quarts	pint
9999999999	1	4	3	1	3	1	3	1
1234567890	1	2	1	0	2	1	2	1

Long

Yards	feet	inches	Miles	furlongs	perches
999999999	2	11	999999999	7	39
123456789	1	2	987654321	2	4

Number

Gross	dozen	brace	Reams	quires	sheets
999999999	11	5	999999999	19	24
123456789	3	2	987654321	3	4

Square

Yards	feet	inches	Acres	roods	perches
999999999	8	143	999999999	3	39
123456789	2	23	987654321	1	9

Days	hours	minutes.	Years	months	weeks
999999999	23	59	999999999	12	3
123456789	7	38	987654321	4	1

Wine

Hhds	gallons	quarts	Tuns	puncheons	tierce
999999999	62	3	999999999	2	1
123456789	6	1	987654321	1	1

2. MONY

English

l.	s.	d.	q.	l.	s.	d.	q.
9999999	19	11	3	9999999	19	11	$\frac{3}{4}$
1234567	6	7	1	7654321	3	2	$\frac{1}{4}$

Foreign

French			Danish		
Livres	ſol	den.	Rixdollars	hors	ſchell.
999999999	19	11	999999999	3	23
123456789	6	7	987654321	2	7

3. Weight

Avoirdupois

Garblage					Wool				
Tuns	cw.	qrs	lb.	oz.	Laſts	ſacks	ſtone	clove	lb.
999999	19	3	27	15	999999	11	25	1	6
123456	6	1	5	3	654321	6	7	1	2

Troy

Apothecary's					Goldſmith's				
lb.	oz.	drams	ſcruples	gr.	lb.	oz.	dw.	car.	gr.
99999	11	7	2	19	99999	11	19	5	3
12345	4	3	1	4	54321	3	4	2	1

II. BILLS.[a]

Baker

Mr A B——Dr——*to* C D.

			£	s.	d.
1748.					
Feb. 4	For	a peck of Bran	0	0	3
	——	a fine peck Loaf	0	1	8
13	——	a peck of fine Flour	0	1	8
17	——	a bushel of Pollard	0	1	0
18	——	small Bread	0	0	$2\frac{1}{2}$
	——	Yeast	0	0	1
	——	a half peck second Loaf . . .	0	0	9
20	——	a quartern second Loaf	0	0	$4\frac{1}{2}$

Brasier

Bought of E F——*July* 17, 1747.

A Copper, with a Cock. . . $66\frac{1}{2}$ lb at s 1 $4\frac{1}{2}$ lb				
Iron-work, and a Crane . . 97 . . . . $2\frac{3}{4}$				
A brass-Pot, and Sauce-pan 38 . . . 1 7				
A stove-grate, with shovel, tongs, poker, & fender		1	18	6
	£	10	12	4

Brick-

a *In the following* Bills *of parcels, Bills on book-debts, &c.* (1) *The* totals *of those, to which the prices of the particulars are affixt, may be kept by the master in manuscript; in order to a speedy and easy examination. And, if he suppo's any collusion among the young folks, who may be under a temptation to borrow the totals of one another's notes: the most obnoxious may be singled-out, and set in full view, while they are working; partly to give them shame for their insincerity; and partly to prevent the imposition they might otherwise be guilty of. With this caution, these assistances will not a little contribute to the quick progress of the learner; as well as to the relief and comfort of the master: it being very certain, as Mr Dilworth (pref. p. vii) observes, that 'It is not in the power of any master (in the course of his business) how full of spirits soever he be, to frame new questions at pleasure in any rule;' much less to write them down too, as I find is commonly done by the drudges of the profession: who, in a route of practise, find it necessary (it would seem) to amuse weak parents with the show of decorations in titles, and a good deal of writing in the children's ciphering-books; though, in fact, it is no better than robing their pupils of so much time; which they might much better employ in the instruction, and good government of them.* (2) *As to the* amounts *of the several particulars, in the following bills, at so much*

BRICKLAYER

1748.				
Mar. 8	For 8000 bricks at 12 s per M . .	4	16	—
	For 4000 tiles at 20 s per M	4	—	—
29.	For 14 load of sand at 2 s 6 d per Ld	1	15	—
	For 500 9-inch tiles at 11 s per H .	2	15	—
	For 30 ridge-tiles at $1\frac{3}{4}$ d a piece . .	—	4	$4\frac{1}{2}$
Apr. 18	For 20 days work, for my self at 3s A-day	3	—	—
	For my man $25\frac{1}{2}$ days, at 2 s 6 d .	3	3	9
	For a laborer, $25\frac{1}{2}$ days, at 1 s 8 d .	1	18	—

BUILDER

Oaken-Timber	12	load, at £2	5	-	per tun
Fir-Timber .	35	tun .	1	12	10	load
Oaken-Plank .	96	feet . .	-	—	$3\frac{1}{2}$	foot
Norway-Deals	590	. . .	6	15	-	hun.
Six-penny Nails	29	thous . -		3	10	tho.
Ten-groat Nails	3	hundr . . -		14	10	tho.
Work for Myself	90	days . -		3	4	day
Ditto for 3 Men	90	. . . . -		2	6	eac.
Wainscot . .	73	yar. 3 f . -		3	2	yar.
Double-Quarter	58	feet . - -			4	foot

£ 181 8 11

CABINET-MAKER

A chimny-Glass, and a pair of Sconces : £	5	18	—
A pair of pier-Glasses, 72 inches, gilt frames .	30	—	—
A pair of indian Cabinets, at £ 43 10 each .			
A fine indian 4-leavd Screen, and Fire-screen	17	10	—
A Book case, with glass-doors; and corner-Cupbo	21	—	—
A walnut-tree Tea-table; and a set of Dressing-boxes japand . . . . : .	3	4	1?

*much per pound, yard, &c. the method of finding them is given, in its proper place, under the head of practise; more particularly, in note b *: and, for the readier satisfaction, where I have not given the particular amounts (which I have omited in several bills, with a view of furnishing examples for the learner's exercise therein) I have subjoind the total amount; which may serve for a proof whether the particulars are right.*

A Tea-table and Stand, plated: wt 103 oz, at 8 s 4 d per oz . . . .
18 fine matted Chairs; at 18 s 6 d, each. . .

£ 224 4 2

Carpenter

1746.		s.	d.		£	s.	d.
May 3	For 30 feet of Fir Timber, at	0	3	per Foot	0	7	6
	— 18 whole Deals . at	1	6	each	1	7	0
	— 16 slit Deals . . at	1	0	. .	0	16	0
	— 4 hundred of sixpenny Nails . .				0	2	0
	— 3 hundred of ten-penny Nails . .				0	2	6
	— 6 hundred of Brads				0	1	6
21	— 18 days Work . . at	3	0	per Day	2	14	0

Cheesemonger

Bought of E F—— July 17, 1748.

		s.	d.		£	s.	d.
3 Glocestershire Cheeses,	wt. 24 lb. at	0	4	per lb	0	8	0
1 Cheshire . . .	wt. 28 lb. at	0	4	. . .	0	9	4
3 Warwickshire . .	wt. 20 lb. at	0	3	. . .	0	5	0
1 firkin of Butter .	wt. 28 lb. at	0	6	. . .	0	14	0
1 flitch of Bacon .	wt. 6 St. at	4	0	per Sto.	1	4	0
7 lb. of Cambridge-Butter .	at	0	6	per lb.	0	3	6
9 lb. of new Cheese . . .	at	0	4	. . .	0	3	0
7 lb. of Cream-Cheese . . .	at	0	6	. . .	0	3	6

Corn-chandler

			s.	d.	
Oats	5	qrs, at	2	3	per bush
Beans	9	bush .	4	10	. . .
Bran	7	qrs .	1	10	. .
Tares	19	bush .	1	11	. .
Peas . . .	16	. . .	3	$11\frac{1}{2}$	. . .
Pale Malt .	28	.	3	2	. .
Hops . . .	17 lb	.	1	4	per lb

£ 22 7 3

Druggist

Galls	wt 156 lb	at £	—	—	$9\frac{1}{2}$	
Cochineal	$18\frac{5}{8}$	.	1	12	10	
Scammony	$37\frac{1}{4}$	.	—	10	—	
Gum arabic	127	.	—	—	$8\frac{1}{8}$	
Saſſafras	364	.	—	—	$3\frac{2}{3}$	
Opium	$10\frac{1}{2}$	.	—	6	—	
Tea (1 caniſter)	75	.	—	13	8	
Aſa-fœtida	48	.	—	1	6	
Contrayerva	$7\frac{1}{2}$	.	—	18	6	
						£ 129 7 —

Dyer

Exeter Stuffs,	yellow	70 ps,	at S	14	-	pr pc.	
Norwich do,	blue	30	.	11	6	——	
Tamies	black	42	.	12	8	——	
Colcheſter Bays	green	28	.	9	-	——	
Camlets	orange	21	.	15	-	——	
							£ 121 4 —

Fishmonger

3 hundred of Haberdins, at	£ 7	10	6	each	
$1\frac{1}{2}$ hundred of Ling	8	12	6	—	
$4\frac{1}{2}$ hundred of Stock-fiſh	4	10	6	—	
4 kegs of Sturgeon	-	16	$10\frac{1}{2}$	—	
$6\frac{1}{2}$ barrels of Herrings	3	10	2	—	
95 dried Salmon	-	1	2	—	
					£ 87 11 11

Fruiterer

					£ s d
7 doz. of Malaga Lemons,	at S	2	3	p. doz.	
$8\frac{1}{2}$ hundr of Liſbon Lemons,	at	7	2	.	
9 ropes of Spaniſh Onions,	at	1	6	.	
1 buſhel of Spaniſh cheſnuts,				.	0 7 10
43 doz of Sevile oranges,	at	1	2	.	
12 pomegranates,	at	-	$4\frac{1}{2}$	.	
					£ 7 12 8

Furrier

						£	s	d
Cony-ſkins	1300,	at	13 s	6 d	per hundr.			
Beaver-ſkins	180,	at	7	8	per pound			
A Sable-muff and tippet					. . . .	21	0	0
Fitch-ſkins,	90,	at	0	$3\frac{1}{2}$	per ſkin			
Otter-ſkins	50,	at	3	-	. . . . .			
Hare-ſkins	140,	at	9	6	per hundr			
						£ 108	5	$0\frac{1}{2}$

Goldsmith

	oz			at s	d
A ſet of Caſters, wt oz	25	10	10	at S 7	9
6 ſoup-Plates . .	85	14	15	6	6
a ſilver Tea-pot and Lamp	29	16	15	6	4
a large Punch-bowl	67	—	16	6	10
12 ſilver-Spoons . .	33	11	10	6	2
12 deſſert-Knives Forks and Spoons, ſhagrin Caſe					

£ 120 8 [illegible]

Grocer

		s	d		£	s	d
8 lb of Raiſins of the ſun .	at	0	5	per lb	0	3	4
15 lb of Malaga-Raiſins . .	at	0	$4\frac{1}{2}$	.	0	5	$7\frac{1}{2}$
10 lb of Currants	at	0	$6\frac{1}{2}$	.	0	5	5
11 lb of Sugar	at	0	$4\frac{1}{2}$	.	0	4	$1\frac{1}{2}$
2 Sugar-Loaves, wt 15 lb .	at	0	9	.	0	11	3
13 lb of Rice . . .	at	0	3	.	0	3	3
5 lb of black Pepper .	at	1	6	.	0	7	6
10 oz of Cloves . .	at	0	10	per oz.	0	8	4

Hosier

		s	d	q		l	s	d
4 pair of ſilk Stockings	at	12	7	2	per Pair	2	10	6
7 pair of worſted Stockings	at	5	—	1	per Pair	1	15	$1\frac{3}{4}$
9 pair of thread Hoſe	at	2	—	1	per Pair	-	18	$2\frac{1}{4}$

6 pair

6 pair of milld Hose .	at	4	1	-	per Pair	1	4	6
3 yards of Flannel .	at	-	10	1	per Yard	-	2	$6\frac{3}{4}$

IRONMONGER

Spring door-Locks, with Hinges	19,	at S4	3	eac
Bolts	42 lb	-	9	p lb
Birmingham brass-Locks .	30	. 7	6	eac
A cast iron-Back . cw 1	3 10	14	8	cw
Sheffield Nails 2	1 12	. .	$4\frac{5}{8}$	lb
Plate-Iron 3	3 —	. .	$6\frac{1}{4}$	

£ 34 4 8

LEATHER-SELLER

Lamb-skins, oild	215	at S 1	$3\frac{1}{2}$	p Skin
Goat-skins . . .	130	. -	$11\frac{1}{4}$	
Sheep-skins, allumd	137	. 1	3	
Calf-skins . . .	19	. 4	3	
Buck-skins, oild .	15	. 12	9	
Russia-hides . . .	82	. 12	9	

£ 94 8 4

LINEN-DRAPER

		s	d		£	s	d
26 ells of Dowlas	at	1	4	per Ell	1	14	8
18 ells of Holland . . .	at	4	0	———	3	12	0
12 ells of Diaper . . .	at	1	0	———	0	12	0
12 damask napkins . .	at	2	0	each	1	4	0
20 yards of printed Linen .	at	2	0	per Yd	2	0	0
10 yards of Cambric . .	at	12	0	———	6	0	0
10 yards of Muslin . .	at	7	0	———	3	10	0
14 yards of Canvas . .	at	3	4	———	2	6	8

MERCER

9 yards of Silk . . .	at S14	6	per Yd	6	10	6
12 yards of flowerd Silk .	at 16	8	———	10	0	0
16 yards of Sarsenet . .	at 6	9	———	5	8	0
10 yards of Satten . .	at 9	6	———	4	15	0

 15 yards

15 yards of Brocade	at 10	8	——	8	0	0
11 Scarves	at 2	0	each	1	2	0
14 yards of Genoa Velvet	at 17	4	per Yd	12	2	8
10 yards of Lustring	at 5	2	——	2	11	8

Milliner

		s	d		£	s	d
15 yards of silver Ribon	at	2	3	p. Yd	1	13	9
3 pair of fine Kid Gloves	at	2	0	p. pair	0	6	0
6 dozen of Irish Lamb ditto	at	1	0	——	3	12	0
6 Sarsenet Hoods	at	4	6	each	1	7	0
15 Fans, India-Mount	at	4	0	——	3	0	0
3 Setts of Knots	at	2	0	p. Sett	0	6	0
16 yards of fine Lace	at	10	0	p. Yd	8	0	0
20 pieces of Bobbin	at	0	6	p. pce.	0	10	[illegible]

Salter

Anchovies	$13\frac{1}{2}$ lb	at S 1	$4\frac{1}{2}$ lb	
Capers	30	-	$10\frac{1}{4}$	
Salt-petre	$12\frac{1}{4}$	1	$2\frac{1}{2}$	
Mushrooms	$2\frac{1}{2}$ gall	3	7 qt	
Lucca-Oil	$4\frac{1}{2}$	12	- gal	
Westphalia-Ham	20 lb	——	$11\frac{1}{2}$ lb	
				£

Silk-man

Tripoli Belladine	44 lb	at S 19	10	per lb	
Legee of Smyrna	$12\frac{1}{2}$	16	7		
A fangot of Raw-silk	130	13	8		
Ditto of Ardas	118	12	4		
Gold & silver Twist	17	6	4	per oz	
Twisted Silk in grain	$12\frac{1}{2}$	3	-		
					£ 331 2 7

Smith

For 4 large Casements, weighing 40 lb, at 6 d per lb	1	—	—
For 5 small Casements, wt 30 lb, at 6d per lb	—	15	—

For

For 12 pair of Hooks and Riders for doors, weighing 65 lb, at 4 d per lb . . .	1	1	8
For 3 great Bars for chimnies, weighing 60 lb, at 4 d per lb . . .	1	—	—
For 4 door-bars, weighing 40 lb, at 4 d per lb	—	13	4
For 4 Dogs, weighing 24 lb, at 4 d per lb .	—	8	—
For 4 large Bolts for doors, weighing 6 lb, at 4 d per lb	—	2	—

Tobacconist

1748.
Mar. 26. 1 hhd of best bright Tobacco, qt Nt $5\frac{1}{2}$ cw, at $10\frac{1}{8}$d per lb . .
15. 1 box of Oroonoko, qt $75\frac{1}{2}$ lb, at $11\frac{3}{4}$d per lb . . . .
19. 5 bags of old Spanish, qt 684 lb, at $4\frac{1}{8}$d per lb . . .
May 25. $\frac{1}{2}$ hhd ditto, qt 293 lb, at $5\frac{3}{8}$d per lb
27. 2 rolls, qt 94 lb, at 1 s $5\frac{1}{8}$d . . .

£ 54 14 2

Upholder

A rich crimson-damask Bed, laced . . .	£ 75	—	—
A set of window-Curtains and Vallants . .	16	11	8
A Carpet, Counter-pane, and otter-doun Quilt	12	10	—
A crimson-velvet easy Chair, and 2 Stools ditto	13	7	6
A wrought Dimity-Bed, and Furniture . . .	28	18	4
A doun-Bed, Bolster, Pillows, Mattress, and Quilt	15	—	—
Chairs 10, with two-armd Do, walnut-tree frames	34	12	6

Wine-cooper

Palm-Sack .	18 gall. at	S 8	6 p. gall		
Red-Port .	35 .	5	4 .		
Sherry . .	17 . .	6	6 .		
Rhenish . .	19 . .	6	8 .		
Lisbon, white .	32 . .	4	10 .		
Burgundy .	$10\frac{1}{2}$ doz . .	50	- per doz		
Côte rotie .	7 . :	2			
Florence, a double chest				4 —	—
				£ 81 10	6

Woolen-

WOOLEN-DRAPER

16 yards of Drugget . . .	at	7	0	per Yd	5	12	0
12 yards of Broad-Cloth .	at	15	0	——	9	0	0
9 yards of Black-Cloth .	at	16	5	——	7	7	9
10 yards of Shalloon . .	at	1	8	——	0	16	8
15 yards of Serge . . .	at	1	10	——	1	7	6
7 yards of fine Spanish Black,	at	18	0	——	6	6	0
16 yards of Frieze . . .	at	4	6	——	3	12	0
12 yards of superfine Scarlet	at	18	0	——	10	16	0

III. INVOYCES

from FRANCE

Bourdeaux, 20 oct. 1747.

Invoyce of $\frac{1}{2}$ a tun of Wine, and 20 pieces of prunes, shipt on the Canary-merchant, A B master, for the account of C D, merchant in London, markt &c.

	Liv	sol	den
To 2 hhds of Claret at 50 *crowns* per tun : .	75	—	—
20 ps of Prunes, wt 17596 lb at *liv* 2 17 7 per quintal			
Custom and Brokerage of wine, at 20 *liv.* per tun	10	—	—
charges in Buying 15 *sols* per tun .	—	7	6
Sledage and Boatage of the said wine . .	—	15	—
Custom of prunes at *liv* 4 15 per piece .	95	—	—
Sledage and Boatage, 9 *sols* per piece . .	9	—	—
the Ship-broker, for the prunes 10 *sol* per tun	4	17	9
Average and Poor's-box 27 *sols* per tun gr	13	3	10
my Commission at $2\frac{1}{2}$ per-cent	17	17	6

from PORTUGAL

Oporto, 2. 1747

Invoyce of wine, laden by E F and G H on board the

3 Invoyce *(or Factory) is a particular account of commodities, custom, provision, charges, &c. sent by a merchant to his factor, or correspondent, in another country.*

the Savannah, I K master, for account of L M and Comp. and consignd to N O and Comp. in Dantzick.

	Mill Reas
To Cost of 10 pipes of wine at 16m per pipe .	160. 000
Custom, at 1055 *reas* per pipe . . .	10. 550
Triming &c. at 400 *reas* . . .	4. 000
Primage, at 60 *reas* per pipe . .	0. 600
Brokerage, at $\frac{1}{2}$ per cent . .	0. 876
Commission, at 3 per cent . .	5. 280
Port-charges of the ship . . .	6. 380

IV. ACCOUNTS CURRENT [4]

Bourdeaux ann. 1747

Mr C D				Dr
Oct. 20. To cost and charges of 20 pcs of Prunes, with $\frac{1}{2}$ a tun of wine, shipt by the Canary-merchant, A B master; as per invoyce sent *Livr.*	732	13	10
To my Bill of 70 *cr.* 5 *sol.* remited him on Mr I S, at $1\frac{1}{2}$ usuance at $55\frac{3}{4}$ *d.* per *cr.* . . .	210	5	—
Dec. 7. To cost and charges of 10 pieces of Brandy, shipt per E S; as per invoyce . . .	1291	1	6
Jan. 10. To cost and charges of 1 tierce of white-Wine, $\frac{1}{2}$ hhd of Vinegar, shipt on the True-love of Yarmouth, N R master . . .	44	15	—
To postage of Letters, this day . .	1	16	—
Feb. 16. To Balance, transferd to your credit, in new account . .	18	4	8
Errors excepted *Liv.*	2298	16	-

Contra

4 Account current *is that, wherein a correspondent is made* Debtor; *for whatever he ought to make good, or allow; and* Creditor, *for what ought to be allowd, or made good to him: and is an account, that sums-up the heads of your dealings with him; and decides how affairs stand betwixt you, to the time of its being made-out.*

Contra Cr.

Oct.	30.	By my Bill on him in favor of Mr F A of 312 *cr.* 11 *sol.* at 2 usance, at $55\frac{1}{4}$ per cent . *Livr.*	936	11	—
Dec.	14.	By his Remitance, at 10 days sight, of 270 *cr.* on Mrs P and J L .	810	—	—
	15.	By his Remitance, at 8 days sight, of 185 *cr.* on Mr R L of R, negotiated at, $\frac{1}{2}$ per cent, loss, with Mr S	552	5	—
		Livr.	2298	16	—

V. QUESTIONS [5]

1. How will you set-down each of the following articles? and What do they all amount-to? Three half-pence, seven farthings, eight groats, eleven groats and two-pence, two-and-twenty-pence, six-and-thirty shillings.———*Total:* £2 6 2 1.

2. A man has 6 bags of hops: the first weighs 2 qrs 14 lb: and each of the rest weighs 14 lb more. What quantity has he, in the whole?——— 5 *quarters*.

3. A man was born in the year 1702. When will he be 57 years of age?———*In the year* 1759.

4. A man borrowd a sum of mony; and payd, in part, 12 l 10 s: the remainder is 17 l 10 s. What was the sum he borrowd?———30 *l.*

5. There

5 NB. *The following questions are designd to put young folks upon reflexion; and to enter them upon the practise of casting-about, and contriving how to prepare what may be proposd to them in different shapes, before they can proceed to the operation. It is not enough that they can add-up a sum, when set: they should be able to manage any concerns in all varieties—For the answering several of these questions, there is requird some knowlege of multiplication, reduction, &c. But then* (1) *Either it is of such a nature as may be compast by the head; an exercise, that ought carefully to be inculcated* (2) *Or, if any of them shall be found too difficult for a child, at his first entrance upon this article; the solution of them may be deferd, till the mind is a little opend by further advances.*

5. There are two numbers, whose difference is 17, and the lesser number is 44. What is the greater number? ——— 61.

6. A owes me 5 guineas, B 50l 12s, C 104l, D threescore and seventeen pounds. How much is due, in all? ——— £ 234 15.

7. There is owing me from several debtors, as follows: A owes me 20l 15s, B 100l, C 56l 10s 8d, D 82l 18s 4d. What is the amount of the whole? ——— £ 260 4.

8. Bought a parcel of goods: the first cost whereof was 40l 10s. Payd, for packing them, 13s; for carriage, 1l 6s 8d; and spent, about making the bargain, 15s 6d. What do these goods stands me in? ——— £ 43 5 2.

9. I have a bank-note of 20l: a note-of-hand for 6l 10s: and, in several coins, as follows: in copper, 13 farthings, and 45 half-pence: in silver, 25 two-pences, 36 three-pences, 56 groats, 96 six-pences, 67 shillings, 97 half-crowns, 126 crowns: in gold, 25 quarter-guineas, 65 half-guineas, 77 guineas, and 34 moidores. I would know what I am worth. ——— £ 245 0 2 3.

10. A father was 18 years 4 months old (reckoning 13 months to one year, and 28 days to one month) when his eldest child was born. Betwixt the eldest and second were 11 months, 10 days. Betwixt the second and third, were 3 years, 8 months. When the third is 12 years, 6 months, 20 days: How old is the father? ——— *35 years, 4 months, 2 days.*

11. A merchant, in the year 1745, imported, by one ship, 8 tuns of claret; by another, 12 tuns, 3 hogsheads, 42 gallons of red port; by another, 14 tuns, 2 hogsheads, 11 gallons of sherry; and, by another, 5 tuns, 3 hogsheads, 10 gallons of canary. What quantity of wines did he import, that year, in all? ——— *41 tuns, 1 hhd.*

12. From the foundation of the world to the begining of the deluge is accounted 1656 years: and, from the beginning of the deluge to the birth of Arphaxad, Helvicus reckons 2 years; and, thence, to Terah, 220 years: thence, to the birth of Abraham 70 years (gen. xi) thence, to the promise given (mentiond gen. xii) he reckons 75 years; and, thence to the going-out of Egypt, 430 years: and, from that going-out, to the temple of Solomon, 480 years: and, thence, to the birth of Christ, 1015 years: and he supposes that, from thence, to the begining of the common christian

or

or Dionysian aera, 2 years have elapst; and, thence, to the present year wherein this was writ, we reckon 1748 years. According to the chronology of Helvicus, therefore, How long is it since the creation of the world?——5698 *years.*

13. A surveyor, having measurd 5 several pieces of land, finds one of them to contain 7 acres, 3 roods, 24 perches; another to contain 18 acres, 1 rood, 16 perches; another 12 acres, 10 perches; and the last, 15 acres, 2 roods. How many acres were surveyd in all?——*Acr.* 57 3 7.

14. In the year 1563, 20000 persons died of the plague in London: in 1593, 10635 died of the same distemper: in 1603, 30578: in 1625, 54265; of the plague but 35417: in 1665, 97351 died; and of them, 68586 of the plague. How many died of the plague, between the years 1563 and 1665, both years included?——165216.

ALLIGATION

I. Medial:

Coin

1. A *Mint-master* has 3 lb weight of gold, of 22 carats fine; and 3 lb, of 20 carats fine: I demand what fineness, an ounce of this mixture will bear——21 *carats fine.*

2. Suppose I have gold to melt, of 16, 18, 19, and 20 carats fine; and put-in 3 oz at 16 car. 5, at 18; 2, at 19; and 2 at 20: What will be the degree of fineness of these 12 oz, when they are all melted together?——18 *car.*

Corn

3. A *Farmer* mixes 12 qrs of wheat, at 20 s; the same quantity of rye, at 15 s; and the same of barley, at 13 s: How much is 1 qr of this mixture worth?——16 *s.*

4. Suppose I mix 19 bushels of wheat, at 6 s a-bushel; and 40 of rye, at 4 s; and 12 of barly, at 3 s. What will 1 bushel of this mixture be worth?——*S* 4 4 $1\frac{1}{71}$.

5. An

5. An *Hostler* mixes provender for his horses: a quantity of beans at 5 s a-bushel; with the same quantity of oats, at 3 s 6 d a bushel: At what price can this mixture be afforded?——*S* 4 3.

6. Suppose provender for horses to be a mixture, as follows: 5 bushels of oats, at 3 s 6 d a bushel; 3 of oats, at 4 s 8 d; 2 of malt, at 2 s 2 d; and 4 of beans, at 5 s 3 d: At what rate must this mixture be sold per peck——*D* 12 $\frac{5}{28}$.

7. I have several sorts of wheat; some, at 22 s a-load; some, at 19 s; some at 15 s; and some, at 14 s: I would know (1) What quantity of each sort I must take, to make the mixture worth 18 s a-load? and (2) How much of each, to make just 30 load?——(1) 3 *load, of the 1st*; 4, *of the 2d*; 4, *of the 3d*; 1, *of the 4th*. (2) 7$\frac{1}{2}$; 10; 10; 2$\frac{1}{2}$.

8. A *Miller* mixes-together 32 bushels of wheat-meal, at 10 s a bushel; 24 bushels of rye-meal, at 6 s 8 d a-bushel; and 8 bushels of barley-meal, at 5 s a-bushel. What will a bushel of that mixture be worth?——*S* 8 1 2.

9. Suppose a mixture of 20 bushels of oats, at 2 s a-bushel; 30 of beans, at 2 s; 20 of peas, at 3 s: What will be the value of 1 bushel of this mixture?——*S* 2 3 1$\frac{5}{7}$.

Malt

10. A *Malster* has several sorts of malt: one at 4 s 6 d; another, at 4 s; and a third at 3 s 6 d a-bushel: To mix an equal quantity of each, What must be the price of a bushel?——*S* 4.

11. A Malster mingles 24 quarters of high-dried malt, at 25 s a-quarter, with 30 quarters of brown-malt, at 28 s a-quarter, and 46 quarters of pale malt, at 30 s a-quarter. The malt being thus mingled, What is the worth of a quarter?——28 $\frac{1}{5}$ s.

Malt-liquors

12. An *Alehouse-keeper* mixt 3 sorts of ale together: viz 12 gallons, at 6 d a-gallon; 16, at 7 d; and 21, at 9 d: What is the value of 1 gallon of this mixture?——*D* 7 2$\frac{22}{49}$.

13. A *Brewer* has several sorts of ale: one sort, of 20 s a-barrel; another, at 25 s; a third, at 30 s; and a fourth,

at 35 s: What will be the value of 1 gallon of this mixture?——*D* 10 $1\frac{8}{31}$.

Metals

14. A *Refiner*, having 5 lb of silver-bullion, of 8 oz fine; 10 lb, of 7 oz fine; and 15 lb, of 6 oz fine; would melt all together: What will be the fineness of 1 lb of this mass?——6 *oz.* 13 *dw.* 8 *gr.*

15. A *Silversmith* has silver of 7, of 8, of 9, of 10, and of 11 oz fine; an equal quantity of which he melts-down: Of what fineness will the mixture be;——9 *oz.*

16. Suppose I melt together the following quantities of silver; 6 lb, of 11 oz fine; 4, of $10\frac{1}{2}$; 7, of 10; 8, of 9: What will be the degree of fineness of the whole?——10 *oz.*

17. One puts into the foundry, and mixes 12 lb of silver, of 11 oz fine; and 4 lb of copper: What the degree of fineness of this mixture?——8 *oz.* 5 *dw.*

Perfumes

18. Of three sorts of rich *Perfumes*, suppose one to be worth 2 s 6 d a-dram; the second, 3 s 9 d a-dram; and the third, 6 s 3 d a-dram. What will the value of a dram of the perfume be, compounded of 10 drams of the first sort, 8 drams of the second, and 12 of the third?——*S* 4 4.

Spices

19. A *Druggist* has 27 lb of large cloves, at 6 s a-pound; 15 lb of a middling sort, at 2 s 6 d a-pound; and 10 lb of a coarser sort, at 2 s 2 d a-pound: How may a mixture of these be sold by the pound?——*S* 4 3 $2\frac{1}{26}$.

Sugar

20. A *Grocer* mixt 2 cw of sugar, at 56 s per cw; and 1, at 43 s; and 2, at 50 s. What the price of 3 cw of this mixture?——*£* 7 13.

Tobacco

Tobacco

21. A *Tobacconist* mixes 36 lb of tobacco, worth 1 s 6 d a-pound, with 12 lb of another ſort, at 2 s a-pound; and 12 lb of a third ſort, at 1 s 10 d a-pound. How may he ſell the mixture per pound?——*S* 1 8.

22. What is the worth of a pound of the following mixture of tobacco (1) 20 lb, at 9 d the pound (2) with 60 lb, at 12 d (3) 40 lb, at 18 d (4) and 12 lb, at 2 s the pound? ——*S* 1 $2\frac{1}{2}$.

Wine

23. A *Merchant* mixes 5 gallons of canary, at 8 s a-gallon; 6 of malaga, at 7 s; and 4 of white-wine, at 6 s. What is a gallon of this mixture worth?——*S* 7 0 $3\frac{1}{5}$.

24. Suppoſe I would mix 24 gallons of canary, at 8 s a gallon; 16 of claret, at 14 s; 42 of rheniſh, at 6 s; and 12 of palm-wine, at 16 s. What will be the value of 1 gallon of this mixture?——*S* 7 $5\frac{1}{4}$.

25. A *Vintner* has wine at 10, 8, 5; and 4 s a-gallon; of which he would mix-up 100 gallons, that may be worth 6 s a-gallon. How much muſt he take of each ſort?——$22\frac{2}{9}$ *gallons of that of* 10 *s*: $11\frac{2}{9}$, *at* 8 *s*: $22\frac{2}{9}$, *at* 5 *s*: $44\frac{4}{9}$, *at* 4 *s*.

26. A Vintner, having 24 gallons of canary, at 8 s per gallon; 16 gallons of claret, at 4 s per gallon; 42 gallons of rheniſh wine, at 6 s per gallon; and 12 gallons of palm-wine, at 16 s per gallon. How may he ſell theſe together, that he may not loſe?——*S* 7 5 1.

II. Alternate.

1. *Simple*

27. A *Diſtiller*, by mixing ſeveral ſorts of ſpirits, would make the quantity of a hogſhead, to be ſold at a crown a-gallon. How many gallons of the firſt ſort, at 6 s 8 d; of the ſecond, at 5 s 10 d; of the third, at 5 s 6 d; of the fourth, at 4 s 4 d; and of the fifth, at 3 s 6 d a gallon,

must he make-use-of, to answer his purpose?——*Gallons of the 1st,* 16$\frac{1}{5}$ .. *2d,* 7$\frac{1}{5}$ .. *3d,* 7$\frac{1}{5}$ .. *4th,* 14$\frac{2}{5}$ .. *5th,* 18.

28. A *Druggist* has several sorts of tea, viz one sort at 12 s per lb, another at 11 s, a third at 9 s; and a fourth at 8 s per lb. I demand how much of each sort he must mix together, that the whole quantity may be afforded at 10 s per lb?

	lb	*s* per *lb*		*lb*	*s p lb*		*lb*	*s p lb*
1 *Answ.*	2 *at*	12	2 *Answ.*	3 *at*	12	3 *Answ*	1 *at*	12
	1 *at*	11		2 *at*	11		2 *at*	11
	1 *at*	9		2 *at*	9		2 *at*	9
	2 *at*	8		3 *at*	8		1 *at*	8

	lb	*s p lb*		*lb*	*s p lb*		*lb*	*s p lb*
4 *Answ.*	1 *at*	12	5 *Answ.*	3 *at*	12	6 *Answ.*	2 *at*	12
	3 *at*	11		1 *at*	11		3 *at*	11
	3 *at*	9		3 *at*	9		1 *at*	9
	1 *at*	8		2 *at*	8		3 *at*	8

7 *Answ.* 3 *lb of each sort.*

29. A *Farmer* is willing to make a mixture of rye, at 4 s a-bushel; barly, at 3 s; and oats, at 2 s. How much must he take of each, to sell it at 2 s 6 d a-bushel?——6, *of rye;* 6, *of barly;* 24, *of oats.*

30. A *Grocer* would mix three sorts of sugar together, viz one sort at 10 d per lb, another at 7 d, and another at 6 d. How much of each sort must he take, that the whole mixture may be sold for 8 d per lb?——3 *lb, at* 10 *d a-pound:* 2, *at* 7; 2, *at* 6.

31. How many raisins of the sun, at 7 d a-pound; and malaga, at 4 d; may be mixt-together for 6 d a-pound?——2 *lb of those of the sun, and* 1 *lb of malaga.*

32. A *Malster* has several sorts of malt, viz one sort at 4 s per bushel; another, at 3 s 6 d; a third, at 3 s; and a fourth, at 2 s per bushel; and he is desirous to mix so much of each sort together, that the whole may be sold, at 2 s 6 d per bushel. I demand how much he must take of each sort?——6 *bushels, at* 4 *s a-bushel;* 6, *at* 3 *s;* 6, *at* 3 *s* 6 *d;* 36, *at* 2 *s.*

33. A *Refiner* would abate bullion of 10 oz fine to 8 oz fine. What must be the alloy?——*To every* 8 *oz of bullion be must put* 2 *oz of alloy.*

2. *Partial*

34. A *Chapman* has yarn, at ſeveral rates; and would mix 40 lb, at 24 d the pound; with ſome, at 20 d the lb; with ſome, at 14 d the lb; with ſome, at 9 d the lb; and ſome, at 7 d the lb. How much of each ſort muſt he mix with the 40 lb, at 24 d the lb, that he may ſell a pound for 16 d?——5, *at* 20 . . 10, *at* 14 . . 20, at 9 and 7.

35. A *Farmer* determind to mix 10 buſhels of wheat (at 4 s a-buſhel) with rye (at 3 s) barly (at 2 s) and oats (at 1 s a-buſhel). How much of each muſt he mix with the 10 buſhels of wheat; to ſell the whole at 2 s 4 d per buſhel?—(1) 8, *of rye*; 10, *of barly*; 14, *of oats*: (2) *or* 40, *of rye*; 50, *of barly*; 20 *of oats*: (3) *or* 5 *&c.*

36. How much wheat, at 5 s a buſhel, muſt be mixt with 12 buſhels of rye, at 3 s 6 d a-buſhel: that the whole mixture may be ſold at 4 s 4 d per buſhel?——15 *buſhels.*

37. What quantity of oats (at 2 s 4 d a-buſhel) and of beans (at 2 s 6 d) muſt I have to mix with 27 buſhels of peas (at 18 d a-buſhel) to ſell the mixture at 20 d per buſhel?——3 *buſhels of each.*

38. A *Founder* has a quantity of ſilver, weighing 3 pounds (avoirdupois weight) which he values at 4 l 8 s a-pound. How much iron, at $1\frac{1}{2}$ d a-pound; and braſs, at $4\frac{1}{2}$ d a-pound; muſt be melted down together with the 3 pounds of ſilver, that the mixt metal may be worth 3 s 6 d a-pound?——*lb* 39 *of iron, and* 39 *of braſs.*

39. A *Goldſmith*, having 20 lb weight of ſilver-bullion, 6 penny-weights fine, would melt it down together with another ſort, 10 dw fine; and another ſort, 12 dw fine: of each ſuch a quantity, that the whole mixture may bear 9 dw fine. What quantity of each of the two laſt ſorts muſt he mix with the 20 lb of the firſt ſort, to anſwer his purpoſe?——15 *lb of each.*

3. *Total*

40. A *Brewer* has 3 ſorts of ale, viz at 10 d, at 8 d, and at 6 d per gallon; and he would have a compoſition of 30 gallons, worth 7 d per gallon. I demand how much of each ſort he muſt have?——5 *gallons* (*at* 10 *d*) 5 (*at* 8 *d*) 20 (*at* 6 *d*).

41. A *Druggist* had three sorts of drugs: one was worth 4 s per lb; another, 5 s; and another, 8 s: and, out of these, he made two parcels; one was 21 lb, at 6 s per lb; and the other, 35 lb, at 7 s per lb. How-much of every sort did he take, for each parcel?—(1) 6, *at* 4 *s per lb* . . 6, *at* 5 . . 9, *at* 8. (2) 5, *at* 4 *s per lb* . . 5, *at* 5 . . 25, *at* 8.

42. A *Goldsmith* has gold of three sorts: to wit, of 22 carats, of 21 carats, and of 20 carats fine: and he would mix, with these, so much alloy; as that the quantity of 21 oz may bear 18 carats fine. How much of each sort must he take; and how much alloy?——*Of gold*, 6 *oz* . . *of alloy*, 3 *oz*.

43. A Goldsmith has several sorts of gold: to-wit, some of 24 carats, some of 22 carats, and some of 18 carats-fine: and he would have compounded, of these sorts, the quantity of 60 oz of 20 carats-fine. How much of each sort must he take?——12, *of* 24 *carats-fine* . . 12 *of* 22 . . 36, *of* 18.

44. A *Grocer* has 4 sorts of sugar: to wit, at 8 d, at 6 d, at 4 d, and at 2 d per lb: and he would have a composition of a cw, worth 5 d per lb. How much of each sort must he take?——28, *of each sort*.

45. A *Vintner* has 4 sorts of wine: to-wit, canary, at 10 s per gallon; malaga, at 8 s; rhenish, at 6 s; and oporto, at 4 s: and he is minded to make a composition of 60 gallons, worth 9 s per gallon. How much of each sort must he have?——*Gallons*, 45 *of canary*; *and* 5, *of each other sort*.

ANNUITIES

I. in Arrears,

i. *at Simple interest*

1. If an annuity of 70 l be forborn 5 years; What will it amount-to, in that time, at 5 per cent?——385 *l*.

2. If

2. If the payment of a pension be omited for 7 years; What will be the amount, in that time, at 6 per cent, when the pension is 56 l per annum?——£ 462 11 2 16.

3. A house is let upon lease for 7 years, at 50 l per annum: What is the amount, for that time, at 4 l per cent for the forbearance of payment?——392 *l*.

4. Suppose a salary of 100 l per annum be forborn 7 years; What is the amount, at $4\frac{1}{2}$ per cent?——£ 794 10.

5. If 70 l annuity, payable every half year, were unpaid 5 years; What will it amount-to, in that time, at 5 per cent?——£ 389 7 6.

6. If 70 l annuity, payable every quarter, were unpaid 5 years; What will it amount-to, in that time, at 5 per cent?——£ 391 11 3.

7. If the amount of an annuity, for 5 years, at 5 per cent, be 385 l. What is the annuity?——70 *l*.

8. If the amount of a pension be 462 l 11 s 2 d 1.6 q the time be 7 years, and the rate, per cent, 6 l: What is the pension?——56 *l*.

9. If a house be let upon lease for 7 years, and the amount, for that time, be 392 l, at 4 per cent; What is the yearly rent?——50 *l*.

10. If a salary amount to 794 l 10 s, in 7 years, at $4\frac{1}{2}$ per cent. What is the salary?——100 *l*.

11. If the amount of an annuity, payable half-yearly, for 5 years, at 5 per cent, be 389 l 7 s 6 d; What is the annuity?——70 *l*.

12. If the amount of an annuity, payable quarterly, for 5 years, at 5 per cent, be 391 l 11 s 3 d; What is the annuity?——70 *l*.

13. If an annuity of 70 l per annum, amounts to 385 l, in 5 years. What is the rate per cent?——5 *l*.

14. If a pension, of 56 l per annum, amounts to 462 l 11 s 2 d 1.6 q, in 7 years; What is the rate per cent.--6 *l*.

15. If a house be let upon lease, for 7 years, at 50 l per annum; and the amount, for that time, be 392 l: What is the rate per cent?——4 *l*.

16. If a salary of 100 l per annum, being forborn 7 years, amounts to 794 l 10 s; What is the rate per cent? ——$4\frac{1}{2}$ *l*.

17. If an annuity of 70 l per annum, payable half-yearly, being forborn 5 years, amounts to 389 l 7 s 6 d; What is the rate per cent?——5 *l*.

18. If an annuity of 70l per annum, payable quarterly, amounts to 391 l 11 s 3 d, in 5 years; What is the rate per cent?——5 *l.*

19. In what time will 70l per annum, amount to 385 l, forborn at 5 per cent?——5 *years.*

20. In what time will a pension of 56l per annum, amount to 462 l 11 s 2 d 1.6 q, at 6 per cent?—— 7 *years.*

21. If a house be let, upon lease, for a certain time, for 50l per annum; and the amount be 392 l, at 4 per cent; What is the time that it was let for?——7 *years.*

22. If a salary of 100 l per annum, being forborn a certain time, amount to 794 l 10 s, at $4\frac{1}{2}$ per cent; What is the time of forbearance?——7 *years.*

23. If an annuity of 70 l per annum, payable half-yearly, being forborn, amount to 389 l 7 s 6 d, at 5 per cent; What is the time, and payments forborn?——5 *years* . . . 10 *payments.*

24. If an annuity of 70 l per annum, payable quarterly, being forborn, amount to 391 l 11 s, 3 d, at 5 per cent: I would know the time, and the payments forborn?——5 *years* . . 20 *payments.*

ii. *at Compound interest*

25. What will an annuity of 30 l per annum, payable yearly, amount to in 4 years, at 5 per cent?——£ 129 6 0 3.6.

26. Suppose a pension of 50 l per annum, payable yearly, be granted to a superannuated officer; What is the amount for 5 years forbearance, at 4 l per cent?——£ 270 6 3 3.4.

27. If the yearly rent of a house, which is 40 l, be forborn 7 years, at 6 per cent; What is the amount?——£ 335 15 0 3.3.

28. If a salary of 35 l per annum, to be paid yearly, be omited for 6 years, at $5\frac{1}{2}$ per cent; What is the amount?——£ 241 1 7 2.5.

29. What annuity, being forborn for 4 years, will amount to 129 l 6 s 1 d, at 5 per cent?——30 *l.*

30. If a pension, being forborn for 5 years, at 4 per cent, per

per annum, amount to 270 l 16 s 4 d; How much is it per annum?——50 *l.*

31. If the yearly rent of a house, being forborn for 7 years, at 6 per cent, amount to 335 l 15 s 0 d 3.4 q; What is the rent?——40 *l.*

32. If the payment of a salary be omited 6 years: I would know how much the salary is, when the amount is 241 l 1 s 7 d 2 6 q, at $5\frac{1}{2}$ per cent?——35 *l.*

33. In what time will 30 l per annum, amount to 129 l 6 s 1 d, allowing 5 per cent for the forbearance of payment?——4 *years.*

34. In what time will a pension of 50 l per annum, amount to 270 l 16 s 4 d, at 4 per cent?——5 *years.*

35. In what time will the yearly rent of a house, being 40 l per annum, amount to 335 l 15 s 1 d, at 6 per cent, for the forbearance of payment?——7 *years.*

36. In what time will a salary of 35 l per annum, amount to 241 l 1 s 7 d 2.6 q, at $5\frac{1}{2}$ per cent for the forbearance of payment?——6 *years.*

II. the Purchase,

i. for a Certain Number of years:

1. *at Simple interest*

1. What is the present worth of 50 l per annum, to continue 6 years, at 5 per cent!——£ 259 12 3 2.4.

2. What is 80 l yearly rent, to continue 5 years, worth in ready mony, at 6 per cent?——£ 344 12 3 2.5.

3. What is a salary of 40 l per annum, to continue 7 years, worth in ready mony, at 4 per cent?——245 *l.*

4. What is a pension of 30 l per annum, for 5 years, worth in ready mony, at $4\frac{1}{2}$ per cent?——£ 133 9 4 2.6.

5. What is the present worth of 50 l per annum, payable half-yearly, for 6 years, at 5 per cent?——£ 262 10.

6. What is the present worth of 50 l per annum, payable quarterly, for 6 years, at 5 per cent?——£263 18 9 3.6.

7. There is a lease of a house 6 years to come: What is

is the yearly rent, when the present worth, at 5 l per cent, is £ 259 12 3 2?——50 *l.*

8. What yearly rent is that, the present worth of which, for 5 years, is 344 l 12 s 3 d 2 q, at 6 per cent?——80 *l.*

9. What salary is that, which, for 7 years continuance at 4 per cent, produces 245 l, for the present worth?——40 *l.*

10. If the present worth of a pension, to continue 5 years, at $4\frac{1}{2}$ per cent, be 133 l 9 s 4 d 3 q; I would know what the pension is?——30 *l.*

11. There is a lease of a house, payable half-yearly, for 6 years to come: What is the yearly rent, when the present worth, at 5 per cent, is 262 l 10 s?——50 *l.*

12. There is a lease of a house, payable quarterly, for 6 years to come: What is the yearly rent, when the present worth, at 5 per cent, is 263 l 18 s 9 d 3.6 q?——50 *l.*

13. If 50 *l* yearly rent, produce the present worth of £ 259 12 3 2, at 5 per cent. What is the time of its continuance?——6 *years.*

14. I would know how long 80 l per annum, may be purchasd for 344 l 12 s 3 d 2 q, at 6 per cent?——5 *years.*

15. How long must a salary of 40 l per annum be enjoyd, for 245 l, at 4 per cent?——7 *years.*

16. What time may a pension of 30 l per annum be bought for 133 l 9 s 4 d 2 q, at $4\frac{1}{2}$ per cent?——5 *years.*

17. A lease of a house of 50 l per annum, payable half-yearly, is sold for 262 l 10 s, at 5 per cent: I would know the number of payments, and the time to come?——12 *payments* . . . 6 *years.*

18. A lease of a house of 50 l per annum, payable quarterly, is sold for 263 l 18 s 9 d 3 q, at 5 per cent: I would know the number of payments, and the time to come?——24 *payments* . . . 6 *years.*

2. *at Compound interest*

19. What is the yearly rent of 20 l, to continue 6 years, worth in ready mony, at 5 l per cent?——£ 101 10 3 3.

20. What is the present worth of a pension of 30 l, per annum, for 5 years, at 4 per cent?——£ 133 11 1.

21. What must be the discount of a lease of 50 l per annum;

annum; when present payment is made for 4 years, at 3 per cent?——£ 14 2 10 2.

22. A house is let, upon lease, for 4 years, at 70 l per annum: and the lessee is desird to make present payment, provided the lessor will allow him $5\frac{3}{4}$ per cent: I would know how much must be paid-down, and how much discounted?——£ 243 19 0 3, *to be paid-down* .... £ 36 0 11 1, *to be discounted.*

23. What annuity, or yearly rent, to continue 6 years, may be purchasd for £ 101 10 3 3, at 5 per cent?—20 *l.*

24. Suppose the present payment of 133 l 11 s 1 d were requird for a pension for 5 years to come, at 4 per cent: What is that pension?——30 *l.*

25. If the present payment of 181 l 17 s 1 d 2 q, be made for the lease of a house, 4 years to come, at 3 per cent. What is the yearly rent?——50 *l.*

26. If a house is let upon lease for 4 years, and the lessee makes present payment of 243 l 19 s 0 d 3 q, for that time, at $5\frac{3}{4}$ per cent. What is the yearly rent of that house?——70 *l.*

27. How long may a lease of 20 l, yearly rent, be had for £ 101 10 3 3; allowing 5 per cent to the purchaser? ——6 *years.*

28. What time may a lease of 30 l per annum be purchasd for; when present payment of 133 l 11 s 1 d is made, at 4 per cent?——5 *years.*

29. If 185 l 17 s 1 d 2 q, be paid down for a lease of 50 l per annum, at 3 per cent; How long is the lease purchasd for?——4 *years.*

30. A house is let, upon lease, for 70 l per annum; and the lessee makes present payment of 243 l 19 s 0 d 3 q he being allowd $5\frac{3}{4}$ per cent: I would know how long the lease is purchasd for?—— 4 *years.*

ii. For Ever:

at Compound interest

31. Suppose a freehold estate, of 40 l per annum, is to be sold: What is it worth, allowing the buyer 5 per cent for his mony?——800 *l.*

32. What

32. What is an estate of 290 l per annum, to continue for ever, worth in present mony, allowing 4 per cent to the buyer?——7250 *l.*

33. If a real estate, of 40 l per annum, be sold for 800 l; I would know what was the rate per cent?——5 *l.*

34. If a freehold estate, of 290 l per annum, be bought for 7250 l: What is the rate per cent allowd?——4 *l.*

35. If a freehold estate is bought for 800 l, and the allowance of 5 per cent is made to the buyer: What is the yearly rent?——40 *l.*

36. If an estate be sold for 7250 l, present mony; and 4 per cent is allowd to the buyer, for the same: I would know the yearly rent?——290 *l.*

iii. in Reversion

1. *at Simple interest*

37. What is the present worth of a lease of 30 lb per annum, to continue 3 years; but is not to commence till the end of 2 years; allowing 4 per cent to the purchaser?——£ 77 7 7 2.

38. I have the promise of a pension for 7 years, which will not commence till the end of 4 years; and I have disposd of the same for the present payment of 84 l 9 s 6 d, allowing 5 per cent to the purchaser; I demand the yearly income?——17 *l.*

2. *at Compound interest*

39. Suppose a freehold estate of 40 l per annum, to commence 3 years hence, is to be sold: What is it worth, allowing the purchaser 5 per cent, for his present payment?——£ 691 1 4 3.

40. What is an estate of 290 l per annum, to continue for ever (but not to commence till the expiration of 4 years) worth in present mony, allowance being made at 4 per cent?——£ 6197 6 5 2.

41. Suppose a freehold estate, to commence 3 years hence, is sold for 691 l 1 s 5 d, allowing to the purchaser 5 per cent: I would know the yearly income?——40 *l.*

42. There

42. There is a certain freehold estate bought for 6197 l 6s 5d 2q; which does not commence till the expiration of 4 years; the buyer allowd 4 per cent for his money. What is the yearly income?——40 *l*.

BARTER.

1. B deliverd 3 hds of *Brandy* at 6s 8d per gallon, to C, for 126 yards of *cloth*. What was the cloth per yard? ——10*s*.

2. C has *Candles*, at 6s per dozen ready money: but, in barter, he will have 6s 6d per dozen. D has *cotton*, at 9d per lb, ready money. What price must the cotton be at, in barter; and how much cotton must be barterd for 100 dozen of candles?——*The cotton is* 9*d* 3*q per lb, in barter: And* 7 *cw* 16 *lb of cotton must be given for* 100 *dozen of candles.*

3. Two merchants barter: A has 20 cw of *Cheese*, at 21½ s the cw: B has 8 pieces of irish-*cloth*, at 3 l 14 s per piece: Whether of them must receive mony, and How-much——*A must pay to B* 8 *l* 2 *s*.

4. A and B barter: A has 41 cw of *Hops*, at 30 s per cw: for which B gives him 20 lb in mony; and the rest, in *prunes*, at 5 d per lb. How many prunes did B give A, beside the 20 l——*Cw* 17 3 4.

5. A has 100 yards of *Kersey* at 3 s per yard, ready-mony; which he barters with B, at 3 s 6 d; taking small hair-*buttons* at 15 d per gross, which are but worth 12 d: How many gross of buttons will pay for the kersey: and (2) Whether does A or B get the better bargain; and (3) by How-much?——280 *gross*. (2) *A's goods are worth* 15 *l*; *and B's goods are worth* 14 *l*: (3) *Therefore B gets the better bargain by* 1 *l*.

6. A has *Linen-cloth*, worth 20 d an ell, ready mony: but, in barter, he will have 2 s. B has *broad-cloth*, worth 14 s 6 d per yard, ready mony. At what price ought the

broad-cloth to be rated in barter?——*S* 17 4 $3\frac{4}{20}$ per yard.

7. A has *Linen*-cloth at 10d the ell, ready-mony; in barter, 12d. B has 3610 lb of *sugar*, at 7d the pound, ready-mony; and would have, of A, 35 l in ready-mony, and the rest in linen-cloth: I would know (1) What rate the sugar bears in barter; and (2) How-much linen-cloth A must give to B.——(1) *The rate of the sugar, in barter, is* 8.4 *l*; *and* (2) *B must have* 1687 *ells of linen-cloth, and* 35 *l in ready-mony.*

8. Two men barter: A has 357 ream of *Paper*, worth 9 s 7d a ream: for which B gives L 74 11 6, ready-mony; and, the rest, he is to give (by agreement) in broad-*cloth* at 21 s 9 d a-yard: The question is How-much broad-cloth will satisfie?——$88\frac{21}{29}$ *yards.*

9. A would exchange cw 5 3 14 of *Pepper*, worth 1 3 10 a pound; with B, for *cotton*, worth 10d a pound. How much cotton must B give to A for his pepper?——*Cw* 4 1 $17\frac{1}{2}$.

10. How much *Rice*, at 28s per cw must be barterd for $3\frac{1}{2}$ cw of *raisins*, at 5 d per lb?——*Cw* 5 3 $9\frac{112}{336}$.

11. A barters with B silk-*Stockings* at 30s per pair, which are vendible but for 26 s; and would have $\frac{1}{3}$ ready-mony; and, again 10 l per cent for *stuff* at 4 s per yard ready-mony: How must the yard of stuff be valued, to equal the barter?——$5\frac{13}{15}$ s.

12. A and B barterd: A had 5 cw of *Sugar*, at 6 d per lb; which he gave to B for a quantity of *cinamon* at 10 s 8 d per lb. How-much cinamon did B give A?——26 *l*, 4 *oz*.

13. Two merchants barter: A had cw 13 3 10 of *Sugar*, worth $6\frac{1}{2}$d lb: for which B gave him cw 27 2 20 lb of *figs*: How did B rate his figs?——$3\frac{1}{4}$ *d per lb.*

14. How-many pound of *Sugar*, at $4\frac{1}{2}$d per lb, must be given, in Barter, for 60 gross of *incle* at 8 s 8 d, per gross? ——$1386\frac{2}{3}$ *lb.*

15. How-much *Sugar*, at 9 d per lb, must be given in barter for $6\frac{1}{2}$ cw of *tobacco*, at 14 d per lb?—— *Cw* 10 0 $12\frac{4}{9}$.

16. What quantity of *Tea*, at 10 s per lb, must be given, in barter, for 1 cw of *chocolate*, at 4 s per lb?——44 *lb* $12\frac{8}{10}$ *oz.*

17. Two

17. Two merchants barter: A has 13 tuns, 2 hhds of *Wine*, worth 50 l per tun: B has *sugar*, worth 6 d a pound: How much sugar must A give B for his wine?——241 *cw*, 8 *lb*.

COMBINATION.

1. Seven gentlemen, that were traveling, met-together, by chance, at a certain inn upon the road; where they were so well pleasd with their host, and each other's company; that, in a frolic, they offerd him 30 l, to stay at that place, so long as they (together with him) could sit (every day) at dinner, in a different order. The host, thinking that they could not sit in many different positions, because there were but a few of them, and that himself would make no considerable alteration (he being but one) imagind he should make a good bargain; and readily (for the sake of a good dinner, and better company) enterd into an agreement with them: and, so, made himself the eighth person. I would know how long they staid at the said inn; and how many different positions they sate in.——*The number of positions were* 40320; *and the time that they stayd, was* 110 *years*, 142 *days*; *allowing the year to consist of* 365 *days, and* 6 *hours*.

DIVISION

SUMS[9].

Simple

Divide . . . . . 171316750004 . . . . . . *By*

1st	1	11	11	21	21	31	187	41	827	51	1394
2	2	12	12	22	22	32	179	42	112	52	1999
3	3	13	13	23	23	33	191	43	119	53	1199
4	4	14	14	24	24	34	321	44	678	54	1234
5	5	15	15	25	25	35	123	45	876	55	5678
6	6	16	16	26	26	36	431	46	277	36	9876
7	7	17	17	27	27	37	143	47	717	57	7893
8	8	18	18	28	21	38	365	48	911	58	4560
9	9	19	19	29	29	39	563	49	299	59	7600
10	10	20	20	30	30	40	782	50	493	60	5000

Answers:	quotient	*rem.*	N°	quotient	*rem.*
1	171316750004	—	16	10707296875	4
2	85658375002	—	17	10077455882	10
3	57105583334	2	18	9517597222	8
4	42829187501	—	19	9016671052	16
5	34263350000	4	20	8565837500	4
6	28552791667	2	21	8157940476	8
7	24473821429	1	22	7787125000	4
8	21414593750	4	23	7448554348	—
9	19035194444	8	24	7138197916	20
10	17131675000	4	25	6852670000	4
11	15574250000	4	26	6589105769	10
12	14276395833	8	27	6345064814	26
13	13178211538	10	28	6118455357	8
14	12236910714	8	29	5907474138	2
15	11421116666	14	30	5710558333	4

Answ.

9 *Instead of the dividend here given, the master (if he find occasion) may substitute any other, of which he may have got the quotients in manuscript.*——NB. (1) *The sum being thus plac'd, and numberd; a question may*

Answers
to the remainder of the sums, in p. 34.

Nº	quotient	*rem.*	Nº	quotient	*rem.*	Nº	quotient	*rem.*
31	916132352	180	41	207154474	6	51	122895803	622
32	957076815	119	42	1529613839	36	52	85701225	1229
33	896946335	19	43	1439636554	78	53	142883027	631
34	533697040	164	44	252679572	188	54	138830429	618
35	1392819105	89	45	195567066	188	55	30172023	3410
36	397486658	406	46	618472021	187	56	17346775	164
37	1198019230	114	47	238935495	89	57	21704896	5876
38	469360958	334	48	188053512	572	58	37569462	3284
39	304292628	440	49	572965719	23	59	22541677	4804
40	219075127	690	50	347498478	350	60	34263350	4

COMPOUND

may be transcribed without seeing the answer; and the answer examind, by only naming the number. (2) And (for exercise in multiplication) the quotients, here found, may be given for multiplicands; to be multiplied into any, or all of the divisors; for a proof of the reverse operation.

Compound

	l	s	d	q		cw	qr	lb	oz	
Div.	8649	19	11	3		3129	3	27	15	*By*

2	2	4	4	6	6	8	8	10	10	12	12
3	3	5	5	7	7	9	9	11	11	13	20

2	4324	19	11	$3\frac{1}{2}$	1564	3	27	$15\frac{1}{2}$
3	2883	6	7	$3\frac{1}{3}$	1043	1	9	5 —
4	2162	9	11	$3\frac{3}{4}$	782	1	25	$15\frac{3}{4}$
5	1729	19	11	$3\frac{4}{5}$	625	3	27	$9\frac{2}{5}$
6	1441	13	3	$3\frac{5}{6}$	521	2	18	$10\frac{3}{6}$
7	1235	14	3	$1\frac{4}{7}$	447	—	15	$15\frac{5}{7}$
8	1081	4	11	$3\frac{7}{8}$	391	—	27	$15\frac{7}{8}$
9	961	2	2	$2\frac{5}{9}$	347	3	3	$1\frac{6}{9}$
10	864	19	11	$3\frac{9}{10}$	312	3	27	$15\frac{9}{10}$
11	786	7	3	1 —	284	2	5	$1\frac{4}{11}$
12	720	16	7	$3\frac{11}{12}$	260	3	9	$5\frac{2}{12}$
13	432	9	11	$3\frac{19}{20}$	156	1	27	$15\frac{19}{20}$

QUESTIONS [8].

1. If 1596 be divided by 25; What is the quotient?—— $63\frac{21}{25}$.

2. If 140s be divided amongst 40 men; How much will they have a-piece?——— *S* 3 6.

3. An army of 19000 men, having plunderd a city, took 266000 l. How much must each man have? —— 14 *l*.

4. A reckoning came to 3 l, to be paid by 16 men. What was each man's club?——— *S* 1 10 2.

5. There was a certain number of men concernd in the payment of 1272 l, and each man paid 3 l. What was the number of men?——— 424 *l*.

6. A certain man, intending to go a journey of about 3270 miles, would complete the same in 136 days. How many miles must he travel each day?—— $31\frac{54}{136}$.

EQUA-

[8] *The following questions may serve for a further exercise in this operation; but the great use of it will frequently occur in all the rules; so that more examples would, here, be unnecessary.*

EQUATION

1. A is indebted to B 100 l, to be payd at the end of 3 months; also 200 l, to be payd at the end of 4 months; and 300 l, to be payd at the end of 5 months. Now, to prevent the trouble of many meetings, they agree to have but one payment of the 3 sums at one time. The question is When that must be, without loss to either A or B?——$4\frac{1}{3}$ *months.*

2. A owes B 100 l, whereof 50 l is to be paid at 2 months; and 50 l, at 4 months: but they agree to reduce them to one payment. When must the whole be paid?——3 *months.*

3. If 40 l is due after 6 months; and 70 l, after 4 months: What is the equated time?——4.72 *months.*

4. A merchant has owing him a certain sum to be discharg'd at 3 equal payments: $\frac{1}{3}$ at 2 months, $\frac{1}{3}$ at 4 months, $\frac{1}{3}$ at 8 months: What is the equated time for the payment of the whole?——$4\frac{2}{3}$ *months.*

5. A merchant has owing him 300 l, to be payd, as follows: 50 l, at 2 months; 100 l, at 5 months; and the rest, at 8 months: and it is agreed to make one payment of the whole; rebate being made at 5 per cent. I would know when that time must be?——6 *months.*

6. A is indebted to B 640 l: of which he is to pay 40 l, present mony; 350 l, at 3 months; and the rest at 8 months. What is the equated time for the payment of the whole?——$4\frac{9}{64}$ *months.*

7. F owes to H 1000 l: whereof 200 l is to be payd down; 400 l, at 5 months; and the rest, at 10 months: but they agree to make one payment of the whole. What is the equated time?——6 *months.*

8. K is indebted to L a certain sum; which is to be discharg'd at 4 several payments: that is, $\frac{1}{4}$, at 2 months; $\frac{1}{4}$ at 4 months; $\frac{1}{4}$, at 6 months; $\frac{1}{4}$, at 8 months: but, they agree to make but one payment of the whole. What is the equated time?——6 *months.*

9. M owes N 5 sums of mony, to be payd at 5 payments; viz. at the end of $\frac{1}{2}$ month, 200 l; of 1 month, 300 l;

300 l; of 3 months, 400 l; of 6 months, 500 l; and, ready mony, 100 l. At what time must the whole be payd, without lofs to either?——— $3\frac{1}{3}$ *months*.

10. H bought of X a quantity of goods, upon trust; for which H was to pay $\frac{1}{3}$ of the debt every three months, till the whole was difchargd: but they (afterwards) agreed to pay the whole at one equated time. What was the time? ——— 6 *months*.

11. I lent my friend 500 l, for 5 months: For what time must he lend me 750 l; to recompenfe my kindnefs to him? ——— $3\frac{1}{3}$ *months*.

12. W owes Z a fum of mony; which is to be payd, $\frac{1}{2}$ prefent; $\frac{1}{4}$, at 4 months; and the reft, at 8 months. What is the equated time for the whole?——— 3 *months*.

13. A merchant owes a fum of mony, to be payd, $\frac{1}{2}$ at 5 months, $\frac{1}{4}$ at 8 months, and $\frac{1}{4}$ at 10 months: and he agrees with his creditor to make one total payment. At what time must it be, without lofs to either of them?——— 7 *months*.

14. P owes Q 420 l; which will be due 6 months hence: but P is willing to pay him 60 l now, provided he can have the reft forborn a longer time. It is agreed on: The time of forbearance, therefore, is requird?——— 7 *months*.

15. Suppofe 300 l due after 4 months; 100 l, after 6 months; and 100 l, after 12 months: What is the equated time, difcounting 6 per cent?——— 5.952 *months*.

16. Suppofe I borrow 300 l, on condition to pay (with the intereft) at the end .. of 2 months, $\frac{1}{3}$ of it .. of 3 months, $\frac{1}{4}$ .. of 5 months, $\frac{1}{6}$ .. of 8 months, the reft: but finding my felf able, the next day, to difcharge the debt at once: I would know when that must be done, that neither I, nor the lender, may be a lofer, with refpect to the intereft that becomes due.——— *At the end of 4 months, $7\frac{1}{2}$ days.*

EVOLU-

EVOLUTION

SUMS.

What the 2. Square Root [13] *of*

QUEST. (1) 4712.81261. (2) 9712.718051. (3) 3.1721812. (4) 1.3976121. (5) 761.801216. (6) .0007612816. (7) 4.000067121.—Fractions (8) $\frac{3844}{6849}$ (9) $\frac{3456}{5400}$. (10) $\frac{7056}{9216}$. [Surds] (11) $\frac{3168}{6192}$. (12) $\frac{208}{272}$. (13) $\frac{387}{738}$. [Mixt] (14) $37\frac{36}{49}$. (15) $17\frac{16}{25}$. (16) $5\frac{288}{648}$.. (17) $76\frac{12}{17}$. (18) $7\frac{9}{11}$.

ANSW. (1) 68.649 (2) 98.553 (3) 1.78106 (4) 1.1822 (5) 27.6007 (6) .02759 (7) 2.000016.—Fractions (8) $\frac{2}{3}$ (9) $\frac{4}{5}$ (10) $\frac{7}{8}$. [Surds] (11) .71528 (12) .87447 (13) .72414. [Mixt] (14) $6\frac{1}{7}$ (15) $4\frac{1}{5}$ (16) $2\frac{1}{3}$ (17) 8.7649 (18) 2.7961.

3. *Cube-root.*

QUEST. (1) 7612.812161 (2) 7612181.7612 (3) 61218.00121 (4) 7121.1021698 (5) 12000.812161 (6) .121861281 (7) .0069761218.———[Fractions] (8) $\frac{352}{1188}$ (9) $\frac{1944}{4608}$ (10) $\frac{648}{3000}$. [Surds] (11) $\frac{4}{9}$ (12) $\frac{6}{7}$ (13) $\frac{1}{3}$. [Mixt] (14) $578\frac{19}{27}$ (15) $42\frac{21}{24}$ (16) $5\frac{104}{125}$ (17) $8\frac{2}{12}$ (18) $7\frac{3}{5}$.

ANSW. (1) 19.67 (2) 196.71 (3) 39.41 (4) 19.238 (5) 22.89 (6) .495 (7) .19107—[Fractions] (8) $\frac{2}{3}$ (9) $\frac{3}{4}$ (10) $\frac{3}{5}$. [Surds] (11) .763 (12) .949 (13) .693. [Mixt] (14) $8\frac{1}{3}$ (15) $3\frac{1}{2}$ (16) $1\frac{4}{5}$ (17) 22.013 (18) 1.966.

4. *Biqua-*

13 NB. *The figure prefixt to this title (to-wit 2) denotes it to be the 2d power; or, the first power involvd into itself.—And those, prefixt to the following, are to be understood in like manner.*

4. *Biquadrate-root.*

Quest. (1) 5308416 (2) 84934659 (3) 21743271636.
Answ. (1) 48 (2) 96 (3) 384.

5. *Surſolid-root.*

Quest. (1) 6436343 (2) 8153726976 (3) 254803968 (4) 8349416423424.
Answ. (1) 23 (2) 96 (3) 48 (4) 3843.

6. *Square-cube-root.*

Quest. (1) 782757789696 (2) 12230590464 (3) 3206175906594816.
Answ. (1) 96 (2) 48 (3) 384.

7. *Second ſurſolid-root.*

Quest. (1) 75144747810816 (2) 587068342272 (3) 12311715481324093444.
Answ. (1) 96 (2) 48 (3) 384.42.

8. *Square biquadrate-root.*

Quest. (1) 7213895789838336 (2) 28179280429056 (3) 47276987448284518809б.
Answ. (1) 96 (2) 48 (3) 384.

9. *Cubed cube-root.*

Quest. (1) 692533995824480256 (2) 1352605460594688 (3) 181543631801412552228504.
Answ. (1) 96.2 (2) 48.09 (3) 384.5.

10. *Square ſurſolid-root.*

Quest. (1) 6492506210854 5024 (2) 6648326359915 0104576 (3) 6971275461174242005588 3776.
Answ. (1) 48 (2) 96 (3) 384.3.

11. *Third*

11. *Third surfolid-root.*

QUEST. (1) 952809757913927 (2) 3116402981210161 152 (3) 6382393305518410039296.
ANSW. (1) 23 (2) 48 (3) 96.

12. *Squared-square cube-root.*

QUEST. (1) 149587343098087735296 (2) 6127097573 29767363772416 (3) 10279563944029090291760398073 856.
ANSW. (1) 48 (2) 96 (3) 384.

EXCHANGE

1. A bill of 200l is remitted to Paris by a merchant in London: What is the value in french *Crowns*, at 4s 6d each.——$888\frac{48}{54}$ *crowns*.

2. A merchant, at London, receivd 100l sterling, for the value payd by his correspondent, at the rate of 3s 6d sterling per *crown*: How many crowns were payd at Paris?——$571\frac{18}{42}$ *crowns*.

3. There are 800 french *Crowns*, at 4s 6d each, remited to London, by a merchant at Paris: What is the value in pounds sterling?———180 *l*.

4. If I draw a bill, per exchange 210l 17s 10d sterling, to be payd in Paris; the exchange at 57s 8d: For how many *crowns* must I draw the bill.—$883\frac{355}{457}$ *crowns*.

5. Admit a bill drawn in Lyons, and payable in London, for 1510 *crowns* 2 livres 10 sols: How much english mony comes it to; the exchange at $55\frac{1}{8}$d?——£ 347 0 $4\frac{5}{8}$.

6. Suppose a merchant in London buys goods for another in Calais, to the value of 102l 4s sterling; for which he is to draw a bill on him in Calais: For how many *crowns* must the bill be drawn?——438.

7. There

7. There are 2000 *Ducats*, at 4 s 4 d each, remited to London; to be payd in pounds sterling: What is the amount?——£ 433 6 8.

8. A bill of 100 l sterling is remited to Venice, to be payd in *ducats*, at 4 s 4 d each: What is the amount?——£ $461\frac{28}{52}$.

9. How many spanish *ducats* at 4 s 4 d, must be drawn for 700 rixdollars, at 5 s 6 d?——$888\frac{24}{52}$.

10. A traveler would exchange 233 l 16 s 8 d sterling, for Venice *ducats* at 4 s 9 d per ducat: How many must he have?——$984\frac{12}{57}$.

11. A bill of 120 *Ducatoons* is remited from Florence, at 53 d each: What is the value in pounds sterling;——£ 26 10.

11. A bill of 220 l 16 s 8 d is drawn from London: What is the value at Florence, in *ducatoons*, at 53 d each?——1000 *ducatoons*.

12. If 247 l 18 s 4 d sterling be remited to Francfort: What is the value in *Florins*, at $59\frac{1}{2}$ d?——1000 *florins*.

13. If 100 *florins*, at $59\frac{1}{2}$ d, each, be remited from Francfort to London: What is the value in pounds sterling?——£ 24 15 10.

14. Remited, from London to Amsterdam, a bill of exchange of 285 l 10 s sterling; the exchange at 33 s 9 d, flemish, per pound sterling: How many *Guilders* flemish must the bill be drawn for?——2890 13.

15. A merchant, in Rotterdam, remits a bill of exchange of 7621 *guilders* 7 stivers, to be payd in London: How-much sterling mony must the said bill be drawn for, the exchange at 33 s 4 d, flemish, per pound sterling?——£ 762 2 8.

16. For how much sterling-mony must a bill be drawn for goods bought in Holland, amounting to 11715 *guilders* 12 stivers; the exchange at 34 s 8 d, flemish, per pound sterling?——£ 1126 10.

17. If a bill is drawn from Lisbon of 1432 *Mill-reas*, at 6 s 8 d per piece: How much English mony is that bill?——£ 477 6 8.

18. If a bill be drawn, from London, of 1333 l 6 s 8 d sterling: How much is it at Lisbon in *mill-reas*, at 6 s 8 d each?——4000 *Mill-reas*.

19. How

19. How many mill-reas must a bill be drawn-for, to pay 125 l 11 s $11\frac{3}{4}$d sterling; the exchange at 5 s $6\frac{1}{4}$d per millrea?———455.

20. How many pounds sterling must a bill be drawn-for, to answer 500 mill-reas; the exchange at 5 s $5\frac{5}{8}$ d per mill-rea?——£ 136 14 $4\frac{1}{2}$.

21. How many pounds sterling must a bill be drawn-for, to answer 600 mill-reas, 550 reas, at 5 s 7 d per mill-rea? ——£ 167 13 $0\frac{32}{45}$.

22. What is the amount of 63 l sterling, in *pieces of eight*, at 5 s 6 d per piece?———270.

23. How many pieces of eight, at $48\frac{1}{4}$ d, will answer a bill of 344 l 11 s $8\frac{1}{2}$ d sterling?———1714.

24. A factor has sold goods, at Cadiz, for 1468 pieces of eight, at 4 s 6 d 2 qrs per piece: How much sterling is the sum?———£ 333 7 2.

25. Being desirous to remit, to my correspondent at London, the sum of 2000 *pounds*, 12 s 6 d flemish, to dispose-of according to my order, (exchange at 34 s 6 d flemish per pound sterling): How much mony sterling shall I be creditor-for in the city of London aforesaid?——— £ 1159 15 7 $3\frac{1}{4}\frac{120}{114}$.

26. My correspondent in England gives me notice that he has disburst, in merchandize, on my account, the sum of 1000 l sterling: What sum must I answer for that, in Holland; the course of exchange being at 33 s 4 d flemish for one pound sterling?——£ 1666 13 4.

27. My correspondent in Rotterdam sends me word that he has disburst, on my account, the sum of 3060 guilders [at 40 d per guilder] and 15 stuyvers [at 2 d per stuyver:] What sum must I answer, for that, at London; the course of exchange being at 37 l 9 d flemish per pound sterling? ———£ 270 5 $3\frac{2}{4}\frac{188}{453}$.

28. A merchant deliverd, at London, 120 l sterling, to receive 147 l flemish, in Amsterdam: How much was one pound valued-at in flemish mony?——£ 1 4 6.

E FALSE

F A L S E

Single Poſition.

1. Two men, A and B, having found a bag of mony, diſputed who ſhould have it. A ſaid the half, third, and fourth of the mony made 130l: and, if B could tell how much was in it, he ſhould have it: otherwiſe he ſhould have nothing. I would know how much was in the bag? ——120*l.*

2. Four men have a ſum to be divided among them, in ſuch manner, that the firſt ſhall have $\frac{1}{3}$ of it; the ſecond, $\frac{1}{4}$; the third, $\frac{1}{6}$; and the fourth, the remainder, which is 28: What was the ſum?——112 *l.*

3. A B and C, determining to buy (together) a certain quantity of timber, worth 36 l, agree that B ſhall pay $\frac{1}{3}$ more than A; and C, $\frac{1}{4}$ more than B. I would know how much each man muſt pay?——A 9 *l.* . *B* 12 *l.* . *C* 15 *l.*

4. A miller having 3 mills; the firſt of which can grind 9 buſhels of corn in an hour; the ſecond, 7; and the laſt, 4: In how long time would they be grinding 300 buſhels? had he?——15 *hours.*

5. A perſon, having about him a certain number of crowns, ſaid: If the half, third, and fourth of them were added-together; they would make 65 crowns: How many ——60 *crowns.*

6. What number is that; the $\frac{1}{2}$, the $\frac{1}{3}$, and the $\frac{1}{4}$ of which, added-together, make 104?——96.

7. A lent B a ſum of mony; to be paid at 4 payments. When 3 of them were made, and A came to demand the fourth; B would give him no more, except he would tell him how much was paid already. A ſaid, the firſt payment was a fourth; the ſecond, a fifth; and the third, a ſixth of the ſum firſt lent; and all together made 74l. What was the ſum lent?——120 *l.*

8. One, carrying a bag of mony in his hand, another aſkt him how much was in it. He anſwerd he could not tell: But the third, fourth, aud fifth of it made 94l. How much was in the bag?——120 *l.*

I have

9. I have deliverd to a banker a certain sum of mony; to receive of him, after the rate of 6 l per cent per annum; and, at the end of 10 years, he paid me 500 l, for principal and interest together: What was the sum deliverd to him at first?——£ 312 10.

Double Position.

10. A B and C, would divide 100 l, between them, so, as that B may have 3 l more than A; and C 4 l more than B: How-much must each man have?——*A* 30 *l*.. *B* 33 *l*..*C* 37 *l*.

11. A certain person, having forgot the day of the month, desird his neighbor to tell him it. He answerd (the month having 30 days) that, If he would add ¼ of the days of the month, which were already past to ½ of the days, which were to come; he would have what he desird. What day of the month was it?——12*th*.

12. A B and C built a house, which cost 100 l: Of this A payd a certain sum; B payd 10 l more than A; and C payd as much as A and B. What was each man's share?——*A* 20 *l*..*B* 30 *l*..*C* 50 *l*.

13. Three men have 100 l to be shard among them: the second is to have, for his share, twice as much as the first, all but 8 l; and the last, three times as much, all but 15 l. What will be the share of each of them?——*I*, £ 20 10 ..*II*, £ 33 ..*III*, £ 46 10.

14. Three persons discourst together about their ages: says A, I am 20 years-of-age: says B, I am as old as A, and half C: and says C, I am as old as you both. Of what age was each of them?——*A* 20..*B* 60..*C* 80.

15. Says A to B: If I had 5 of your crowns, I should have twice as many as you would have, left. And, says B to A: If I had three of yours, I should have 4 times as many as you. How many had each of them?——*A* 6⅔..*B* 10⅓.

16. A man, lying at the point of death, left to his three sons all his estate in mony: viz. to A, half, wanting 50 l: to B, one third: and to C, the rest; which was 10 l less than the share of B. I would know the sum left, and each man's share.——*Sum* 360 *l*.. *A* 130 *l*.. *B* 120 *l*.. *C* 110 *l*.

17. What two numbers are those, whose total is 82; and the $\frac{1}{6}$ of one of them, added to the $\frac{1}{5}$ of the other, makes 14?——72 *and* 10.

18. What two numbers are those, whose difference is 4; and their product, when multiplied together, 96?——8 *and* 12.

19. A certain man, having driven his swine to the market, viz. hogs, sows, and pigs; received 50 l for them: being payd, for every hog, 18 s; for every sow, 16 s; for every pig, 2 s. There were as many hogs as sows; and, for every sow, there were 3 pigs. How many were there of each sort?——25 *hogs* . . 25 *sows* . . 75 *pigs*.

20. What two numbers are those, which, added together, make 8; and, multiplied together, produce 12?——2 *and* 6.

21. Three merchants put into stock, each an unknown sum: but this they knew, that, What the first put-in, added to half what the other two put-in, makes 17 l: What the second put-in, added to the third part of what the two others put in: makes also 17 l: and What the third put-in, added to the one fourth of the two others, makes also 17 l. How much did each of them put-in?——*I* 5 *l* . . *II* 11 *l* *III* 13 *l*.

22. Says A to B: If I had 4 of your sheep, I should have as many as you. And says B to A: If I had 4 of yours, I should have twice as many as you. How many had each?——*A* 20 . . *B* 28.

23. What two numbers are those, which, added together, make 32; and, divided by one another, give the quotient 3?——8 *and* 24.

24. A day laborer having thresht-out 40 quarters of grain (part of it wheat, and the rest barley) receivd, for his labor, 28 s; being payd after the rate of 12 d for every quarter of wheat, and 6 d for each quarter of barley. I would know how many of those 40 quarters were wheat, and how many barley.——*Wheat* 16 . . *Barley* 24.

25. Into what 2 parts must the number 50 be divided, that, If 45 be added to the greater part, and 25 to the lesser; the former sum will be double the latter?——35 *and* 15.

26. Good-morrow, good fellow, with your 20 geese. Nay, says he, I have not 20: but, if I had as many, $\frac{1}{2}$ as many, 2 geese and $\frac{1}{2}$; then I should have 20. How many had he?——7.

27. A.

27. A, stealing apples, was taken by B; and (to appease him) gives him half he had, and B gives him back 10: going-further he met-with C, and was forc'd to give him half of what he had left; and he returns him back 4: then, meeting with D, he gives him half he had; and he returns him 1. So, geting safe away, he finds he had 13 left. I would know how-many he had at first.——60.

FELLOWSHIP

1. A and B were sharers in a parcel of merchandize; in the purchase of which, A laid out 3 l, and B 7 l: and, the commodity being sold, they find their clear gain amount to 25 s. What part of it must each man have?——*A 7 s 6 d.. B 17 s 6 d.*

2. Four men share among themselves 400 l, which they have gaind: the 1st takes the $\frac{1}{2}$ of it; the 2d, a $\frac{1}{3}$; the 3d, a $\frac{1}{4}$; the 4th, a $\frac{1}{6}$. What does each take in particular?——*I £* 160.. *II*, 106 13 4.. *III*, 80.. *IV*, 53 6 8.

3. A B and C, trading together, gaind 120 l; which is to be shard according to each man's stock. A put-in 140 l; B 300 l; and C 160 l. What is each man's share?——*A, 28 l.. B, 60 l.. C, 32 l.*

4. Three merchants, trading to Virginia, lost goods to the value of 800 l. Now, if A's stock was 1200 l; B's, 4800 l; and C's, 2000. What sum did each man lose?——*A*, 120 *l*.. *B*, 480 *l*.. *C*, 200 *l*.

5. Five old partners take into partnership four new ones, on condition that each old partner should have twice the profit of each new-one. How-much is each-one to have of 300000 l, which they have gaind?——*Old*, £ 42857 $\frac{1}{7}$. *New*, 21428 $\frac{4}{7}$.

6. Three merchants traded together; and put into one common stock 1000 l, each man; and gaind 600 l. How-much must each man have?——200 l each.

7. Four men traded with a stock of 800 l; and they gaind, in two years time, twice as much, and 40 l over. A's stock was 140 l; B's 260 l; C's 300 l. What was D's stock: and What did each man gain by trading?——*D's*

stock was 100*l*. . *and A gaind* 287 *l*. . *B* 533 *l*. . *C* 615 *l* . . *D* 205 *l*.

8. Two men have gaind 760l; which they find to be 10 per cent, profit. Of this, the first is to have $\frac{1}{4}$ more than the other; How-much did each of them put into the stock; and What did each of them gain?——*I*. . *put-in* £ 4222$\frac{2}{9}$ . . *gaind* 422 4 5$\frac{1}{3}$. *II* . . *put-in* 3377$\frac{7}{9}$ . . *gaind* 337 15 6$\frac{2}{3}$.

9. A, B, and C, trading to Guinea, with 480 l, 680 l, and 840 l; in three year's time, gaind 1010 l. How much is each man's share of the gain?——*A*, 242 *l* 8 *s*. . *B*, 343 *l* 8 *s* . . *C* 424 *l* 4 *s*.

10. A, B, and C, freighted a ship, from the Canaries to England, with 108 tuns of wine; of which A had 48; B, 36; and C, 24. But, by reason of bad weather, they were obligd to cast 45 tuns over-board. How much must each man sustain of the loss?——*A*, 20 *tuns* . . *B*, 15 . . *C*, 10.

11. A merchant is indebted to S, 70l; to T, 400l; to V, 140l 12s 6d. But, upon his decease, his estate is found to be worth no more than 409 l 14s. How must it be divided among his creditors?——*S must have l* 46 19 3 3 $\frac{143750}{146550}$ . . *T*, 268 7 7 1 $\frac{77250}{146500}$ . . *V*, 94 7 0 2 $\frac{74100}{146550}$.

12. If the money and effects of a bankrupt amount to 1400 l 14s 16d; and he is indebted to A 742l 12s, to B 641 l 19s 8d, and to C 987 l 19s 9d: How must it be divided among them?——*A must have l* 438 8 4 1 $\frac{303527}{569417}$ . . *B*, *l* 379 0 3 3 $\frac{158301}{569417}$ . . *C*, *l* 583 5 9 3 $\frac{107529}{569417}$.

Compound

13. Three merchants traded together. A put-in 120l, for 9 months; B, 100 l, for 16 months; and C, 100 l, for 14 months; and they gaind 100 l. How must it be divided?——*A must have l* 26 9 4 3 $\frac{3120}{4080}$ . . *B*, 39 4 3 3 $\frac{240}{4080}$ . . *C*, 34 6 3 1 $\frac{720}{4080}$.

14. Three merchants join in trade; A put-in 400 l, for 9 months; B, 680 l, for 5 months; C, 120 l, for 12 months: but, by misfortune, lost goods to the value of 500 l. What must each man sustain of the loss?——*A must lose l* 213 5 4 3 $\frac{2840}{8440}$ . . *B*, 201 8 5 0 $\frac{7840}{8440}$ . . *C*, 85 6 1 3 $\frac{6200}{8440}$.

15. A, B, and C, hold a pasture in common; for which they pay 20l per annum. In this pasture A had 40 oxen,

M for.

for 76 days; B, 36, for 50 days; and C, 50, for 90 days. What part of the 20l is every one of these tenants to pay? ——*A ought to pay* l 6 10 2 1 $\frac{2340}{9340}$ .. *B*, 3 17 1 0 $\frac{2000}{9340}$ .. *C*, 9 12 8 2 $\frac{5000}{9340}$.

FRACTIONS

I. VULGAR.

i. Reduction.

1. *To the Lowest term.*

$\frac{144}{240}$	$\frac{72}{94}$	$\frac{637}{819}$	$\frac{182}{196}$	$\frac{48}{56}$	$\frac{84}{170}$	$\frac{60}{125}$	$\frac{435}{630}$	$\frac{298}{534}$	$\frac{111}{3000}$
$\frac{3}{5}$	$\frac{36}{47}$	$\frac{15}{17}$	$\frac{13}{14}$	$\frac{6}{7}$	$\frac{42}{85}$	$\frac{12}{25}$			

2. *To a common denominator.*

$\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$	$\frac{3}{6}$ $\frac{5}{8}$	$\frac{7}{8}$ $\frac{9}{10}$ $\frac{11}{12}$	$\frac{6}{10}$ $\frac{4}{8}$ $\frac{1}{9}$ $\frac{6}{7}$
$\frac{12 \quad 16 \quad 18}{24}$	$\frac{24 \quad 30}{48}$	$\frac{840 \quad 864 \quad 880}{900}$	$\frac{3024 \quad 2520 \quad 560 \quad 4320}{5040}$

3. *To a Simple, a compound.*

$\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$	$\frac{12}{14}$ of $\frac{5}{6}$ of $\frac{1}{2}$	$\frac{5}{9}$ of $\frac{4}{8}$ of $\frac{3}{4}$	$\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$
$\frac{6}{24}$	$\frac{60}{168}$	$\frac{60}{288}$	$\frac{24}{60}$

4. *To an improper, a mixt.*

12 $\frac{15}{17}$	19 $\frac{12}{18}$	16 $\frac{18}{100}$	12 $\frac{19}{56}$	100 $\frac{19}{59}$	79 $\frac{12}{19}$	6 $\frac{2}{3}$
$\frac{219}{17}$	$\frac{354}{18}$	$\frac{1618}{100}$	$\frac{691}{56}$	$\frac{5919}{59}$	$\frac{1513}{19}$	$\frac{20}{3}$

5. To

5. *To a mixt, an improper.*

$\frac{219}{17}$	$\frac{141}{17}$	$\frac{126}{48}$	$\frac{961}{17}$	$\frac{13}{7}$	$\frac{24}{7}$	$\frac{36}{5}$	$\frac{144}{12}$	$\frac{87}{7}$
$12\frac{15}{17}$	$8\frac{5}{17}$	$2\frac{30}{48}$	$56\frac{9}{17}$	$1\frac{6}{7}$	$3\frac{3}{7}$	$7\frac{1}{5}$	12	$12\frac{3}{7}$

6. *To a Greater Name, a fraction of lesser.*

$\frac{5}{6}$ of d. to l	$\frac{9}{13}$ of p. to hhd	$\frac{6}{7}$ of lb. to cw	$\frac{8}{9}$ of oz to lb
$\frac{5}{1440}$	$\frac{9}{6552}$	$\frac{6}{784}$	$\frac{8}{108}$

7. *To a Lesser name, a fraction of greater.*

$\frac{5}{1440}$ l. to d	$\frac{9}{6552}$ hhd. to pin.	$\frac{6}{784}$ cw. to lb.	$\frac{8}{108}$ lb. to oz.
$\frac{5}{6}$	$\frac{9}{13}$	$\frac{6}{7}$	$\frac{8}{9}$

8. *To a Fraction of Greater-name, any quantity.*

6s 8d to l	1 hhd 49 gal. to tun	8 oz $14\frac{2}{9}$ dr. to lb.
$\frac{33}{30}$	$\frac{4}{9}$	$\frac{5}{9}$

9. *To an Equivalent,*

with a given Numerator

$\frac{7}{8}$ to 42	$\frac{3}{4}$ to 34	$\frac{5}{9}$ to 73	$\frac{4}{6}$ to 18	$\frac{5}{7}$ to 9
$\frac{42}{48}$	$\frac{34}{45\ \frac{1}{3}}$	$\frac{37}{131\ \frac{2}{5}}$	$\frac{18}{27}$	$\frac{9}{12}\ \frac{3}{84}$

with a given Denominator

$\frac{3}{4}$ to 20	$\frac{7}{8}$ to 49	$\frac{3}{4}$ to $46\frac{2}{4}$	$\frac{5}{9}$ to $131\frac{2}{5}$
$\frac{15}{20}$	$\frac{42\ \frac{7}{8}}{49}$	$\frac{34\ \frac{2}{4}}{46}$	$\frac{73}{131\ \frac{2}{5}}$

10. *To a Single, a fraction of fraction:*

$\frac{34}{48}$ $\frac{1}{2}$	$\frac{17}{43}$ $\frac{4}{9}$	$\frac{41}{73}$ $\frac{1}{4}$	$\frac{7}{19}$ $\frac{3}{5}$
$\frac{3}{4}$	$\frac{157}{387}$	$\frac{104}{293}$	$\frac{35}{98}$

11. *To a Fraction, a whole.*

9 to denom. 8	19 to 11	21 to 12	$7\frac{7}{8}$	$21\frac{13}{27}$
$\frac{72}{8}$	$\frac{209}{11}$	$\frac{252}{12}$	$\frac{63}{8}$	$\frac{580}{27}$

12. *To a Decimal Fraction.*

$\frac{3}{4}$	$\frac{1}{8}$	$\frac{35}{721}$	$\frac{5}{26}$	$\frac{5}{28}$	$\frac{11}{14}$ of $\frac{10}{13}$
.75	.125	.04854+	.1923076+	1785714+	.6043956+

ii. Addition

1. *All, Fractions.*

$\frac{1}{2}+\frac{[illegible]}{8}$	$\frac{7}{10}$ $\frac{11}{12}$ $\frac{4}{9}$	$\frac{14}{27}$ $\frac{3}{4}$ of $\frac{5}{6}$	$\frac{2}{13}$ $\frac{5}{9}$	$\frac{3}{5}$ l $\frac{3}{7}$ s	$\frac{1}{2}$ lb $\frac{7}{12}$ oz
$1\frac{[illegible]}{16}$	$2\frac{66}{1080}$	$\frac{247}{216}$	$\frac{83}{117}$	$\frac{87}{140}$	oz 6 11 16

2. *Integers, and Fractions.*

$\frac{3}{11}+47$	$7\frac{3}{5}$	5 17 $\frac{5}{12}$ $\frac{3}{7}$ of $\frac{9}{13}$	11 l $\frac{5}{6}$ s
$47\frac{3}{11}$	$\frac{38}{5}$	$\frac{24803}{1092}$	$\frac{1325}{120}$

3. Inte-

3. *Integers, and Mixt*

$7 + 5\frac{3}{5}$	$13 \quad 21\frac{11}{13}$	$3 \quad 9 \quad 2\frac{11}{13} \quad 5\frac{7}{9}$
$\frac{63}{5} = 12\frac{3}{5}$	$34\frac{11}{13}$	$\frac{5102}{103}$

4. *All, Mixt*

$2\frac{3}{5} + 7\frac{5}{9}$	$5\frac{4}{9} \quad 4\frac{3}{9}$	$12\frac{1}{2} \quad 3\frac{2}{3} \quad 4\frac{3}{4}$	$\frac{1}{3}$ of $95 + \frac{7}{8}$ of 14
$\frac{457}{45}$	$9\frac{7}{9}$	$20\frac{22}{24}$	$43\frac{22}{24}$

5. *Mixt, and Fractions*

$17\frac{1}{2} + \frac{2}{3}$	$6\ \frac{7}{8}$ of $\frac{9}{10}$ and $\frac{4}{7}$ of $\frac{1}{2}$ and $7\frac{1}{2}$	$2\frac{3}{7} \quad 13\frac{2}{9} \quad \frac{3}{11} \quad \frac{21}{25}$
$18\frac{1}{6}$	$14\frac{1284}{2240}$	$\frac{295378}{17325} = 17\frac{853}{17325}$

iii. SUBTRACTION [16]

1. *Both, Fractions*

$\frac{5}{7} - \frac{3}{7}$	$\frac{2}{13} \quad \frac{5}{9}$	$\frac{7}{8}$ of $\frac{4}{11} - \frac{4}{5}$ of $\frac{6}{7}$	$\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4} - \frac{109}{110}$	$\frac{3}{4}$ s. $\quad \frac{1}{2}$ l.
$\frac{2}{7}$	$\frac{47}{117}$	$\frac{283}{770}$	$\frac{1956}{2640}$	9 s. $\quad$ 3 d.

2. *Integers, and Fractions*

$\frac{3}{5} - 96$	$\frac{3}{11} \quad 47$	$\frac{13}{19} \quad 67$	$\frac{31}{49} \quad 429$	$\frac{7}{13} \quad 46$
$95\frac{2}{5}$	$46\frac{8}{11}$	$66\frac{6}{19}$	$428\frac{18}{49}$	$45\frac{6}{13}$

3. *Inte-*

16 *When there is room to doubt Whether of the two propos'd fractions is the greater; reduce them to a common denominator: So, you will be certain.*

3. *Integers, and Mixt*

$2\frac{1}{3}$ — 7	11 $\frac{3}{7}$ 13	13 34 $\frac{11}{13}$	18 29 $\frac{5}{11}$	8 $\frac{3}{7}$ 14	16 22 $\frac{3}{4}$
$4\frac{2}{3}$	$1\frac{4}{7}$	$41\frac{11}{13}$	$11\frac{5}{11}$	$5\frac{4}{7}$	$6\frac{3}{4}$

4. *Both, Mixt.*

$11\frac{9}{13}$ $16\frac{2}{3}$	$8\frac{7}{18}$ s $13\frac{5}{18}$ l	$\frac{2}{3}$ of 19 $14\frac{1}{4}$	$14\frac{3}{7}$ $96\frac{1}{3}$	$12\frac{2}{3}$ — $14\frac{4}{5}$
$\frac{194}{39} = 4\frac{38}{39}$	$12\frac{542}{372}$ l	$1\frac{7}{12}$	$81\frac{19}{21}$	$2\frac{2}{15}$

5. *Mixt, and Fractions*

$\frac{3}{5}$ — $7\frac{2}{5}$	$\frac{21}{95}$ $16\frac{9}{11}$	$\frac{17}{19}$ $71\frac{1}{2}$	$\frac{3}{8}$ $13\frac{1}{3}$
$6\frac{4}{5}$	$16\frac{624}{1045}$	$70\frac{23}{38}$	$12\frac{23}{24}$

IV. MULTIPLICATION

1. *Both, Fractions*

$\frac{3}{7} \times \frac{3}{11}$	$\frac{4}{8}$ $\frac{7}{9}$	$\frac{11}{17} \times \frac{18}{37}$	$\frac{1}{3}$ of $\frac{4}{5} \times \frac{7}{10}$ of $\frac{11}{18}$
$\frac{9}{77}$	$\frac{28}{72}$	14 $\frac{198}{629}$	$\frac{308}{1800}$

2. *Integers, and Fractions*

$\frac{2}{5} \times 7$	$\frac{5}{18}$ 12	24 $\frac{3}{5}$	11 $\frac{5}{7}$	151 $\frac{112}{121}$	$\frac{21}{63}$ 37	$\frac{5}{7}$ 39
$\frac{14}{5}$	$\frac{10}{3}$	$\frac{72}{5}$	$7\frac{6}{7}$	$139\frac{93}{121}$	$12\frac{1}{3}$	$27\frac{6}{7}$

3. *Inte-*

3. *Integers, and Mixt*

$12 \times 3\frac{3}{5}$	171 $56\frac{35}{71}$	$17\frac{5}{9}$ 47	51 $\frac{23}{27}$ 13	64 8 $\frac{2}{3}$ of $\frac{5}{7}$
$43\frac{1}{5}$	9660 $\frac{21}{71}$	$825\frac{1}{9}$	674 $\frac{2}{27}$	567 $\frac{8}{21}$

4. *Both, Mixt*

$2\frac{3}{5} \times 5\frac{3}{7}$	$7\frac{1}{2}$ $9\frac{1}{4}$	$12\frac{3}{5}$ $\frac{2}{6}$ of 7	$\frac{4}{5}$ of 91 $71\frac{1}{2}$	$\frac{3}{5}$ of 8 $\frac{7}{8}$ 5
$\frac{494}{35}$	$69\frac{3}{8}$	$29\frac{12}{30}$	5205 $\frac{2}{10}$	21

5. *Mixt, and Fractions*

$\frac{7}{8} \times 13\frac{9}{10}$	$4\frac{1}{2}$ $\frac{1}{8}$	$17\frac{3}{7}$ $\frac{5}{9}$	$5\frac{3}{5}$ $\frac{4}{7}$	$\frac{3}{7}$ 1 ; $\frac{3}{5}$	$\frac{11}{13}$ 17 $\frac{23}{27}$
$12\frac{13}{80}$	$\frac{9}{16}$	$9\frac{43}{63}$	$3\frac{1}{5}$	$4\frac{34}{35}$	14 $\frac{278}{351}$

V. DIVISION

1. *Both, Fractions*

$\frac{3}{17} \div \frac{4}{13}$	$\frac{30}{114}$ $\frac{0}{19}$	$\frac{17}{21}$ $\frac{3}{5}$	$\frac{13}{19}$ $\frac{7}{9}$	$\frac{14}{18}$ $\frac{7}{10}$	$\frac{2}{3}$ of $\frac{3}{4} \div \frac{1}{2}$ of $\frac{2}{3}$
$\frac{2}{9}$	$\frac{684}{1684}$	1 $\frac{22}{63}$	$\frac{117}{133}$	1 $\frac{14}{126}$	1 $\frac{12}{24}$

2. *Integers, and Fractions*

$\frac{2}{5} \div 7$	7 $\frac{2}{5}$	$\frac{7}{8}$ 4	4 $\frac{7}{8}$	$\frac{21}{31}$ 37	$\frac{3}{11}$ 19	261 3 $\frac{2}{5}$ 8
$\frac{2}{35}$	$\frac{35}{2}$	$\frac{7}{32}$	4 $\frac{4}{7}$	$\frac{21}{1147}$	$\frac{3}{209}$	22 $\frac{2}{9}$

3. *Inte-*

3. *Integers, and Mixt*

$43\frac{1}{5} \div 12$	$9660\frac{21}{71}$ 171	$825\frac{1}{9}$ 47	$16\frac{3}{11}$ 4	$\frac{3}{5}$ $17\frac{1}{2}$
$3\frac{3}{5}$	$57\frac{35}{71}$	$17\frac{5}{9}$	$4\frac{3}{44}$	$\frac{6}{175}$

4. *Both, Mixt*

$5\frac{3}{7} \div 2\frac{3}{5}$	$1\frac{1}{2}$ $4\frac{8}{30}$	$42\frac{2}{21}$ $3\frac{5}{7}$	$19\frac{13}{17}$ $7\frac{23}{31}$
$\frac{190}{91}$	$2\frac{30}{90}$	$11\frac{1}{3}$	$2\frac{47}{85}$

5. *Mixt, and Fractions*

[illegible] $\div 5\frac{7}{11}$	$7\frac{6}{7}$ $\frac{5}{7}$	$139\frac{93}{125}$ $\frac{112}{121}$	$4\frac{5}{9}$ $\frac{5}{9}$ of 4	$\frac{5}{9}$ of 4 $4\frac{5}{9}$
$\frac{231}{[illegible]}$	11	151	$2\frac{1}{20}$	$\frac{20}{41}$

VI. PROPORTION

1. Single

a. *Direct*

1. If $\frac{11}{13}$ lb of ſugar coſt $\frac{7}{13}$ s: What coſt $\frac{32}{43}$?——D 4 $3\frac{4971}{7095}$.
2. If $\frac{4}{7}$ of an ell coſt $\frac{7}{13}$ l: What coſt 1 ell?—*S* 18 $10\frac{8}{32}$.
3. If 2 oz of ſilver coſt 16 s 5 d: What coſt $\frac{3}{4}$ oz?——S 6 1 $3\frac{1}{2}$.
4. If an ingot of ſilver weighs $16\frac{11}{15}$ oz: What is it worth at 5 s 6 d an ounce?————*L* 4 12 0 $1\frac{9}{15}$.
5. A mercer bought $3\frac{1}{2}$ pieces of ſilk, each containing $24\frac{1}{3}$ yards, at S 6 $0\frac{1}{2}$ per yard: What was the value of the $3\frac{1}{2}$ pieces, at that rate?——*L* 25 14 6 $2\frac{1}{3}$.

b. *Inverse*

6. How-many yards of canvas $1\frac{1}{4}$ yard-wide, will line 20 yards of say $\frac{3}{4}$ yard-wide?——12 *yards.*

7. If $1\frac{1}{4}$ yard, in breadth, require $20\frac{1}{2}$ yards to make a garment; What length will $\frac{3}{4}$ yard-wide require to make the same?——$136\frac{4}{6}$ *yards.*

8. How-many pieces of goods, at $20\frac{1}{8}$s per piece, are to be given for $240\frac{1}{7}$ pieces, at $12\frac{1}{2}$s per piece?——$104\frac{1784}{2254}$ *pieces.*

9. If 16 men finish a piece of work in $28\frac{1}{3}$ days; How-long will 12 men require to do the same work?——$37\frac{28}{36}$ *days.*

10. If $3\frac{1}{4}$ yards of cloth, that is $1\frac{1}{3}$ yard-wide, be sufficient to make a cloak; How-much must I have of that sort, which is $\frac{4}{5}$ yard-wide, to make a cloak of the same bigness?——$4\frac{7}{8}$ *yards*

2. Double

11. If 9 students spend $10\frac{7}{9}$l in 18 days; How-much will 20 students spend in 30 days?——*L* 41 15 11 2+.

12. Three men having workt $19\frac{1}{2}$ days received $8\frac{9}{10}$l: How-much must 20 men have for $100\frac{1}{4}$ days?——*L* 305 0 8+.

13. A man and his wife earnd $45\frac{5}{8}$s in 1 day: How-much must they have for $10\frac{1}{2}$ days, when their 2 sons help them?——*L* 4 17 1 2.

14. A man, with his family, which (in all) were 5 persons, did usually drink $7\frac{4}{5}$ gallons of beer in a week: How-much will be drank in $22\frac{1}{2}$ weeks, when 3 persons more come into the family?——$40\frac{4}{35}$ *gallons.*

15. Three sailors, having been abroad $9\frac{1}{4}$ months, receivd $40\frac{3}{15}$l wages: I would know How-much 100 sailors must receive for $28\frac{3}{7}$ months service?——*L* 4118 6 0 1+.

II. DECI-

II. DECIMALS.

i. Reduction

to the Decimal of an

acre .. 4 perches	- - - - - - - - - - - -	.025
day ... 7 minutes	- - - - - - - - - -	.0048611
gallon .. 1 pint	- - - - - - - - - - -	.125
hhd ... 1 gallon	- - - - - - - - - -	.015873
hund. w . 174 drams	- - - - - - -	.0060686
league .. 1 mile	- - - - - - - -	.33333333
mile ... 76 yards	- - - - - - -	.4318181
pound . . 24 grains	- - - - -	.0041666
week ... 2 days	- - - - - - - -	.2857142
yard ... 3 qrs 2 nails	- - - - - - -	.875
year ... 72 days	- - - - - - -	.1972602

ii. Valuation

of the Decimal of a

.07	*barrel* - - - - - - -	2 gall 1.92 pints
.461	*chaldron* . - - -	16 bush. 2.384 pecks
.761	*day* - - - - -	18 hrs 15 min. 504 seconds
.4712	*ell english* - - - - - -	2 qrs. 1.424 nails
.712	*furlong* -	28 poles, 2 yds, 1 foot, 11.04 inches
.761	*hhd* - - - -	47 gall. 3 qrs. 1.544 pints
.5	*hour* - - - - - - - - - - -	30 min.
.861	*hundr. wt* -	3 qrs, 12 lb, 16 oz, 14.592 drams
.67	*league* -	2 miles, 3 poles, 1 yd, 3 inch, 1.8 barl-c
.7	*lb* of silver - - - - - -	8 oz. 8 dw.
.71	4 *oz* of gold - -	2 oz. 16 dw. 19.2 grains
.76	*pound* sterling - - - - -	15 s. 2 d. 1 6 q
.461	*shilling* - - - - - - - -	5 d. 2.128 q
.61	*tun* - -	2 hhds. 27 gall. 2 qrts. 1.76 pints
.3	*year* - - - - - -	109 days, 12 hours

iii. PROPORTION

For the further practise of Decimals, may be wrought the same sums as are proposed in vulgar fractions. Thus n. 1, in direct proportion (p. 55) being stated (by Fractions, line 12) as follows [.846 : .466 : : .744] will give nearly the same answer, viz. *D* 4 3.4484.

GAIN

1. A parcel of *Goods* being bought for 60 l, and sold for 75 l: What was the rate of gain per cent?——5 *l*.

2. Suppose I have goods to the value of L 415 12 6, that come to a bad market, and know they impair by lying: What will they come-to, if I am obligd to sell them at the loss of 12 in the 100?——*L* 365 15.

3. If I propose to get, in any goods, 20 l (per cent) profit; What is that in the shilling?——*D* 2 1$\frac{3}{5}$.

4. A half-penny in the shilling; What is that per cent? ——*L* 4 3 4.

5. Bought 18 cw of *Cheese*, at 28 s per cw; which I sell-out again at 3$\frac{1}{2}$d per lb: What is the profit in the whole? ——*L* 4 4.

6. Having sold 11 yards of *Cloth* for 4 l 16 s; and, thereby, gaind at the rate of 10 per cent: What was the prime cost of 1 yard?——*S* 8 7 2$\frac{6}{11}$.

7. Having sold 2 yards of *cloth* for 11 s 6 d, I gaind, at the rate of 15 per cent: but, had I sold it for 12 s; what would be the rate of gain per cent?——20 *l*.

8. If *Deal*-boards be bought at 18 d a-piece, and sold again at 21 d: What is that per cent profit?——*L* 16 13 4.

9. If I buy *deals* at 20 d a-piece; and sell them again at 17 d: What shall I lose by 120 dozen?——18 *l*.

10. If

10. If I sell 500 *deals* at 15 d a-piece, and 9 l per cent, loss: What do I lose in the whole quantity?—*L* 2 16 3.

11. Bought *Hats*, at 4 s a-piece; and sold again at 4 s 9 d: What is the profit in laying-out 100 l?——*L* 18 15.

12. If I buy 500 pair of silk-*Hose*, at S 8 6 a-pair; How-much must I sell them for per pair, to gain 20 per cent profit?——*S* 11 $0\frac{12}{25}$.

13. If I buy *Incle* for 8 s the gross: How many yards may I sell for a penny, to gain 20 l per cent?——$7\frac{1}{2}$.

14. I have *Lace*, that cost me 5 l per yard: How must I sell it, to gain 8 per cent?——8 *s per yard*.

15. Bought 19 fother of *Lead*, at 14 s per cw. What is gaind by the whole, sold-out at 4 d a-pound?——*L* 432 5.

16. Bought 3 *Oxen* for 24 l 10 s: which I sell again for 2 s per stone: What ought the three oxen to weigh together; the hides and offal being the only clear gain?——245 *stone*.

17. Bought 60 reams of *Paper*, at 15 s per ream: What is the loss in the whole quantity at 4 per cent?——*L* 1 16.

18. Suppose I buy 28 pieces of *Stuff* at 4 l per piece; and I sell 10 of the pieces at 6 l; and 8, at 5 l: At what rate must I sell the rest, to gain 10 per cent by the whole?——*L* 2 6 5 *per piece*.

19. If I buy a cw of *Tobacco* for L 4 13 4, and sell it again for 11 d the pound; Do I gain, or lose? and What per cent?——*Gain* 10 *l*.

20. Bought 7 tuns of *Wine* at 17 l per hhd; which I sell again at 1 s per pint: What is the whole gain; and How-much per cent?——*The whole gain, l* 229 12 ... *The gain, per cent, l* 48 4 8 $1\frac{420}{476}$.

21. A manchester-man buys *Yarn* for 6 s the bundle: which not proving so good as expected, he was willing to put-it-off again, so as to lose but 6 per cent by it. The question is, At what price the bundle is to be sold?——*S* 5 7 2.

INTEREST

I. Simple

What is the

1. *Interest*

of	l	s	d		per cent		y	w	m	d
1	321	16	8	at	6	for	2	—	3	—
2	420	10	—		5½		[14]—	—	—	—
3	432	12	6		5		—	—	—	8
4	589	—	—		6		1	—	—	—
5	589	—	—		6		8	—	—	—
6	7020	—	—		5		—	5	—	—
7	1000	—	—		7		—	—	1	—
8	5429	10	8		5		—	—	—	20
9	836	—	—		6		[15]—	—	—	—

10 500: after the rate of the 30th penny[16], for one year?

Answ. (1) L 1 2 3 1. (2) L 39 9 5 3. (3) S 9 5 3. (4) L 35 6 9 2. (5) L 282 14 4. (6) L 146 5. (7) L 1 6 11. (8) L 14 17 6. (9) L 8 7 10. (10) L 16 13 4[17].

2. *Amount*

14 *From the 10th of July 1727, to the 25th of March 1729.*

15 *From the 4th of June 1733, to the 10th of January 1735.*

16 *The* penny-interest *(viz. 1, for the interest of 20, 25, &c. l, s, d, &c.) is the common method of stating the rate of interest in France, Holland, &c.—To find which, divide 100 by our rate: And—To find our rate, divide 100 by the penny-interest.*

Thus:—To find the penny-interest, by our rate: 100 *(pounds)* ÷ 8⅓ *(the rate per cent)* = 12, *viz. the 12th penny.—To find our rate, by the penny-interest:* 100 ÷ 12 = 8⅓.

17 *For* 500 ÷ 30 = £ 16 13 4.

2. *Amount*

1. What sum will 567 l 10 s amount to in 9 years, at 6 per cent, per annum?——£ 873 19.

2. What will 20 l amount-to, forborn 7 years, at 6 per cent?——£ 28 8.

3. What will 36 l amount-to, lent from may 9. 1712, till november 17 next following; interest being reckond at 5 per cent?——£ 36 18 11 1.

4. What will 508 l 14 s amount-to, in 1 year, at 5 per cent?——£ 534 2 8 1.6.

5. What will 600 l 14 s amount-to, in 10 years, at $4\frac{1}{2}$ per cent?——£ 871 0 3 2.4.

6. What will 4000 l amount-to, in 5 years, at $3\frac{1}{2}$ per cent?——4700 *l*.

7. What will 7200 l amount-to, in $6\frac{1}{2}$ years, at 5 per cent?——9540 *l*.

8. What will 1110 l 18 s amount-to, in $12\frac{3}{4}$ years, at 5 per cent?——£ 1819 1 11 2.8.

9. What will 280 l 10 s amount-to, in 3 years and 148 days, at 5 per cent?——£ 382 5 2 3.38.

10. What will 196 l amount-to, in 189 days, at 4 per cent?——£ 200 1 2 1.23.

3. *Principal*

11. What principal will amount to 873 l 19 s, in 9 years, at 6 per cent?——£ 567 10.

12. What present mony will pay a debt of 28 l 8 s, due 7 years hence, at 6 per cent?——20 *l*.

13. What principal will amount to 534 l 2 s 8 d 1.6 q, in 1 year, at 5 per cent?——£ 508 14.

14. What present mony will pay a debt of L 36 18 11 1, due 6 months, 3 weeks, and 3 days hence; rebate being allowd at 5 per cent?——36 *l*.

15. What principal will amount-to 9540 l, in $6\frac{1}{2}$ years, at 5 per cent?——7200 *l*.

16. What principal will amount-to 1819 l 1 s 11 d 2.8 q, in $12\frac{3}{4}$ years, at 5 per cent?——£ 1110 18.

17. What principal will amount to 871 l 0 s 3 d 2.4 q, in 10 years, at $4\frac{1}{2}$ per cent?——£ 600 14.

18. What

18. What principal will amount to 4700 l, in 5 years, at $3\frac{1}{2}$ per cent?——4000 l.

19. What principal will amount-to 328 l 5 s 2 d 3.38 q, in 3 years, and 148 days, at 5 per cent?——£ 280 10.

20. What principal being put to interest for 189 days, at 4 per cent, will amount-to 200 l 1 s 2 d 1.23 q?——196 *l.*

4. *Rate*

21. At what rate, per cent, will 567 l 10 s amount to 873 l 19 s, in 9 years?——*6 l, per cent.*

22. At what rate will 20 l amount-to L 28 8, in 7 years?——6 *per cent.*

23. If 36 l amount-to L 36 18 11 1, in 6 months 3 weeks and 3 days; What rate of interest is implied in this bargain?——5 *l.*

24. At what rate, per cent, will 508 l 14 s amount-to 534 l 2 s 8 d 1.6 q, in 1 year?——5 *l.*

25. At what rate, per cent, will 7200 l amount-to 9540 l, in $6\frac{1}{2}$ years?——5 *l.*

26. At what rate, per cent, will 600 l 4 s amount-to 871 l 0 s 3 d 2.4 q, in 10 years?——$4\frac{1}{2}$ *l.*

27. At what rate, per cent, will 4000 l amount-to 4700 l, in 5 years?——$3\frac{1}{2}$ *l.*

28. At what rate, per cent, will 280 l 10 s amount-to 328 l 5 s 2 d 3.38 q, in 3 years and 14 days?——5 *l.*

29. At what rate, per cent, will 196 l amount-to 200 l 1 s $2\frac{1}{2}$d, in 189 days,——4 *l.*

30. A certain person let-out 300 l; and, at the end of 2 years, he receives (for principal and interest) 330 l: At what rate of interest was it let-out?——5 *l.*

5. *Time*

31. In what time will 567 l 10 s amount-to 873 l 19 s, at 6 per cent?——9 *years.*

32. In what time will 20 l raise a stock of 28 l 8 s, at 6 per cent?——7 *years.*

33. In what time will 36 l amount-to L 36 18 11 1, at 5 per cent?——6 *months,* 3 *weeks,* 3 *days.*

34. In what time will 508 l 14 s amount-to 534 l 2 s 8 d 1.69 q, at 5 per cent?——1 *year.*

35. How-long must 300l be let-out, after the rate of 5 per cent, to bring-in 330l for the principal and interest together?—— *2 years.*

36. How-long should I be in receiving 330l interest, at 15l per annum?——— *22 years.*

37. In what time will 7200l amount-to 9540l, at 5 per cent?——$6\frac{1}{2}$ *years.*

38. In what time will 1110l 18s amount-to 1819l 1s 11d 2.8q, at 5 per cent?——— $12\frac{3}{4}$ *years.*

39. In what time will 600l 14s amount-to 871l 0s 3d 2.4, at $4\frac{1}{2}$ per cent?——— 10 *years.*

40. In what time will 4000l amount-to 4700l, at $3\frac{1}{2}$ per cent?———— 5 *years.*

41. In what time will 280l 10s amount to 328l 5s 2d 3.38q, at 5 per cent?——3 *years,* 148 *days.*

42. In what time will 196l amount-to 200l 1s $2\frac{1}{2}$d, at 4 per cent?——189 *days.*

II. Compound

What is the

1. *Interest*

of	l	s	d	per cent	years?	Answ.			
1	450	—	—	5	3	£ 70	18	7	2
2	400	—	—	6	4	104	19	9	1
3	480	—	—	5	6	163	4	10	2
4	500	—	—	$4\frac{1}{4}$	4	90	11	5	2
5	400	10	—	$3\frac{1}{2}$	3	43	10	9	2

2. *Amount*

1. What sum will 450l amount-to, in three years time, at 5 per cent?——£ 520 18 7 2.

2. What will 400l amount-to, in 4 years, at 6 per cent? ——£ 504 19 9 3.15264.

3. What will 480l amount-to, in 6 years, at 5 per cent? ——£ 643 4 11 0.178.

4. What

4. What is the amount of 500l, at 4½ per cent, for 4 years?——£ 590 11 5 2.95 +.

3. *Principal*

5. What principal must be put-to-interest, to amount-to the sum of 520l 18s 7d 2q, in 3 years, at 5 per cent per annum?——450l.

6. What principal will amount-to 504l 19s 9d 3.15264q, in 4 years, at 6 per cent, per annum?——400*l*.

7. What principal will amount-to 643l 4s 11d 0.178q, in 6 years, at 5 per cent?——480*l*.

8. What principal will amount to 590l 11s 5d 2.95q, in 4 years, at 4½ per cent?——500*l*.

4. *Rate*

9. At what rate, per cent, will 450l amount-to 520l 18s 7d 2q, in 3 years?——5.

10. At what rate, per cent, will 400l amount-to 504l 19s 9d 3.2q, in 4 years?——6.

11. At what rate, per cent, will 480l amount-to 643l 4s 11d 0.178q, in 6 years?——5.

12. At what rate, per cent, will 500l amount-to 590l 11s 5d 3q, in 4 years?——4¼.

5. *Time*

13. In what time will 450l amount-to 520l 18s 7d 2q, at 5 per cent?——3 *years*.

14. In what time will 400l amount-to 504l 19s 9d 3.2q, at 6 per cent?——4 *years*.

15. In what time will 480l amount-to 643l 4s 11d 0.178q, at 5 per cent?——6 *years*.

16. In what time will 500l amount-to 590l 11s 5d 3q, at 4¼ per cent?——4 *years*.

MEA-

MEASURING

1. *Superficial*

1. A *board* 15 *f* 6 *i* long, and 3 *f* 4 *i* broad; How-many square feet;——*F* 51 8.

2. A square *cieling* contains 114 *y* 6 *f* of plastering; the room 28 feet broad: What was the length of it?——$36\frac{0}{7}$ *f*.

3. What difference is there between a *floor*, 28 foot long by 20 broad; and 2 others, that measure 14 foot (a-piece) by 10: and What do all three come-to, at 45 *s* per square?——*Difference*, 280 f sq . . *Amount*, 18 *l* 18 *s*.

4. A *pavement* F 21 6 long, and F 15 3 broad; What the dimension?——*F* 327 10 6.

5. A painter has done a *pillar* of 6 *f* 3 *i* in circumference, and 14 *f* 9 *i* in height: How-many square yards of painting does that amount-to?——10 *y*, 1 *f*, $0\frac{9}{12}$ *i*.

6. A piece of *wainscot* F 20 4 long, and 10 *f* deep; How-many square yards?——2 *y*, 4 *f*, 7 *i*.

2. *Solid*

7. A *box* F 7 5 long, F 3 2 broad, and F 2 8 deep. How-many foot square?——*F* 62 7 6 8.

8. A *stone*, F 4 6 long, 2 9 broad, 3 4 deep: How-many solid feet?——*F* 41 3.

9. In a piece of *timber*, length 14 *f*, breadth 3 9, depth 4 5: How-many square feet?——*F* 231 10 6.

10. How-many yards of diging in a *well*, F 17 6 deep, 3 4 broad, and 5 7 long, on the mouth?——*Y* 12 1 8 3.

MULTI-

MULTIPLICATION

i. Sums [18].

1. *Simple.*

1897659700 x 780——70043 x 174664798

14801745660oo 12234046446314

2. *Compound*

	l	s	d	q		lb	oz	dw	gr	
11 x	16578	9	3	2	——	15736	10	12	16	x 12
	182363	2	2	2	——	188842	7	12	0	

ii. Questions [19].

1. What is the product of 76, multiplied into 3 and 7? ——760.

2. If 1 yard cost 2 s 3 d; What will 60 yards cost? ——£ 6 15.

3. If one man's pay be 3 s; What must 40 men have? ——6 *l.*

4. There are 124 men employd to finish a piece of work; and they are to have 3 l, each man: What will the work come to?——372 *l.*

5. If a hogshead of tobacco cost L 3 7 9 1; What will 729 cost?—£ 2470 4 11 1.

6. An

18 *Multiplication being the reverse of division, the learner may be referd to that head for plenty of examples; for his further exercise, and for the proof of the several operations there. V. Division, p. 34. n. 9.*

19 *To the following questions may be added, those of the article Practice, under the head 'If one:' they being, all, of the nature of the 2d and 3d questions here.*

6. An army of 10000 men, having plunderd a city, took so-much, that, when it was shard among them, each man had 27 l: What was the value of the plunder?—— 270000 *l.*

7. What number is that, which, divided by 1 2 3 4 5 6 7 8 9, will leave no remainder?——362880.

8. There were 40 men concernd in the payment of a sum of mony; and each man payd 1271 l: How-much was payd in all?——50840 *l.*

9. What is the content of a square piece of ground, whose length is 28 perches, and breadth 13?——364.

10. If 1 foot contains 12 inches; How-many inches are there in 126 feet?——1512 *inches.*

11. How-many diamonds, of 16 in a square inch, will pave the globe we live-on; supposing the ambit 25040 miles? and What would be the value; supposing each diamond worth 100 l?——12813844858011648000 *diamonds*.. 1281384485801164800000 *pounds.*

NUMERATION

Read

(1) 88. (2) 100. (3) 104. (4) 4000. (5) 40,000. (6) 4,006. (7) 50,505. (8) 600,004. (9) 18.700,007. (10) 8.000,080.018,008. (11) 100.000,000. (12) 200,000,000. (13) 999,999. (14) 22,011. (15) 72.

Write

in arabic characters

(1) Eighty-eight. (2) A hundred. (3) A hundred and four. (4) Four thousand. (5) Forty thousand.

 6. Four

6. Four thousand and six. (7) Fifty thousand, five hundred and five. (8) Six hundred thousand, and four. (9) Seventeen millions, seventeen-hundred thousand, and seven. (10) Eight trillions, eighty millions, eighteen thousand, and eight.

11. Ten thousand times ten thousand, *Rev.* v. 11. (12) Two hundred thousand thousand, *Rev.* ix. 16. (13) A million wanting one. (14) Twenty thousand, twenty hundred, and twenty, save nine. (15) Six dozen.

PRACTISE

I. *If one:*

What is the Price, or Value

OF

(1) 9. (2) 95. (3) 100. (4) 1000. (5) 69 $\frac{1}{4}$. (6)

	cw	qr	lb	oz		bush	pec	gal	pint
	12	3	20	10.	(7)	63	1	1	7.

A T

s	d	q	.. per *Piece, Hundred-weight, Bushel, &c.*
—	$\frac{5}{8}$	—	D $5\frac{5}{8}$. (2) S 4 $11\frac{3}{8}$. (3) S 5 $2\frac{1}{2}$. (4) L 2 13 1. (5) S 4 $1\frac{5}{8}$. (6) D $8\frac{1202}{1752}$. (7) S 3 3 $\frac{5}{8}$.
—	—	1	D 2 1. (2) S 1 11 3. (3) S 2 1. (4) l 1 0 10. (5) S 1 5 $1\frac{1}{2}$. (6) D $3\frac{1674}{1792}$. (7) S 1 3 $3\frac{31}{64}$.
—	—	2	d 4 2. (2) s 3 11 2. (3) s 4 2. (4) l 2 1 8. (5) s 2 10 2. (6) d 6 $1\frac{1556}{1792}$.
—	—	3	d 6 3. (2) s 5 11 1. (3) s 6 3. (4) l 3 2 6. (5) s 4 3 $3\frac{1}{2}$. (6) d 9 $2\frac{1438}{1742}$. (7) s 3 11 1.
—	1	1	d 11 1. (2) s 9 10 3. (3) s 10 5. (4) l 5 4 2. (5) s 7 2 $3\frac{1}{2}$. (6) s 1 3 $1\frac{938}{1792}$. (7) s 13 2 $2\frac{19}{64}$.

—	4	1	s 3 2 1. (2) l 1 13 7 3. (3) l 1 15 5. (4) l 17 14 2. (5) l 1 4 7 $1\frac{1}{2}$. (6) s 4 6 $3\frac{1478}{1792}$. (7) l 1 2 5 $3\frac{15}{64}$.
—	5	3	s 4 3 3. (2) l 2 5 6 1. (3) l 2 7 11. (4) l 23 19 2. (5) l 1 3 0 3. (6) s 6 2 $1\frac{870}{1792}$. (7) l 1 10 $5\frac{9}{64}$.
—	7	3	s 5 9 3. (2) l 3 1 4 1. (3) l 3 4 7. (4) l 32 5 10. (5) l 2 4 10 $2\frac{1}{2}$. (6) s 8 4 $0\frac{1718}{1792}$. (7) l 2 1 0 $0\frac{1}{64}$.
—	9	1	s 6 11 1. (2) l 3 13 2 1. (3) l 3 17 1. (4) l 38 10 10. (5) l 2 13 6 $3\frac{1}{2}$. (6) s 9 11 $2\frac{1010}{1792}$. (7) l 2 8 11 $0\frac{57}{64}$.
—	11	1	s 8 5 1. (2) l 4 9 0 3. (3) l 4 13 9. (4) l 46 17 6. (5) l 3 5 1 $3\frac{1}{2}$. (6) s 12 1 $2\frac{66}{1792}$. (7) l 2 19 6 $0\frac{51}{64}$.
1	2	1	s 10 8 1. (2) l 5 12 9 3. (3) l 5 18 9. (4) l 59 7 6. (5) l 4 2 6 $1\frac{1}{2}$. (6) s 15 4 $1\frac{442}{1792}$. (7) l 3 15 4 $2\frac{39}{64}$.
1	5	3	s 13 3 3. (2) l 7 0 6 1. (3) l 7 7 11. (4) l 73 9 2. (5) l 5 2 9 $2\frac{1}{2}$. (6) s 19 1 $2\frac{582}{1792}$. (7) l 4 13 10 $3\frac{21}{64}$.
1	10	2	s 17 1. (2) l 8 18 1 2. (3) l 9 7 6. (4) l 93 15 (5) l 6 10 3 3. (6) l 1 4 3 $0\frac{132}{1792}$. (7) l 5 9 0 $1\frac{38}{64}$.
3	2	1	l 1 8 8 1. (2) l 15 2 9 3. (3) l 15 18 9. (4) l 159 7 6. (5) l 11 1 6 $1\frac{1}{2}$. (6) l 2 1 2 $2\frac{1656}{1792}$. (7) l 10 2 4 $1\frac{7}{64}$.
97	10	1	l 44 0 8 1. (2) l 463 15 3 3. (3) l 489 5 5. (4) l 4892 14 2. (5) l 335 3 0 $0\frac{1}{2}$. (6) l 62 19 10 $0\frac{242}{1792}$. (7) l 310 12 2 $2\frac{7}{64}$.

II. *What'll one?*

What is the Price, or Value

O F

one Piece, Hundred-weight, Bushel, *&c.*

A T

the rate of

s d q
19 2 1 for (1) 9. (2) 95. (3) 100. (4) 1000, &c [18].
ANSW. (1) s 2 1 $2\frac{3}{9}$. (2) q $9\frac{66}{95}$. (3) q $9\frac{21}{100}$. (4) &c.

III. *further exemplified*

1. *in questions, wherein any thing is rated at so-much per cent* [19].

such

18 *Thus any, or all the questions, under the former head [If one] being inverted, will afford so many questions with their answers, under this head [What'll one?]*——Quest. (1) *If 9 pieces cost* s 19 2 1; *What will 1 piece?*—Answ. s 2 1 $2\frac{3}{9}$. (2) *&c.*

19 NB. An Example, *operated, will make the application of the several particulars, under mentiond, easy and familiar. Be it therefore enquird, in the affair of purchasing of* stocks.——Quest. *At* $124\frac{5}{8}$ *per cent, What is the purchase of* £758 17 10 —

——*Answ.* (1) The *Stating is* 100 : $124\frac{5}{8}$: : 758 17 10 : (2) *Therefore, to abbreviate the work by practise.. Multiply the*

	£758	17	10	—
	× .	.	.	10
	7588	18	4	—
Sought	× .	.	.	2
× 20 =	15177	16	8	—
× 4 =	3035	11	4	—

sum

such as

AVERAGE [20], BROKERAGE [21], COMMISSION [22], INSURANCE [23], PRIMAGE [24], STOWAGE [25], &c.

G 3 1. What

sum to be purchasd by the excess above 100, *viz.* $34\frac{5}{8}$ . . *And the product of that, plus the given sum, is the purchase*

$\div \frac{4}{8} =$		379	8	11	—
$\div \frac{1}{8} =$		94	17	2	3
Amnts to . .		186|87	14	1	3
that is *		186 . .	17	6	1
+ sought,		758 . .	17	10	—
Purchase:		945 . .	15	4	2

* *The remainder of* 18687 *l* &c, (*divided by* 100, *to-wit* £ .87 14 1 3) *valued, according to the directions given in the former part, p.* 79, *note* ee, *gives, as in the margin, S* 17 *6* 1.

£ . . ,87	14 1 3	
× . . 20	*taking-in*	
S . 17|54	*the subdi-*	
12	*visions,*	
d . . 6|49	*as in com-*	
4	*mon re-*	
q . . 1|99	*duction.*	

20 Average *is the quota, or proportion, which each proprietor in a ship or loading, is adjudgd, upon a reasonable estimation, to contribute, for defraying such damages, as a vessel or the goods thereof may sustain, from the time of its departure to its return.*——Petty-average *is a duty, which those merchants, who send goods in another man's ship, pay to the master thereof, for his care of them, over and above the freight.*

21 Brokerage *is the mony payd to brokers, for helping merchants or factors, to buy or sell them goods.*

22 Commission, or factorage, *or* provision, *is an allowance given to a factor, for selling goods put into his hands by his employer.*

23 Insurance *is security given in consideration of a sum of mony payd in-hand, to make-good ships, merchandises, houses, &c. to the value of that for which the praemium is receivd, in case of loss by storms, pirates, fire, &c.*

24 Primage, *a duty, appointed (by a statute of H. VIII) to be payd to the mariners, for loading a ship, at its first seting-forth from the port.*

25 Stowage, *the mony payd for the stowing, or laying-up of goods in a ship, &c.*

1. What is the *brokage* (1) of L 248 12 10 at $\frac{1}{2}$ per cent? (2) of L 675 11 9 at $\frac{3}{4}$ per cent——(1) £ 1 4 10 1.48. (2) £ 5 1 4.05.

2. What is the *commission* (1) of L 487 18, at $2\frac{1}{4}$ per cent? (2) of L 7528 14 6 3, at 2 $\frac{3}{4}$ per cent?——(1) £ 10 19 $1\frac{44}{100}$. (2) £ 207 0 9 $2\frac{41}{100}$.

3. What comes the *insurance* of L 148 15 3 to, at 6 guineas per cenr?——£ 937 4 9 3.

4. At $2\frac{1}{2}$ per cent, to what comes the *insurance* of L 128 11 6?——£ 3 4 3 1.

5. What is the *purchase* (1) of L 3287 14, bank-stock, $108\frac{3}{8}$ per cent. (2) of L 758 17 10, at $124\frac{5}{8}$ per cent. (3) of L 845 19 11 3, at $105\frac{3}{4}$ per cent?——(1) £ 3563 0 10 3.08. (2) £ 945 15 4 2.99. (3) £ 894 12 10 2.13.

ii. as also

in the computation of Duties *payable (in the custom-house) upon goods imported, or exported* [20].

1. What is the *Duty* of 96 dozen, at S 1 8.52 per dozen?——£ 8 4 1.92.

2. What

[20] *Here, also, it may be useful to exhibit a question, of this nature, operated*——Quest. *What is the neat Duty of* $96\frac{1}{2}$ *cw, at* 2 l *per cent; paying Subsidy at* 5 *per cent, and* 5 *(per cent) off; Impost, at* 2 s 6 d *per cw, and* $6\frac{1}{4}$ *(per cent) off?*——Answ. *Having found (as in the margin)* the neat Subsidy; £ 9 3 4.20 *and* 11 6 $2.06\frac{1}{4}$ the neat Impost: *these, added, give* £ 20 9 $6.26\frac{1}{4}$ the neat Duty.

Cw		$96\frac{1}{2}$
at 2 l per cw		× 2
L		193
at 5 per cent		× .05
gives Subsidy	L	9|65
		× 20
	S	13|00
L (subsidy)		9 13
at 5 per cent		× 5
gives	L	48|.05
Off . per cent		× 20
	S	9|65
		× 12
	d	7|80

V. Note 19.

Cw

2. What is the duty of 108 gross, at S 2 6.49½ per gross?——£ 13 14 5.46.

3. What is the duty of 496 pounds, at D 1.03⅛ per lb? ——£ 2 2 7.50.

4. What is the duty of cw 22 1 15, at S 6 8 per lb; paying 5 per cent, and 5 (per cent) off?—£ 39 13 10.60.

5. What is the neat duty of cw 35 3 24, at S 3 4 per lb?; paying subsidy at 5 per cent, and 5 (per cent) off; impost, at 10 per cent, and 6¼ (per cent) off?—— £ 94 16 6.20.

6. What is the neat duty of 976 dozen, at 6 *l* per dozen; paying old-subsidy and new-subsidy, each 5 per cent, and 5 (per cent) off; and ⅓-subsidy, at L 1 13 4 per cent, and 5 (per cent) off?——£ 649 0 9.60.

PRO-

Cw	. . . . .		96	½
at 2 s 6 d :	÷ ⅛		L	12
½ 1 s 3 d	for the ½ cw			
Impost :		L 12	1	3
at 6 per cent	. .		×	6
		72	7	6
and ¼ ÷	. .	3	0	3¾
In all :	L	75	7	9¾
		20		
Off 6¼ per cent	s	15|07		
		12		
	d	93 : ¾		
Subsidy	. .	9	13	0
off, 5 per cent	—		9	7.80
Neat	. . .	9	3	4.20
Impost	. .	15	21	3
off, 6¼ per cent	—		1	0.93¾
Neat	. . .	11	6	2.06¼

PROGRESSION

1. ARITHMETICAL

1. What is the last number of an arithmetical progression, begining at 4, and continuing by the increase of 12, to 18 places?——208.

2. The *ages* of 7 children increase by arithmetical progression: the youngest is 2 years old; the oldest 32: What is the common difference of their ages?——5 *years.*

3. 12 persons give their *charity* to a poor man, in arithmetical progression: the first gave 2 pence, the last 2 shillings. How much did the poor man get?——13 *s.*

4. A gentleman traveld 100 *leagues*, in 8 days; and, every day, he traveld equally farther than the preceding day. Now, it being discoverd that the first day he traveld two leagues, the question is, How many leagues he traveld on each of the other days.——3 *leagues. So, on the 2d, he traveld* 5 *leagues; on the 3d,* 8; *and so on.*

5. A traveller went 100 *leagues* in 8 days; and, every day, 3 leagues more than the preceding day: How-many leagues did he travel a day.——2 *leagues, the first day;* 5, *the second; and so on.*

6. A butcher bought 100 head of cattle, to-wit, *oxen*; and gave, for the first ox, 1 crown; for the second, 2 crowns; for the third, 3 crowns, &c. What did the cattle cost him?——£ 1262 10.

7. A man takes out of his pocket, at 6 several times, 6 several numbers of *shillings*; every one exceeding the former by 6: the last was 42: What was the first?——12 *s.*

8. Admit 100 *stones* were laid 2 yards distant from each other, in a direct line; and a basket plac'd 2 yards from the first stone: How-many miles must a man go, in gathering them singly into the basket?——11 *miles,* 3 *furlongs,* 180 *yards.*

9. A gentleman bargains with a bricklayer to have a well sunk, upon these terms: He is to allow him three livres for the

the first *toise* of depth; five, for the second; seven, for the third; and so on, rising two livres every toise, till the well is 20 toises deep. How much will be due to the bricklayer, when he has dug 20 toises deep?——440 *livres*.

10. A merchant has sold 100 *yards* of superfine cloth; to-wit, the first yard, for 1 s; the second, for 2 s; the third, for 3 s, &c. How-much did he receive for the said cloth? ——£ 252 10.

11. Bought 19 *yards* of shaloon; and gave 1 d for the first yard; 3d, for the 2d; 5d, for the third, &c, increasing 2 d, every yard. What did I give for the 19 yards?—— £ 1 10 1.

12. A mercer sold 20 *yards* of silk, at 3 d for the first yard; 6 d, for the second; 9d, for the third, &c, increasing 3 d, every yard. What did he sell the 20 yards for?—— £ 2 12 6.

13. A merchant sold 1000 *yards* of linen, at 2 pins for the first yard; 4, for the second; 6, for the third, &c, increasing 2 pins for every yard. (1) How much did the linen produce, when the pins were afterwards sold at 12 for a farthing? (2) Did the merchant gain, or lose by the sale thereof? and, How much was it; supposing the said linen to have been bought at 6 d per yard?——(1) *The linen produced* £ 86 17 10. (2) *The merchant gaind* £ 61 17 10.

2. Geometrical

1. A thresher workt 20 *days*, at a farmer's; and receivd, for the first day's work, 4 barly corns; for the second, 12 barly-corns; for the third, 36 barly-corns; and so on, in triple proportion geometrical: I would know what the 20 days labor came-to, supposing the whole quantity to be sold for 2 s 6 d per bushel?——£ 1773 7. 6, *rejecting remainders*.

2. A great ship pursues a little one, steering the same way, at the distance of 4 *leagues* from it; and sails twice as fast as the small ship: How far must the great ship sail, before it overtakes the lesser?——8 *leagues*.

3. One agrees for 14 *oranges*, to pay only the price of the last; at a farthing for the first; a half penny the second, &c.

&c. still doubling the price for the next: What must he give? ——£.8 10 8.

4. A grazier offers 40 *oxen* for a farthing a head, and treble it throughout: To what sum will it amount? ——£ 63321174265921 50 8 4.

5. A sum of mony is thus to be divided among 9 *persons*: the 1st, to have 50l; the 2d, 150l; and so on, in that proportion (one, three times more than the other) to the last: What will the last have? ——328050 *l*.

6. A merchant sold 30 *yards* of fine velvet, trimd with gold very curiously, at 2 pins for the first yard; 6 pins, for the second; 18 pins, for the third, &c. in triple proportion geometrical: I would know How much the velvet produc'd when the pins were afterwards sold at 100 for a farthing; (2) and Whether the said merchant gaind, or lost, by the sale thereof; supposing the said velvet to have been bought for 50l per yard? ——*The velvet produc'd* £2144699292 13 0 2 . . . *The merchant gaind* £ 2144697792 13 0 2.

7. A coffee man, upon the signing of the last peace (in the way of *wagering*) for 50 guineas down, agreed to pay, the 1st day, one coffee berry; the second, 2; the 3d, 4; and, so on, to double the quantity every day, till the same was proclaimd. (1) What number of berries would it amount to, supposing the time 60 days; and (2) What would their value be, supposing 1000 berries to the pound, and the pound to be sold for 5s? ——(1) *Berries:* 1152921504606346975 . . (2) *Their value:* 288230376151711 *l* 10 *s*.

8. A crafty servant agreed with a farmer (ignorant in numbers) to serve him twelve *years*; and to have nothing for his service but the produce of a wheat-corn, for the first year; and that product to be sowd, for the second year; and so on, from year to year, till the end of the sayd time. I would know the worth of the whole produce; supposing the increase to be put in a tenfold proportion, and sold-out at 4s per bushel [2]? ——£ 452112 4, *remainders rejected.*

PRO-

2 NB: 7880 *corns are suppos'd to make a pint; and 64 pints, a bushel.*

PROPORTION

i. SINGLE

1. *Direct*

1. If 3 lb of any thing cost 3 s; What will 26 lb cost? —— £ 1 6.

2. If an ingot of gold, weighing 96 lb 9 oz 12 dwts be worth l 411 12: What is a grain of that gold worth? —— D 1 $3\frac{1700}{56208}$.

3. If 1 gallon of *Ale* cost 8 d what cost 36 gallons? —— £ 1 4.

4. If a gallon of *Beer* (at London) cost 4 pence: What cost a barrel? —— 12 *s*.

5. At a noble per week, How many months *Board* may I have for 50 l? —— 37 *months*, 2 *weeks*.

6. Bought a firkin of *Butter*, containing 56 lb, for 18 s 8 d: What is that per lb? —— 4 *d*.

7. If a yard of *Cambrick* cost 12 s; What cost 4 pieces, each 20 yards? —— 48 *l*.

8. If a pipe of *Canary* cost 40 l: How much is that per pint? —— D 9 $2\frac{96}{1008}$.

9. How much must I pay for the *Carriage* of $10\frac{1}{2}$ cw, at the rate of 1 d per lb? —— £ 7 7.

10. If 1 cw of *Cheese* cost 37 s 4 d; What is that per lb? —— $4\frac{20}{112}$ d.

11. At 33 s per cw, What is the price of 1 lb of *cheese*? —— D 3 $2\frac{16}{112}$.

12. At D 3 2 per lb, What come cw 30 3 25 of *cheese* to? —— £ 50 11 9 2.

13. What is *cheese* per cw at $3\frac{1}{2}$d per lb? —— £ 1 12 8.

14. If a yard of *Cloth* is worth 14 s: What is the worth of 5 pieces, each 19 yards? —— £ 66 10.

15. Bought 12 pieces of *cloth*, each 12 yards, at 10 s 6 d per yard: What come they to? —— £ 75 12.

16. If

16. If, at 5 s the ell, I gain 8 l per cent, by my *cloth*; What shall I gain, per cent, if I sell the ell at 6 s 3 d?——10 l. £35 the true ansr. is

17. What cost 120 yards of *cloth*, at 3 s per yard?——18 *l*.

18. A man bought a piece of *cloth* for 16 l 10 s, at 15 s per yard. How many yards did it contain?——22.

19. A draper bought 4 bales of *cloth*, each bale containing 6 pieces, and each piece 27 yards; at l 16 4 per piece: What was the price of the whole; and What the rate, per yard?——*The whole cost l* 388 16 . . 1 *yard cost* 12*s*.

20. If a yard of bread-*cloth* cost 18 s; What cost 5 pieces, each 20 yards?——90 *l*.

21. The *clothing* of a regiment of 740 men, comes to 3000 l: How much is that, for each man?——£4 1 0 3.

22. If the *clothing* of a regiment of soldiers, consisting of 680 men, cost l 2574 1 8; How much is that a man?——£3 15 $8\frac{1}{2}$.

23. Bought 19 chaldrons of *Coals* at 29 s 6 d per chaldron: What come they to?——£28 0 6.

24. If a bushel of *coals* cost 10 d: How many chaldron for 100 l?——66 *chald.* 24 *bush.*

25. How many quarters of *Corn* for 40 guineas; at 4 s per bushel?——26 *quar.* 2 *bush.*

26. If a merchant has owing to him 1000 l, and his *debtor* agrees to pay him, for every pound, 12 s 6 d: How much must he pay him in all?——625 *l*.

27. A *debtor*, owing several persons, in all l 1490 5 10 compounds with, and pays them as far as his effects will go; which amount to no more than l 931 8 $7\frac{3}{4}$: How much do the creditors, by this composition, receive per pound?——*S* 12 6.

28. If the *Expences*, in house-keeping, six weeks, amount to l 9 3 6: How long will 100 l last, at that rate?——$65\frac{145}{367}$ *weeks.*

29. If an ell of *Holland* cost 4 s 6 d: What is the value of 5 pieces, each 12 ells?——£13 10.

30. Bought 5 pieces of *Holland*, each containing 56 ells flemish, at 3 s 2 d per ell: What shall I gain in the whole, if I sell it for 5 s 8 d per ell english?——£3 5 4.

31. A merchant bought 4 pieces of *holland*, each 12 ells, for 7 l 10 s: What did 1 ell cost?——*S* 3 $1\frac{1}{2}$.

I 32. If

32 If a dozen ells of *Holland* are valued at l 3 6; How much will 8 pieces, (each piece containing 54 ells) amount-to, at the same rate?——£ 118 16.

33. If a man's yearly *Income* be 300l: What is it per day?——S 16 5 $1\frac{15}{365}$.

34. What cost 49392 case-*Knives*, at 4 s 4 d per dozen? ——£ 891 16.

35. How many yards of *Lace* for 100 lb, at 3 s 6 d per yard?——$571\frac{18}{42}$ *yards*.

36. How long shall I be *Laying-up* 10000l; if I put by ½ a guinea a-week?——366 *years*, 15 *weeks*, 4 *days*.

37. If 1 cw of *Lead* cost 15 s 11 d; What cost 5 fother?——£ 77 11 10 2.

38. A merchant sends-over, to France, 482 tons of *lead*, at 4 l 10 s per fother. What quantity of wine, at 30 l per pipe, may he expect in return?——74 *pipes*, 17 *gallons*.

39. If *lead* be sold for 1½ d per lb; What is 3 cw worth? ——£ 2 2.

40. If 6 horses eat up 21 bushels of *Oats* in a week's time; How many bushels will serve 20 horses the same time?——70 *bushels*.

41. 500 seamen are to have 4½ d per day, each: What will *Pay* them for 23 months?——£ 6037 10.

42. What does the whole *Pay* of a man-of-war's crew, of 640 sailors, amount-to, for 32 months service; each man's pay being s 22 6 a month?——£ 23040.

43. How many pieces of marble, each 1½ foot square will *Pave* a hall containing (in area) 70 square yards?—— 280.

44. How many ounces of *Plate*, at 5 s 6 d an ounce, will l 67 6 1½ pay-for?——244 *oz.* 15 *dw.*

45. If ¼ of a *Ship* be worth l 387 15 s; What is $\frac{1}{16}$ of that ship worth?——*l* 96 18 9.

46. If 19 dozen pair of *Shoes* cost 25 l 13 s; What cost 1 pair?——*S* 2 3.

47. If 2 oz of *Silk* cost 2 s 6 d; What cost 7 lb?—— 7 *l*.

48. If 1 oz of *Silver* cost 5 s 6 d: What is the price of a tankard, that weighs 1 lb 10 oz 10 dwts 4 gr?—— £ 6 3 9 $2\frac{36}{480}$.

49. If an ingot of *silver* weighs 36 oz 10 dwts: What is it worth, at 5 s per oz?——£ 9 2 6.

50. If a man *Spend* 7 d per day; How much is that in a year?——£ 10 12 11.

51. What will an estate of 4000l per annum allow a gentleman to *spend* a day?——£ 10 19 2.

52. If a family of 10 persons *spend* 3 bushels of malt in a month; How many bushels will serve them, when they are 30 in family?——9 *bushels*.

53. A gentleman *spends* at the rate of 13s 7 d a-day; and lays-up, yearly, 600 nobles: What is his estate worth per annum?——£ 447 17 11.

54. If a gentleman has an estate of 245l 10s a-year; How much may he *spend*, one day with another, to lay-up 60 guineas at the years end?——10*s*.

55. If one pair of *Stockings* cost 2s 3d: What cost 19 dozen pair?——£ 25 13.

56. If 1 lb of *Sugar* cost $4\frac{1}{2}$ d: What cost 48l?——18 *s*.

57. If 1 lb of *sugar* cost 4 d: What cost 1 cw;——£ 1 17 4.

58. If 1 cw of *sugar* cost 2l 12s; What cost 1 lb?——D 5 $2\frac{32}{112}$.

59. If 1 lb of *sugar* cost 9 d: What must I give for 17 cw 2 qrs?——£ 73 10.

60. A gold-smith sold a *Tankard* for 10l 12s, at the rate of 5 s 4 d per oz. What was the weight of it?——39 *oz.* 15 *dw.*

61. Sold. 3 cw of *Tobacco*, at 18d per lb: What is the price of the whole?——£ 25 4.

62. If 17 cw 3 qrs 17lb of *tobacco*, cost 133l 13s 4d; What cost 1 oz?——1 *d*.

63. If 1 lb of *tobacco* cost 15 d; What cost 3 hhds, weighing (together) 15 cw 1 qr 19 lb?——£107 18 9.

64. If $\frac{3}{4}$ of a yard of *Velvet* cost s 7 3; How many yards will l 13 15 6 buy, at that rate?——$28\frac{1}{2}$.

65. One bricklayer, can build a certain *Wall* in 56 days; another, can build the same in 42 days: In how many days then can they finish the same; if they work together?——24 *days*.

66. If a pint of *Wine* cost 10 d: What cost 3 hhds?——63*l*.

67. A

67. A vintner lays-out L 142 . 10 . 9, in 4 several sorts of *wine*; and of each a like quantity: to-wit, red-port at 5 s; sherry, at 6 s; french-claret, at 8 s 8 d; and burgundy at 10 s 6 d, a-gallon: What quantity of each did he buy?——$94\frac{1}{2}$ *gallons*.

68. When the tun of *wine* cost 42 l, What cost 1 quart?——10 *d*.

69. What cost a pack of *Wool*, weighing 2 cw 1 qr 19lb, at 8 s 6 d per stone?——£ 8 4 6 $1\frac{10}{14}$.

2. *Inverse*

1. There was a certain *Building* raisd in 8 months, by 120 workmen; but the same being demolisht, it is requird to be rebuilt in 2 months. How-many men must be employd about it?——480 *men*.

2. If 28 s will pay for the *Carriage* of a cw, 150 miles; How far may 6 cw be carried for the same money?——25 *miles*.

3. If, for 5 l 5 s, I have 14 cw *carried* 136 miles: How-many miles may I have 24 cw carried for the same mony?——$79\frac{1}{3}$ *miles*.

4. There is a *Cistern* having a cock which will empty it in 12 hours: How-many cocks, of the same capacity, must there be, to empty it in a quarter of an hour?——48 *cocks*.

5. How-many pounds of *Coffee* at 5 s and 9 d per lb, is equal (in value) to 426 lb of tea, at 13 s 4 d per lb?——$987\frac{21}{69}$ *lb*.

6. How-many *Dollars*, at 4 s 4 d, must be given for 360 guilders, at 2 s 2 d?——180.

7. If a piece of grass will *Graze* 56 oxen, 6 days: How-many must be turnd-out, that it may last the remaining oxen 16 days?——35.

8. If 100 l, in 12 months, gain 6 l *Interest*; What principal will gain the same in 8 months?——150 *l*.

9. If 100 l principal gain 5 l interest, in 12 months: What principal will gain as much, in 5 months?——240 *l*.

10. If a foot man performs a *Journy* in 3 days, when the days are 16 hours long; How-many days will he require of 12 hours long, to go the same journey in?——4 *days*.

11. If a man performs a *Journy* in 6 days, when the day is 8 hours long: In what time will he do it, when the day is 12 hours long?——4 *days.*

12. If a man performs a *journy* in 9 days when the day is 11 hours long; In how many days will he perform the same, when the day is 15 hours long? the length of the day being accounted from sun rising to sun-set.——6 *days,* 9 *hours.*

13. If I *Lent* my friend 100 l for 6 months (allowing the month to be 30 days) How long ought he to lend me 1000 l, to requite my kindness?——18 *days.*

14. Admit I *lend* a friend, on his occasion, 100 l, for 6 months; and he promises me the like kindness, when I desire it; but, when I came to request it, he could lend me only 75 l: the question is, How long I may keep his mony, to recompense my courtesy to him?——8 *months.*

15. How much shaloon, of 3 qrs wide, will serve to *Line* 9 yards of cloth, of 7 qrs wide?——21 *yards.*

16. How many yards of *Matting*, that is half-yard wide, will cover a room that is 18 feet wide, and 30 feet long?——120 *yards.*

17. If 736 pieces of *Mony* (viz. pieces of-eight) at 4 s 6 d each, were equivalent to, and given for 144 pieces, of another value per piece: What was that value?——23 s a *piece.*

18. If 6 *Mowers* can mow a common field, in 12 days: In what time will 24 mowers do it in?——3 *days.*

19. Suppose 800 soldiers were plac'd in a garrison, and their *Provisions* were computed sufficient for 2 months? How many soldiers must depart, that the provisions may serve them 15 months?——480 *men.*

20. A governor of a fort has *provision* sufficient for 1850 soldiers, for 6 months: but, How many of them must he dismiss immediately from the garrison; that the provisions may last 3 months longer?——450.

21. How much in length that is 3 inches broad, will make a foot *Square*?——48 *inches.*

22. A piece of *Tapestry* is 3 ells flemish wide, and 4 ells flemish long; and it is requird to be lind with something that is but 3 quarters wide: I would know how many yards there must be, to complete the lining?——9 *yards.*

1. If 48 men can build a *Wall* in 24 days; How many men can do the same in 192 days?——6 *men.*

4. If

24. If 16 men enclose a garden with a brick *wall* in 28 days; How-many men will do the same in 64 days?——— 7 *men.*

25. If, when the price of a bushel of *Wheat* is 6 s 3 d, the penny-loaf will weigh 9 oz: What must the penny-loaf weigh, when wheat is 4 s 6 d the bushel?——— 12 *oz.* 7 *dr.* $\frac{38}{54}$.

26. If the penny white-loaf ought to weigh 9 ounces troy, when *wheat* is at 4 s 6 d a bushel: What ought it to weigh, when wheat is at 6 s 9 d a bushel?—— 6 *ounces.*

27. At what price per bushel is *Wheat*, when a penny white-loaf weighs 5 ounces, 8 penny weights? if it weighs 9 ounces when wheat is at 4 s 6 d a bushel.—— *s* 7 6.

28. If 15 shillings-worth of *Wine* will serve 46 men, when the tun is worth 12 l: How-many men will the same 15 shillings-worth suffice, when the tun is worth but 8 l? —— 69 *men.*

29. If 10 pound's worth of *wine*, at 18 d the bottle, accommodate 30 men: How-many will the said 10 pounds entertain with wine, at 3 s 6 d the bottle?——— $12\frac{36}{42}$.

30. If 1 l 2 s-worth of *wine* will suffice a club of 12 men, when wine is sold after the rate of 25 l 4 s a hogshead: How many men will 1 l 2 s-worth serve, when the wine is sold after the rate of 18 l 18 s a hogshead?—— 16 *men.*

ii. Double

1. If 24 l Board 9 men 18 months: How long will 4 l board 5 men? — 6 *months*, $8\frac{2}{3}$ *days.*

2. How much will pay 8 months *board* of 3 men; when 24 l 5 s payd for 2 years 4 months, of 7 men?——— £ 2 15 $5\frac{1}{13}$.

3. If 56 lb of *Bread* will be sufficient for 7 men, 14 days: How much bread will serve 21 men, 3 days?——— 36 *lb.*

4. If I get 8 oz weight of *bread* for 6 d; the wheat at 15 s per boll: What ought the boll of wheat to be; that I may get 12 oz of bread for 4 d?——— *s* 6 8.

5. When wheat is at 12 s 10 d per boll, 7 oz of *bread* cost 5 d: How much ought to be had for 8 d, the wheat being 15 s?—— 9 *oz*, 11 *dw*, $14\frac{2}{3}$ *gr.*

6. What

6. What ought to be the price of 4 lb 10 oz of *bread* the wheat being 16 s 5 d the boll; supposing that, when the wheat is at 12 s I have 8 oz for 4 d? ——S 3 2 2.

7. If 30 s be the *Hire* of 8 men for 5 days; How-many days must 20 men work for 15 l?——12 *days*.

8. If 700 l, in half a year, raise 14 l *Interest*; How-much will 400 l raise, in 5 years?————80 *l*.

9. If 100 l (principal sum) give 5 l 16 s in 1 year; What is the *interest* of 72 l for 5 years 8 months?——£ 9 4 9 $2\frac{2}{5}$.

10. At the rate of 6 l per cent, per annum; What principal sum will raise 48 l in 2 years 4 months (supposing 12 months to a year?) ——£ 342 17 1 $2\frac{6}{7}$.

11. An usurer put out 86 l to receive interest for the same: and, when it had continued 8 months, he receivd for principal and interest 88 l 17 s 4 d. I would know at what rate per cent, per annum, he receivd interest?——5 *l per cent*.

12. What is the *interest* of 200 l for 3 years and $\frac{3}{4}$, at 5 per cent, per annum?————£ 37 10.

13. What is the *interest* of 400 l for a week, at 5 per cent, per annum?————S 7 8 $1\frac{13}{13}$.

14. What is the *interest* of 120 l, for 126 days, at 4 per cent, per annum?——£ 1 13 1 $2\frac{258}{365}$.

15. If 7 qrs of *Malt* are sufficient for a family of 7 persons, for 4 months: How many quarters are enough for 46 persons, 10 months?————115 *qrs*.

16. If 6 quarters of *malt* are sufficient for a family of 12 persons, for 3 months: How many quarters will serve a family of 24 persons, 12 months?——48 *quarters*.

17. If 36 acres of grass be *Mowd* by 6 men, in 8 days: How many acres will be mowd by 36 men, in 38 days? ————1026 *acres*.

18. If 10 bushels of *Oats* be enough for 18 horses, 20 days; How many bushels will serve 60 horses, 36 days? ——60 *bushels*.

19. If 750 bushels of *oats* serve 500 horses, 6 days; How many bushels will serve 1000 horses, 14 days?—— 3500 *bushels*.

20. If 15 s *Pay* 5 men, for 6 days; How much will pay 10 men for 10 days?——5 *l*.

21. If

21. If 7 men can *Reap* 84 acres of wheat in 12 days; How many men can reap 100 acres, in 5 days?——20 *men*.

22. How many *reapers* will cut-down 7 acres of wheat in 4 days; when 6 men cut-down 12 acres in 8 days and 4 hours?——$5\frac{43}{80}$ *men*.

23. If 8 *reapers* have 3l 4s for 4 days work; How much will 48 men have for 16 days work?——£ 76 16.

24. How many men must be employd to *reap* 420 acres, in 17 days: if there were requird 37 men to reap 54 acres, in 5 days?——84 *men*.

25. If 4 *reapers* have 24 s, for 3 days work; How many men will earn 4 l 16 s in 16 days?——3 *men*.

26. If 1000 lb of *Beef*, or pork, serve 250 seamen, 7 days: How many pounds of the same will serve 550 seamen, 9 weeks?——19800 *lb*.

27. If a footman *Travel* 240 miles in 12 days, when the days are 12 hours long: How many days may he travel 720 miles in, of 16 hours long?——27 *days*.

28. If 36 bushels of wheat, in one year, *yield* 216 bushels: How much will 36 quarters yield, in 6 years?——10368 *bushels*.

iii. Conjoind

1. If 6 *Braces* at Leghorn, make 3 ells english; and 5 ells english, 9 braces at Venice: How many braces at Leghorn will make 45 braces at Venice?——50 *braces at Leghorn*.

2. If 20 *braces* at Leghorn be equal to 10 varas at Lisbon; and 40 varas at Lisbon, to 80 braces at Lucca: How many braces at Lucca are equal to 100 braces at Leghorn?——100 *braces at Lucca*.

3. If 3 *Ells* english make 6 braces at Leghorn; and 150 braces at Leghorn, 135 braces at Venice? How many ells english are equal to 27 braces at Venice?——15 *ells english*.

4. If 7 *ells* of Paris make 9 yards of London; and 36 yards of London make 49 Dutch ells; and 7 Dutch ells, 9 fathoms of Milan; and 3 fathoms of Milan, 2 varas of Aragon, and 5 varas of Aragon, 2 canes of Montpelier; and

9 canes

9 canes of Montpelier, 10 of Thoulouse; and 4 canes of Thoulouse, 9 ells of Troy: How many ells of Troy in 100 ells of Paris?——150.

5. If 4 *Pears* are worth 2 apples; and 3 apples, 2 oranges; and 4 oranges, 8 d: What are 12 pears worth?——8 *d.*

6. If 60 french *Pence* be worth 80 dutch pence: How many dutch pence are 360 french pence worth?——480.

7. If 100 *Pounds* English make 95 lb flemish; and 19 lb flemish make 25 lb at Bologna: How many pound english are equal to 50 lb at Bologna?——40 *l english.*

8. If 25 *pounds* at London be 22 lb at Nurenburgh; 88 lb, at Nurenburgh, 92 lb at Hamburgh; 46 lb at Hamburgh, 49 lb at Lyons: How many lb at London are equal to 98 lb at Lyons?——100 *lb.*

9. If 10 *pounds* at London make 9 lb at Amsterdam; and 90 lb at Amsterdam, 112 lb at Thoulouse: How many lb at Thoulouse are equal to 50 lb at London?——56 *lb at Thoulouse.*

10. If 3 *pound* weight, at A, are equal to 2 lb at B; and 5 lb, at B, equal to 2 lb at C; and 7 lb, at C, equal to 8 lb at D: What is the proportion betwixt A and D?—— $\frac{32}{35}$ *lb.*

11. If 9 *Yards* of London make 7 ells of Paris: How many ells of Paris will 63 yards of London make?——49.

R E B A T E

I. at Simple interest:

1. *Discount*

1. What is the rebate of L 795 11 2, for 11 months, at 6 per cent?——£ 41 9 5 $3\frac{131}{211}$.

2. What

2. What the discount of L 161 10, for 19 months, at 5 per cent?——£ 11 16 11 1.

3. If a legacy of 1000l is left me in july 24, 1743; to be payd on the christmas-day following: What must I discount; when I allow 6 per cent, for present payment?——£ 24 16 11 1.

4. Sold goods for 312l, to be payd at two 3 months (that is, half at 3 months, and the other half at 3 months after that) what must be discounted, for present payment, at 5 per cent?——£ 95 14 7.

5. Sold goods for 300l, to be payd at three two months, What must be discounted for present payment?——£ 3 18 9.

2. *Present worth*

1. What is the present worth of L 795 11 2, for 11 months, at 6 per cent?——£ 754 1 8+.

2. What the value of L 161 10, discounting for 19 months, at 5 per cent?——£ 149 13 0 3+.

3. If a legacy of 1000l is left me, july 24, 1743; to be payd on the christmas-day following: What must I receive, when I allow 6 per cent, for present payment?——£ 975 3 0 3+.

4. What is the present worth of 100l, at 5 per cent, payable at 2 4-months?——£ 97 11 4 2.

4. Being obligd, by a bond, bearing date august 29, 1743; to pay next midsummer, 326l: What must I pay down, if they allow discount after the rate of 8 per cent?——£ 305 16 6 1.

5. What is the present worth of 200l, at 4 per cent, payable as follows: viz. 100l, at 2 months; 50l, at 3 months; and 50l, at 5 months?——£ 198 0 6.

3. *Sum*

1. Suppose I receive L 754 1 8, now, for a sum of mony due 11 months hence, allowing 6 per cent for present payment: What was the sum, due at first?——£ 795 11 2.

2. There

2. There is a certain debt, payable 19 months hence: but I agree with the debtor to pay me down L 149 13 0 3 and allow him 5 per cent for present payment: How-much is the debt?——£ 161 10.

3. A legacy was left me the 24th of July, 1744; to be payd on the christmas-day following: but I agree with the executor, and allow him 6 per cent, for the present payment of L 975 3 0 3: What was the legacy?——1000*l*.

4. *Time*

1 The present worth of L 795 11 2 due for a certain time to-come, is L 754 1 8, at 6 per cent: I would know in what time the first sum should have been payd, if no rebate had been made?——11 *months*

2. There is L 161 10 due at a certain time-to-come; but I allow 5 per cent to the debtor for the present payment of L 149 13 0 3: When should the sum have been payd without any rebate?——*In* 19 *months*.

3. I have receivd L 975 3 0 3, for a legacy of 1000l, allowing the executor 6 per cent: When was the legacy payable, without rebate?——*In* 155 *days*.

5. *Rate*

1. At what rate, per cent, will L 795 11 2, payable 11 months hence, produce L 754 1 8, for present payment?——6 *per cent*.

2. At what rate, per cent, will L 161 10, payable 19 months hence, produce the present payment of L 149 13 0 3?——5 *per cent*.

3. Suppose a legacy of 1000l is left me the 24th of july, 1744, to be payd on the christmas-day following; but I agree with the executor for the present payment of L 975 3 0 3: What was the rate, per cent, allowd for the mony?——6 *per cent*.

II. AT

II. AT COMPOUND INTEREST

1. *Discount*

1. What is the rebate of L 520 18 7 2, payable 3 years hence, after the rate of 5 per cent?——£ 70 18 7 3.

2. What the discount of L 504 19 9 3, for 4 years at 6 per cent?——£ 104 19 9 3.

3. What must I discount for the present payment of L 643 4 11; payable in 6 years time, at 5 per cent?——£ 163 4 11.

2. *Present Worth*

1. What is the present worth of L 520 18 7 2, payable 3 years hence, after the rate of 5 per cent?——450 *l*.

2. There is a debt of L 504 19 9 3, which is not due till 4 years hence: but it is agreed to be payd in present mony. What sum must the creditor receive, allowing the rebate of 6 per cent to the debtor for his mony?——400 *l*.

3. If L 643 4 11 be payable in 6 years time; What is the present worth, rebate being made at 5 per cent?——480 *l*.

3. *Sum*

1. If 450 l be receivd for a debt, payable 3 years hence; and an allowance, of 5 per cent, was made to the debtor for his present payment: What was the debt?——£ 520 18 9 2.

2. There is a sum of mony due at the expiration of 4 years; but the creditor agrees to take 400 l down, allowing 6 per cent on present payment. What was the debt?——£ 504 19 9 3.

3. If a sum of mony, due 6 years hence, produces 480 l for present payment, rebate being made at 5 per cent; I would know how much the debt was?——£ 643 4 11.

4. *Time*

4. *Time*

1. A certain man receivd 450l down, for a debt of L 520 18 7 2; rebate being made at 5 per cent: At what time was the debt payable?——3 *years*.

2. There is a debt of L 504 19 9 3, payable at a certain time; but it is agreed to pay 400l down at the allowance of 6 per cent to the debtor for his present mony. In what time would the debt become due, if no such payment were to be made?——4 *years*.

3. The present payment of 400l is made for a debt of L 643 4 11; rebate at 5 per cent. When was the debt payable?——6 *years*.

5. *Rate*

1. The present worth of L 520 18 7 2, payable 3 years hence, is 450l. At what rate per cent was rebate made? ——5 *per cent*.

2. A debt of L 504 19 9 3 is due 4 years hence; but it is agreed to take 400l down. What was the rate per cent, that the rebate was made at?——6 *per cent*.

3. The sum of L 643 4 11 is payable in 6 years time; and the present worth of that sum is 480l. At what rate per cent must rebate be made, to produce the sayd present worth?——5 *per cent*.

REDUCTION

I. Descending:

I. Descend-

REDUCTION

I. Descending [32]

How-many	In	Answ.
1 Brace	1000 great grofs, 11 fmall grofs, 11 dozen	864858
2 Deniers	1000 livres, 19 fols, 11 deniers	240479
3 Farthings	1002 pound, 19 fhillings, 11 pence, 3 farthings	962879
4 Feet	1003 acres, 3 rood, 39 perches, 29 yards, 8 feet	43734236 $\frac{3}{4}$
5 Grains	1004 ounces, 19 penny weights, 23 grains	482399
6 Inches	1005 miles, 7 furlongs, 39 perches, 1 fathom	63740034
7 Minutes	1006 years, 364 days, 23 hours, 59 minutes	529279199
8 Nails	1007 yards, 2 quarters, 3 nails	16123
9 Ounces	1008 tuns, 19 cw, 3 quarters, 27 pounds, 15 ounces	36162559
10 Pecks	1009 weys, 4 quarters, 3 ftrike, 1 bufhel, 3 pecks	161599
11 Pints	1010 pipes, 1 puncheon, 1 tierce, 1 runlet	1019232
12 Pounds	1011 lafts, 11 facks, 25 ftones, 1 clove	4420409
13 Quarts	1012 buts, 1 hhd, 1 kilderkin, 1 firkin, 7 gallons	388924
14 Scruples	1013 pounds, 11 ounces, 7 drams, 1 fcruple	292030
15 Sheets	1111 reams, 19 quires, 24 fheets	555999

32 *When*——In Defcending, *you come to a term, that is not an aliquot part of the preceding; reduce that, with what follows, to the term fought, and add them together. . Thus (in n. 4.) having brought-down acres, roods, and perches, to perches* [160639] *becaufe the next term (yards) is not an aliquot part of*

I II. Ascen-

II. Ascending

The Answers before, will make as many Questions: e. g. . . . In 864858 braces How-many grofs . . . and *The Answers to them will be the Proof of the work.*

III. Mixt

1. *Measure*

1. How many *Barley-corns* will reach round the globe of the earth, which is 360 degrees, and each degree 69 miles and an half?———4755801600.

2. How many *Days* have paft fince the birth of Chrift, to chriftmas 1743?———636630 *days*, 18 *hours*.

3. In half-a-year's time, the fun makes his progrefs through 6 figns of the zodiac; How-many *Degrees*, *minutes*, *and feconds*, does that amount to?——180 *degrees* . . 10800 *minutes* . . 648000 *feconds*.

4. In 30 chaldron of coals, each 36 bufhels, How many *Pecks?*———4320.

5. If a piece of ground contains 24 acres, and an inclofure (of 17 acres, 3 roods) be taken out of it; How many *Perches* are there in the remainder——1000.

6. In 47128 nails of Holland, How many *Pieces*, each 12 yards?———245 *pieces*, 5 *yards*, 2 *quarters*.

7. If a vintner be defirous to draw-off a pipe of canary into bottles, containing *Pints*, *quarts*, *and two quarts*; and each an equal number; How-many muft he have?——— 144 *of each fort*.

8. In 4 pieces of cloth, each 14 yards, How many *Quarters and nails?*———224 *quarters* . . 896 *nails*.

9. One field contains 7 acres; another, 10 acres; and a third, 12 acres 1 rood; How many *Shares*, of 76 perches each,

of the preceding (perch) proceed no further downwards: but, having reduc'd the perches to the term fought (to-wit, feet) by [1089] the quarters of feet in a perch; reduce the yards and feet to feet [269] and add them to the number of feet in ... 03 acres, 3 roods, 39 perches ... wit, 437339673] the amount ... 437342362.—In Afcending, having reduced the feet, upwards, to perches; in order to value the remainder [42920] multiply it into [1089] the quarters of feet in a yard; and divide the product by the original divifor: the quotient will be quarters of feet: [to-wit, 1073 + 3] which (valued) will be 29 yards 8 feet.

each, are contain'd in the whole?——61 *shares, and* 44 *perches over.*

10. How many *Times* does the wheel, which is 18 feet 6 inches over, turn between London and York, which is 192 miles?———54797 *times, and* 186 *inches over.*

11. In 10 bales of cloth, each 10 pieces, each 12 yards, How many *Yards?*——1200.

12. What is the value of 1 *yard* of cloth; whereof 48 yards cost 15 l 10 s 4 d?——*S* 6 5 $2\frac{1}{3}$.

2. *Mony*

1. Four men brought, each, 17 l 10 s (value in gold) into the mint, to be coin'd into *Guineas*: How many must they have?——— 66 *guineas,* 14 *s.*

2. There are 12 purses, with each 12 guineas; How much *Mony* is the sum?——£ 151 4.

3. There are 7 chests of drawers; in each of which there are 18 drawers; and, in each of these, there are 6 divisions; in each of which there is 16 l 6 s 8 d; How much *mony* is there in the whole?——12348 *l.*

4. There are 34 l 17 s to be divided among 17 men; How much is it *a-Piece?*——£2 1.

5. A certain ground-tenant was behind with his landlord, for 16 years *Rent*, at 5 l 10 s a year; How much was the debt?——88 *l.*

6. Eight men have equal shares of a stock of 146 l 16 s; What is each man's *Share?*———£18 7.

3. *Weight*

1. In 17 pigs of *Lead*, each weighing $4\frac{3}{4}$ cw; How many *Fothers?*——4 *fothers,* 2 *cw,* 3 *qrs.*

2. In 17 ingots of silver, each 27 oz 10 dwts, How many *Grains?*——224400.

3. In 470 parcels of sugar, each 26 lb; How many *Hundred-weight?*———*Cw* 109 0 12.

4. A goldsmith, having 3 ingots of silver, each weighing 27 oz, was minded to make them into spoons of 2 oz; cups, of 5 oz; salts, of 1 oz; and snuff-boxes, of 2

oz; and to have an equal number of each: the question is, What was the *Number?*——8, *and* 1 *oz over.*

5. In 461 great pounds of Morea silk, How many *Ounces, and drams?*——11064 *oz* .. 17-024 *dr.*

6. In 17 cw 1 qr 6 lb of sugar, How many *Parcels*, each 17 lb?——114.

7. How many *Porringers*, each 11 oz, are in 19 lb 10 oz 11 dwts of silver?——21, *and* 151 *dwts over.*

8. In 8 hhds of tobacco, each weighing neat 7 cw; How many *Pounds?*——6720.

9. In 672 great pounds of silk, How many common *pounds?*——1008.

10. In 480 common pounds of silk, How many great *pounds?*——320.

11. In 10 lb of silver, How many *Spoons*, each 5 oz 10 dwts?——21 *spoons, and* 90 *dwts over.*

12. In 4560 grains of gold, How many *Tea-spoons*, each half an ounce?——19.

SUBTRACTION

SUMS[33].

SIMPLE

From	31261812	312617127	71261871	7612641
Take	19879128	173121712	26571914	5910817
Remains	11382684	139495415	44689957	1701824

COMPOUND

	L	S	D	Q		Cw	Qr	Lb	Oz
Between	325643	16	7	1	——	139	2	18	13
And . .	156798	19	9	2		106	3	22	10
Difference:	168844	16	9	3		32	2	24	3

Lent

33 *A further exercise in this operation is recommended under the head of Addition, p. 1, n. 1.*

	l	s	d	q		l	s	d	q
Lent	136	17	11	1	—	462	17	10	2
Payd	106	19	9	2	—	393	19	7	3
Due	29	18	1	3		68	18	2	3

	l	s	d		l	s	d
Borrowd	6134	15	$6\frac{1}{4}$	—	6734	16	$8\frac{1}{2}$
Payd . . .	1987	17	$9\frac{3}{4}$	—	5279	18	$9\frac{1}{4}$
Owe . . .	4146	17	$8\frac{1}{2}$		1454	17	$11\frac{1}{4}$

	ya	qrs	na		tu	hhd	gal		gal	qu	p
Bought	171	2	1	—	16	2	10	—	67	1	0
Sold . .	161	3	2	—	12	3	20	—	25	3	1
Have . . .	9	2	3		3	2	53		41	1	1

QUESTIONS.

1. A man borrowd 30 l, and payd (in part) 12 l 10 s; How much remains unpaid?——£ 17 10.

2. King Charles I was beheaded in the year 1648; How many years was that before king William came to the crown; to wit, in 1689?——41.

3. A owes his brewer 109 l 10 s; B owes him 94 l 4 s $10\frac{1}{2}$ d. How much does one owe more than the other? ——£ 15 5 1 2.

4. What sum is that; which, taken from 100 l, leaves 48 l 7 s $6\frac{1}{2}$ d?——£ 51 12 5 2.

5. There were 4 bags of mony, containing, as follows, viz. the first bag 34 l; the second, 50 l; the third, 100 l; and the fourth, 150 l; which were to be payd by several persons. But, one of the bags being lost, there was but 234 l payd. I would know which bag was wanting?——100 *l-bag*.

6. A merchant had 5 debtors, A, B, C, D and E; which, together, owe him 1156 l. B, C, D and E, together, owe him 737 l. What is A's debt?——419 *l*.

7. What sum is that, to which, if I add L 40 19 $11\frac{3}{4}$; the sum will be L 509 11 4?——£ 468 19 $4\frac{1}{4}$.

8. The sun runs through the zodiac in 365 days, 5 hours

49 minuts; the moon in 254 days, 8 hours, 48 minutes. What is the difference of each period?——10 *d.* 21 *h.* 1 *m.*

9. The sum of two numbers is 1964; and the lesser of them is 856; What is the greater?——1108.

10. Two persons are of different ages; the elder of them, A, is 95 years, and 5 months; and the difference of their age is 32 years and 6 months; What is B's age?——62 *years*, 11 *months*.

11. George II, king of great Britain, was born october 30, in the year of our lord 1683; How old is he this year (1748) oct. 30?——65 *years*.

12. In the year 1174 Henry II conquer'd Ireland, and annext it to the title of the crown of England; How long is that ago, this year, 1748?——574.

13. What number is that; which, being added to 168, makes the sum to be 205?——37.

14. The sum of two numbers is 517; the lesser is 40; What is the greater?——477.

15. The greater of two numbers is 130; their difference is 49: What is the lesser number?——81.

16. There are three towns lie in a streight line, to-wit, London, Huntingdon, and York. Now the distance between the farthest of these towns, to-wit London and York is 192 miles; and from London to Huntingdon is 57. I would know far it is from Huntingdon to York.——135 *miles*.

17. A robbery being committed on the highway, there was assest on a certain hundred, in the county of York, the sum of L 373 14 8; of which the 4 parishes payd L 37 16 4 a-piece; the 4 hamlets, L 28 3 10, each; the 4 townships, L 19 19, each; What was the deficiency?——£ 29 18.

TARE

1. What is the neat produce of 20 barrels of *Anchovies*; each, gross, 33 lb; tare, per cent, 10 lb?——£ 601 2.

2. In 12 buts of *Currants*, each 7 cw 1 qr 10 lb, grofs; tare, per cent, 16 lb; How much neat weight?——*Cw* 75 1 26 14.

3. What is the neat weight of 30 barrels of *Figs*, each 2 cw 3 qrs, grofs; tare, per cent, 14 lb?——*Cw* 72 21.

4. In 29 bags of *Hops*, containing grofs, 88 cw 1 qr 19 lb; tare, 4 lb per cw; How many neat?——*Cw* 85 1 2.

5. Four barrels of *Indigo*, containing, each, as follows: (1) cw 4 1 10; tare, 36 lb. (2) cw 3 3 20; tare, 29 lb. (3) cw 4 0 19; tare, 32 lb. (4) cw 4 0 0; tare, 35 lb: How many pounds neat?——1709 *lb*.

6. What is the neat produce of 17 barrels of *Pot-afh*; each, grofs, 203 lb; tare, 10 lb per cent?——*lb* 3142 14.

7. In 46 cw of *Pruans*, tare 16 lb: How many cw neat?——*Cw* 39 1 20.

8. In 70 bales of Smyrna-*Silk*, each 317 lb grofs; tare, per bale, 16 lb; How many lb neat?——21070 *lb*.

9. What is the neat weight of 30 bales of cyprus-*filk*; each weighing 249 lb grofs; tare, per bale, 14 lb?——7050 *lb*.

10. In 17 chefts of *Sugar*, weighing 120 cw 2 qrs, grofs; tare, 176 lb; tret, 4 lb per 104 lb: How many cw neat?——*Cw* 114 1 12.

11. In 16 hogfheads of *Tobacco*, each 5 cw 1 qr 19 lb grofs; tare, per hogfhead, 100 lb; How much neat weight?——*Cw* 72 1 20.

12. Suppofe 15 cw 2 qrs 13 lb, tare, were allowd on 456 cw 1 qr 19 lb of *tobacco*; What would be the neat weight?——*Cw* 440 3 6.

13. In 14 hhds of *tobacco*, weighing (grofs) 89 cw 3 qrs 17 lb; tare, per hhd, 100 lb; How much neat weight?——*Cw* 77 1 17.

14. What is the neat weight of 38 hogfheads of *tobacco*, weighing (grofs) 201 cw 3 qrs 12 lb; tare, in the whole, 3140 lb?——*Cw* 173 3 8.

15. What's the neat weight of 3 hogfheads of *tobacco* weighing, (1) cw 5 3 18. (2) cw 4 2 11. (3) cw 5 1 19? tare, 7 lb per cw: tret, 4 lb per 104 lb: clough, 2 lb per 3 cw.——*Cw* 14 1 $2\frac{3}{4}$.

16. What is the neat weight of 3 hhds of *tobacco*, weighing as follows: (1) cw 3 1 2; tare, 80 lb. (2) cw 3 2 1; tare,

tare, 80 lb. (3) cw 5 1 12; tare, 100 lb?——*Cw* 9 3 7.

17. Three hogsheads of *tobacco*, each containing, as follows: (1) cw 5 1 17; tare, 90 lb. (2) cw 6 2 10; tare, 87 lb. (3) cw 5 3 20; tare, 85 l; How many pounds neat?——1745 *lb*

18. Six hogsheads of *tobacco*, each containing, as follows: (1) cw 4 3 21; tare, 76 lb. (2) cw 5 2 17; tare, 96 lb. (3) cw 6 1 20; tare, 100 lb. (4) cw 4 3 24; tare, 84 lb. (5) cw 7 1 13; tare, 102 lb. (6) cw 5 2 26; tare, 98 lb; tret, 4 lb per 104 lb.; and clough, 12 lb. How many pounds neat?——3231½ *lb*.

(II).

EXAMPLES

PROMISCUOUSLY

DISPOS'D.

1. Write-down nine hundred millions, seven hundred sixty thousand, and twenty-one.——900.760,021.

2. What part of cw 10 1 12 is cw 8 1 25 1 $7\frac{3}{11}$? ——$\frac{9}{11}$.

3. What is the value of 8 chaldron, 3 quarters, and 5 bushels of coals at the rate of 1 l 15 s the chaldron?—— £ 15 11 1 $1\frac{1}{3}$.

4. Write-down the value of each of the following numbers, in words at length: 370087.418427900.6210003745. 41027308751.293417604712.6180020306947 13.

5. If

5. If the $\frac{1}{3}$ of 6 be 3, What shall the $\frac{1}{4}$ of 20 be?—— $7\frac{1}{2}$.

6. A goldsmith has gold, 12 oz at 4 l per oz; 8, at 4 l 5 s; 3, at 4 l 6 s 8 d; and 9, at 4 l 13 s 4 d: What is an ounce worth, suppose these be melted down together?—— £4 7 5 $\frac{1}{2}$.

7. What is the commission of 487 l 18 s at $2\frac{1}{4}$ per cw? —— £ 10 19 1 3.

8. What is the sum of 1748, added to itself?——3496.

9. What is the product of 76 multiplied into itself?—— 5776.

10. What is the difference between 14676 and the 4th of its-self?——11007.

11. When I bought 40 gallons of brandy for 6 l 8 s 3 d: What is the rate per gallon?——*S* 3 2 $1\frac{}{10}$.

12. At $2\frac{1}{2}$ per cent, What is the commission of 3456 l 19 s 10 d?——£ 86 8 5 3.

13. What is the quotient of the square of 476, divided by the half of its root?——952.

14. What difference is there between twice eight and twenty, and twice twenty-eight?——20.

15. What number, added to the 43d part of 4429, will make 240?——137.

16. There is, in three bags, the sum of 1468 l, viz. in the first bag 461 l, in the second 581 l: What then is in the 3d bag?——426 *l.*

17. In what time will 13 men finish a work, which 5 such men could do in 3 days, 8 hours?——*1 day, 6 hours, $46\frac{2}{13}$ minutes.*

11. What number is that, which being multiplied into 13, the product will be 221?——17.

19. Reduce 4 fur. 125 yds 2 feet, 1 in. $2\frac{1}{7}$ barly-c. to the fraction of a mile?——*$\frac{4}{7}$ mile.*

20. If 3 men are boarded 9 months and 20 days, for 30 l: How many men will the same mony pay-for, at that rate, for 4 months?——$7\frac{1}{2}$.

21. Two persons, A, and B, owe several debts; the lesser debt (being that of A) is 2173 l: the difference is 371 l. What is the debt of B?——2544 *l.*

22. Reduce 2 feet 8 in 1 bc $\frac{2}{15}$ to the fraction of a yard?——*$\frac{9}{10}$ yard.*

23. A

23. A Captain, and 160 sailors, took a prize worth 1360 l: of which the captain had $\frac{1}{5}$ for his share; and the rest was equally divided among the sailors: What was each man's part?——272 *l, the captain* . . . 6 *l* 16 *s each sailor.*

24. Reduce 1 yard to the fraction of an ell?——$\frac{4}{5}$ *ell.*

25. One man is boarded 3 months for 5 l: What will be owing, if he remains at board 8 months, and 7 days?——£ 13 15.

26. An ancient lady, being demanded how old she was; to avoid a direct answer, said, 'I have 9 children; and there are 3 years between the birth of each of them: the eldest was born when I was 19 years old; which is now exactly the age of the youngest: How old was the lady?——62 *years.*

27. Reduce 1 rood, 30 poles, to the fraction of an acre?——$\frac{7}{16}$ *acre.*

28. If I ride 6 miles in 3 days, when the days were 14 hours long, counting from sun-rising to setting: How long must the day be, that I may ride 100 miles in the same time?——23 *hours,* 23 *min.*

28. What number is that, from which if you take 341, the remainder will be 726?——1067.

29. What number is that, which being added to 168, makes the sum to be 706?——538.

30. Reduce 31$\frac{1}{2}$ gallons of beer to the fraction of a barrel?——$\frac{7}{8}$ *barrel.*

31. A person comes into a bookseller's (who was an accomptant) and asks the price of a book; which he was told was 5 s. But, as he was not willing to give it, the bookseller told him there were 100 leaves in it: and, if he would give a pin (of 4 rows a penny, and 18 to the row) for the first leaf, 2 for the second, and so on, doubling, for each leaf, he should have the book? What did it come to?——73.359409.735429.942216.244398 *l* 9 *s* 2 *d* 15 *pins.*

32. What number is that, which being divided by 19, the quotient will be 72?——1368.

33. A farmer has 4 sorts of wheat; to-wit, 5 s, 6 s, 7 s, and 7 s 6 d, per bushel: and he is minded to mix so much of each sort, as will make 64 bushels worth 6 s 6 d per bushel: How much of each sort must he take?——*Bushels* 18$\frac{12}{42}$ *(of that of* 5 *s per bushel)* 9$\frac{6}{42}$ *(of* 6 *s)* 9$\frac{6}{42}$ *(of* 7 *s)* 27$\frac{18}{42}$ *(of* 7 *s* 6 *d).*

34. A

34. A broker bought, for his principal, in the year 1720, 400l capital stock in the South-sea; at 650 per cent; and sold it again, when it was worth but 130 per cent. How much was lost in the whole?——2080*l*.

35. The sum of two numbers is 4139; their difference is 948: What is the lesser number?——3191.

36. Reduce $13\frac{1}{2}$ bushels of coals to the fraction of a chaldron?——$\frac{3}{8}$ *chaldron*.

37. In what time could I travel 50 miles, (the day being 12 hours long) at the rate of 50 miles in 5 days, when the day is 16 hours?——3 *days*, 12 *hours*.

38. A gentleman went to sea at 17 years of age: 8 years after that, he had a son born; who livd 46 years; and died before his father: after whom the father livd twice 20 years; and then died also: I demand the age of the father when he died?——111 *years*.

39. Reduce 2 bushels $1\frac{1}{7}$ peck of corn to the fraction of a quarter?——$\frac{2}{7}$ *qr*.

40. At $\frac{1}{2}$ per cent, What is the brokerage of 248l 12s 10d?——£ 1 4 10 1.

41. Three gardeners (A, B, and C) having bought a piece of ground, find the profits of it amount to 120l per annum. Now, the sum of mony, which they layd-out, was in such proportion, that as often as A paid 5l, B payd 7l; and as often as B paid 4l, C payd 6l. I demand How-much each man must have per annum, of the gain?——*A*, 26*l* 13*s* 4*d*. . *B*, 37 6 8 . . *C*, 56.

42. A, B, and C, freight a ship with wine: viz. A lays-out 1342l, B 1178l, C 630l. The whole, 212 tuns, are sold at 32l per tun: What shall each man receive?——*A*, 2890*l* 3*s* 11*d* $3\frac{1235}{3150}$ *q* . . *B*, 2537 $\frac{2}{3150}$ . . *C*, 1356 16.

43. What part of L 5 9 is L 4 13 $5\frac{1}{7}$——$\frac{6}{7}$.

44. At $\frac{3}{4}$ per cent, What is the brokerage of 675l 11s 9d?——£ 5 1 4.

45. A, B, and C, make-up a stock of 1001: whereof A put-in 409l, B 198l: and they improvd it to 1964l. I demand what was the stock of C; and what was each man's share of the whole gain?——*C's stock was* 393*l* . . *A's share*, 803 5 6.240 . . *B's*, 388 17 5.280 . . *C's* 771 17 0.480.

46. Reduce 3 weeks 1 day 9 hours 36 minutes to the fraction of a month?——$\frac{4}{5}$ *month*.

47. A

47. A, B, and C, freight a ship for the Canaries, worth 3696 l: whereof A put-in 369 l, B 897 l: but, by reason of a storm, one third of the goods was thrown overboard. I would know each man's share of the loss?——*A's loss was* 123 *l* . . *B's*, 299 . . *C's*, 810.

48. Reduce 3 qrs 2 na. to the fraction of a yard?—— $\frac{7}{8}$ *yard*.

49. A and B traded together, and gaind 100 l. A put-in 640 l: B put-in so much, that he must receive 60 l of the gain. I demand how much B put in?——960 *l*.

50. Reduce 12 gallons of beer to the fraction of a hogshead?——$\frac{4}{18}$ *hhd*.

51. If a piece of cloth is 20 yards in length, and $\frac{3}{4}$th in breadth: How broad is another piece, which is 12 yards in length, and contains as much cloth as the other?——$1\frac{1}{4}$ *yard*.

52. What is the value of 27 dozen, and 10 lb of candles, at 5 d per lb?——£ 6 9 2.

53. Reduce 6 gallons of ale to the fraction of a barrel?——$\frac{3}{16}$ *barrel*.

54. How much shaloon of 1 yard 1 quarter breadth, will serve to line a cloth-cloak of 5 yards, 3 quarters broad?——3 *yards*.

55. At $\frac{3}{4}$ per cent, What is the brokage of 345 l 12 s $10\frac{3}{4}$ d?——£ 2 11 10.

56. Bought 28 quarters, 2 bushels of wheat, at 4 s 6 d per bushel. What is the worth of it?——£ 50 17.

57. Reduce 13 hours 13 minutes to the fraction of a day?——$\frac{9}{16}$ *day*.

58. If a man earns 2 s 6 d 2 qrs, per day; How much is that for 19 weeks, sundays excepted?——£ 14 9 9.

59. If the rate of carriage is 1 penny for 1 pound weight, carried 50 miles: How far ought 1 pound to be carried for 15 shillings?——$37\frac{1}{2}$ *miles*.

60. At $108\frac{3}{8}$ per cent, What is the purchase of 3287 l 14 s South-sea stock?——£ 3563 0 10 3.

61. A, B, and C, traded together: the first layd-in I dont know how much; B put-in 20 pieces of cloth; and C put in 500 l: and they have gaind 1000 l; whereof A ought to have 350 l; and B, 400 l. I demand C's share; How much the first man laid-in; and What the twenty pieces of cloth were worth?——*C's share was* 250 *l* . . *A laid-in* 700 *l* . . *B's cloth was worth* 800 *l*.

62. Re-

63. Reduce 9 oz (troy) to the fraction of a lb.——$\frac{3}{4}$ *lb.*

64. C has candles at 6 s per dozen, ready mony: but, in barter, he will have 6 s 6 d per dozen: D has cotton at 9 d per lb, ready mony. I demand What price the cotton must be at, in barter; also How much cotton must be barterd for 100 dozen of candles?——*The cotton must be 9 d 3 q per pound, in barter; and . . 7 cw 0 q 16 lb of cotton must be given for 100 dozen of candles.*

65. How many ducats must I deliver at Venice; to receive, at London, 178 l 2 s; the exchange being at 4 s 4 d per ducat? — 822 *ducats.*

66. When wheat is at 12 s per bushel, the 6-penny loaf of bread weighs 1 lb 4 oz (troy-weight) What ought it to weigh, the wheat being 9 s 6 d per bushel?——16 *oz* 14$\frac{2}{67}$ *dw.*

67. A Traveller would change 500 french crowns, at 4 s 6 d per crown, into sterling mony; but he must pay a half-penny per crown for change: How much must he receive? ——£ 111 9 2.

68. What was the price of wheat when the penny-loaf of bread weighd 8 oz; the statute being that it must weigh 10 oz, the wheat at 12 s the bushel?——15 *s.*

69. When a factor takes 1 l per cent for his commission; What must he have for 743 l 17 s 3 d?——£ 7 8 9 1$\frac{192}{240}$.

70. At 124$\frac{5}{8}$ per cent, What is the purchase of 758 l 17 s 10 d, India-Stock——£ 945 15 4 2.

71. In 117 times 406 pieces of coin worth 3 s 8$\frac{3}{4}$ d apiece: How-many reas at 20 for 3 d?——14145040.

72. Two merchants in company gaind 120 l. A laid-in so much, that (for his share of the gain) he must have 60 l. B laid-in 720 ducats at 6 s 8 d per ducat. I demand how much A laid-in, and What the ducats were worth?—— *A laid-in 360 l; and . . The ducats were worth 240 l.*

73. Reduce cw 3 0 8 9 13$\frac{12}{78}$ to the fraction of a tun. ——$\frac{12}{78}$.

74. There were two merchants, who traded in company: the first laid-in the sum of 640 l. and took $\frac{5}{8}$ of the gain: How-much did the second merchant lay-in?——1384 *l.*

75. Three pound weight of bread cost 2 s 6 d, the wheat at 14 s the bushel: What is the wheat worth, if I pay 2 s for the same weight of bread?——*S* 11 2 1$\frac{3}{5}$.

76. What number is that, which, being multiplied by 15; the product will be $\frac{3}{4}$?——$\frac{1}{20}$.

77. What is the interest of 64l for 1 year; the rate of interest being 5l 10's, to 100l, for 1 year?———£ 3 10 4 $3\frac{1}{5}$.

78. What is the value of $\frac{5}{8}$ of 20 shillings?—*S* 12 6.

79. What number is that, from which if you deduct the 25th part of 22525, and to the remainder add the 16th of 9696; the sum will be 1440?———1735.

80. In what time will 500l yield 40l, interest; When 86l does it in 4 years, 8 months?——$20\frac{16}{25}$ *months*.

81. In 672 nine-pences How many thirteen-pence-half-pennies?———448.

82. What fraction is that, to which if you add $\frac{2}{5}$, the sum will be $\frac{5}{6}$?——$\frac{13}{30}$.

83. At 6l per cent, per annum, What principal sum must be employ'd to yield 6 l, in 2 years, and 6 months?——£ 45 3 2 $2\frac{10}{31}$.

84. In 100 thirteen-pence-half-pennies How many nine pences?———150.

85. What number is that, to which if you add $7\frac{2}{3}$, the whole will be $12\frac{1}{4}$?——$4\frac{7}{12}$.

86. Of what principal sum did 20l interest arise, in 1 year at the rate of 5l per cent per annum?——— 400*l*.

87. What number is that, from which if you take $\frac{3}{5}$, the remainder will be $\frac{1}{8}$?——$\frac{29}{40}$.

88. What number is that, from which if you take $13\frac{1}{2}$, the remainder will be $5\frac{5}{7}$?——$19\frac{3}{14}$.

89. If a piece of cloth is 20 yards in length, and $\frac{3}{4}$ in breadth: How broad is another piece, which is 12 yards in length; and contains as much as the other?——$1\frac{1}{4}$ *yard*.

90. What number is that, which being divided by $\frac{3}{4}$, the quotient will be 21?———$15\frac{3}{4}$.

91. In 672 english ells How many yards english?——— 40.

92. At $105\frac{3}{4}$ per cent, What is the purchase of 845 l 19s $11\frac{3}{4}$d Million-bank.———£ 894 12 10 2.

93. What number is that, which being multiplied by $\frac{2}{3}$, produces $\frac{1}{4}$?———$\frac{3}{8}$.

94. The remainder of a division is 423; the quotient, 723: the divisor is the sum of both, and 19 more. What was the number to be divided?———366318.

95. How much shaloon of 1 yard, 1 quarter breadth, will serve to line a cloak of 5 yards of cloth, 3 quarters broad?———3 *yards*.

96. In

96. In 642 nobles How many crowns?——856.

97. What number is that, from which if you take $\frac{2}{5}$ of itself, the remainder will be 12?—— 20.

98. If the rate of carriage is 1 penny for 1 pound-weight, carried 50 miles: How far ought 1 pound to be carried for 15 shillings? —— $37\frac{1}{2}$ *miles.*

99. What part of 25 is $\frac{5}{8}$ of an unit?——$\frac{1}{40}$.

100. In 856 crowns How many nobles?——642.

100. I would plant 2072 elms in 14 rows, 25 feet asunder: How-long will this plantation be?——$616\frac{2}{3}$ *fathoms.*

101. What number is that, to which if you add its own $\frac{2}{3}$, the whole shall be 20?—— 12.

103. When wheat is at 12 s per bushel, the 6 penny loaf of bread weighs 1 lb 4 oz (troy-weight) What ought it to weigh, the wheat being 9 s 6 d the bushel?——16 *oz* $14\frac{2}{57}$ *dw.*

104. What number is that, which makes 9 to be the $\frac{2}{3}$ of it?——$13\frac{1}{2}$.

105. What was the price of wheat, when the penny-loaf of bread weighd 8 oz; the statute being, that it must weigh 10 oz, when the wheat was at 12 s the bushel?—— 15 *s.*

106. In 672 guineas, at 1 l 1 8 per piece, How many pounds sterling?——728.

107. If a cannon may be dischargd, at twice, with 6 lb of powder; How many times will 7 cw 3 qrs 17 lb discharge the same piece?—— 295 *times.*

108. A brigade of horse, consisting of 384 men, is to be formd into a square body, having 32 men in front: How-many ranks will there be?—— 12.

109. What is the price of 3257 oz at $\frac{1}{4}$ of a penny per ounce?——£3 7 10 1.

110. If $\frac{3}{8}$ of a ship be worth 3740 l, what is the whole worth?——£9973 6 8.

111. Three pound-weight of bread cost 2 s 6 d; the wheat at 14 shillings the bushel: What is the wheat worth, if I pay 2 s for the same weight of bread?——*S* 11 2 $1\frac{3}{5}$.

112. A young man receivd 210 l, which was $\frac{2}{3}$ of his elder brother's portion: Now three times the elder brother's portion was half of the fathers estate: What was the estate? ——1890 *l.*

113. Reduce 4 inches to the decimal of a yard.—— .1111111.

114. What come 6-87 pounds to, at $\frac{3}{8}$ of a penny per pound?——£ 10 12 1.

115. A factor bought a certain quantity of broad cloth, and drugget; which, together cost him 81 l. The quantity of broad cloth that he bought, was 50 yards, at 18 s per yard: and for every 5 yards of broad-cloth, he had 9 yards of drugget. How many yards of drugget had he; and how much did the drugget cost him per yard?——90 *yards of drugget, at 8 s per yard.*

116. A certain usurer lent out 90 l, for 12 months; and receivd, principal and interest, 95 l 8 s. At what rate per cent did he receive interest?——6 *l.*

115. Having bought 40 yards of cloth, at 8 s per yard; and 70 yards at 12 shillings; What is the value of both pieces?——58 *l.*

116. What the value of 5324 lb, at $\frac{1}{2}$ of a penny per pound?——£ 11 1 10.

117. Two men depart both from one place: the one goes north; and the other, south: the one goes 7 miles a day; the other, 11 miles a day: How far are they distant the 12 day of their departure?——216 *miles.*

118. Reduce 4 cw 3 qrs to the decimal of a tun.—— .225.

119. What is the price of 5872 grains at $\frac{5}{8}$ of a penny per grain.——£ 15 5 10.

120. A merchant bought 8 tuns of wine: which having receivd damage; he sells it for 400 l, and 12 (per cent) loss How much did it cost him per tun? and How did he sell it per gallon, to lose after the said rate?—— *Cost* 56 *l per tun.. Sold at* 3 *s* 11 *d* $2\frac{900}{2016}$ *q per gallon.*

121. What are 3296 grains worth, at $\frac{3}{4}$ of a penny per grain?——£ 10 6.

122. Two men depart both from one place; and both go the same road: the one travels 12 miles every day; the other, 17 miles every day. How far are they distant the tenth day after their departure?——50 *miles.*

123. If a gentleman has an estate of 1000 l per annum; How much may he spend, one day with another, to lay up threescore guineas at the year's end?——£ 2 11 $4\frac{40}{365}$.

124. What number, divided by 419844, will quote 9494, and leave just a third part of the divisor remaining?—— 3986138884.

125. If

125. If 76 lb of cinnamon, cost 40 l 10 s 8 d; and 1 cw of nutmegs 59 l 14 s 8 d: I demand What is the price of three ounces, one with another?——*2 s.*

126. The sum of 2 numbers is 360; the less is 114; What is their (1) difference (2) product (3) and larger quote?——(1) 132 (2) 28044 (3) $2\frac{9}{57}$

127. What is the price of 4522 drams, at $\frac{7}{8}$ of a penny per dram?——£ 16 9 $8\frac{3}{4}$.

128. A grocer deliverd 17 cw 3 qrs 10 lb of tobacco, in the roll, to be cut and dried: and, when it came home, it held-out 16 cw 0 qr 14 lb. I would know how much was lost in every pound; and also, supposing it cost in the roll $8\frac{6}{7}$d per lb, and the cuting $1\frac{5}{8}$ per lb: I demand what it now stands him in?——*Lost, per pound,* 1 *oz* $8\frac{1200}{1998}$ *dr* .. *It stands him in* £ 87 5 3 $1\frac{16}{56}$.

129. If tallow be sold for 4 d per lb.; What is the value of three tubs, each 3 cw 1 qr 10 lb gross; tare, per tub, 25 lb?——£ 17 9.

130. What number, multiplied into 72084, will produce 5190048?——72.

131. Shipt, from Spain, 10 tuns of wine, at 10 l sterling per hhd: payd, custom at the port of London, 1 s per gallon; the carriage, for lighterage, cartage, and porterage, amounted to 5 l. Afterwards, by the misfortune of a pipe staving, containing 126 gallons, I lost 59 gallons: the next day, 28 gallons more run-out; and, the remainder of the pipe not being saleable, I threw it away, the market-price not running high. I sold the rest for 17 l per hhd: I would know how much I gaind, or lost, by the sale of the said wine?——*Gaind* 115 *l.*

132. What is the price of 57 ya. 3 qu. 4 na. at $7\frac{1}{4}$ d per yard.——£ 57 6: 1.

133. A ship's company took a prize of 300 l; which was to be divided among them according to their pay, and the time they have been on board: the officers, and midshipmen 5 months, and the sailors 3 months. The officers, one with another had 40 s per month; the midshipmen 30 s per month; and the sailors 22 s. There were 6 officers, 12 midshipmen, and 84 sailors. What must each party have of the prize; and What, each single person?——*The* .. *officers* £ 144 4 7 $1\frac{224}{416}$ .. *midshipmen,* £ 108 3 5 $2\frac{64}{416}$ .. *sailors,* £ 47 11 11 $0\frac{128}{416}$——*each man of the* .. *officers* £ 24 0 9 0.. *midshipmen,* £ 9 0 3 1, *sailors,* £ 0 11 3 3.

134. What number, deducted from the 26th part of 2262, will leave the 87th part of the ſame?——61.

135. If 1000 lb of beef ſerve 240 men 8 days; How many lb will ſerve 460 men, 10 weeks?——*lb* 16770 13 $\frac{640}{1920}$.

136. In 672 ſpaniſh guilders How many french piſtoles, at 17 s 6 d per piece?——$76\frac{28}{35}$.

137. What is the amount of 1000 l for 5 years and a half, at $4\frac{1}{4}$ per cent, ſimple intereſt?——£ 261 5.

138. Reduce 14 drams to the decimal of a lb averdupois. ——.0546875.

139. Four men drink, at table, 16 penny-worth of wine; How many men, each of whom drinks but half of what each of the other does, will 22 penny-worth ſerve?—— 11 *men.*

140. Sold goods, amounting to the value of 700 l, for two 4-months; What is the preſent worth, at 5 per cent, ſimple intereſt?——£ 682 19 5 2.

141. The ſpectator's club of fat perſons, though it conſiſted but of 15 perſons, is ſayd (n. 9.) to weigh no leſs than 3 tuns. How-much was that per man?——4 *cw.*

142. A merchant bought 400 cloths, at 12 l per cloth; which he ſhipt for Spain, to have returns from thence; the one half in wine, at 30 l per tun; and the other half in rice, at 28 per cw. How much of each muſt be returnd for the cloths?——80 *tuns of wine, and* . . *cw* 1714 1 4 *of rice.*

143. What is the price of 84 ya. 2 qu. 1 na. at 16 s $11\frac{1}{2}$d per yard?——£ 71 14 0 1.

144. A tobacconiſt having ſeveral ſorts of tobacco; to-wit, of 12 d per lb; of 16 d per lb, of 18 d per lb, of 2 s per lb; and being deſirous to make a mixture of a cw worth at 20 d per lb. I deſire to know how much of each ſort he muſt take?——*lb* 17 $3\frac{18}{26}$, *at* 12 . . 17 3 $1\frac{18}{26}$, *at* 16 . . 17 $3\frac{18}{26}$, *at* 18 . . 60 $4\frac{21}{26}$, *at* 24.

145. What comes 65 cw 3 qu 27 lb to, at 13 s $6\frac{3}{4}$ d per cw?——£ 44 14 11 1.

146. A brewer mixt 17 gallons of ale, at 8 d per gallon; with 19 gallons, at 10 d per gallon; and with 40 gallons, at 6 d per gallon; What is one gallon of this mixture worth and What the worth of the whole quantity?——*D* 7 $1\frac{60}{76}$ *per gallon* . . £ 2 7 2 *the price of the whole mixture.*

147. There

147. There are two numbers; the one 48, the other twice as much: What is the difference between their sum, and difference? —— 96.

148. There are two numbers; the one 63, the other half as much? What is the product of their squares, and What the difference of their product and sum? —— *Product of the squares* 3938240.25 . . *Difference* 1890.

149. There are two numbers; the one 25, the other the square of 25; What is the square root of the sum of their square? —— 625.4998.

150. A merchant, at Amsterdam drew a bill upon London, for 300 l sterling; receiving the value in crowns at 4 s 6 d, and dollars, at 4 s; and got an equal number of each; What is that number? —— $705\frac{90}{182}$.

151. Seven men, with their wives, upon examining into their expenses for 20 weeks past, found that they had layd out $40\frac{4}{5}$ l, I would know in what time $20\frac{3}{7}$ l may be spent by 46 men, in the like proportion. —— $3\frac{31136}{65688}$ *weeks*.

152. There are two numbers, whose product is 1058 and multiplicand 46: What is the multiplier; What the sum of the factors; and What the difference between the sum of the cubes of the factors, and the square of the product? —— *Multiplier* 23 . . *Sum of the factors* 69 . . *Difference* 1009861.

153 There are two numbers, whose dividend is 1216, and the quotient 76; What is (1) the divisor (2) the difference between the cube of the quotient, and the sum of the squares of the divisor, and dividend (3) and the cube-root of the sum of the cubes of the divisor, dividend, and quotient? —— (1) *Divisor* 16. (2) *Difference* 1039936. (3) *Cube-root* 1216.

154. If I receive 11 crowns and 7 dollars, for 4 l 10 s 10 d; or 4 crowns and 3 dollars, for 1 l 15 s; the value of 1 crown and 1 dollar being the same in both: What is that value? —— S 4 4.

155. Suppose a bill of exchange were accepted at London, for the payment of 400 l sterling; for the value delivered at Amsterdam, in flemish mony, at 1 l 13 s 6 d for one pound sterling; How much flemish mony was deliverd at Amsterdam? —— 670 *l*.

156. Two men set out, at the same time, from the same

place;

place; but go contrary ways: and they travel, each of them, 34 miles a-day; In what time will they have traveld 2000 miles?——*Days* 29 9. $52\frac{64}{68}$.

157. There are three numbers, 17, 19, and 48; I would know the difference between the sum of the squares of the first and last; and the cube of the middlemost?——4266.

158. If a man performs a journy in 9 days, when the day is 11 hours long; In how many days will he perform the same, when the days are 15 hours long?——6 *days*, 9 *hours*.

159. What is the value of Cw 227 1 14 at 3 l 11 s 6 d. per cw.——£ 812 17 3 3.

160. What is the duty of 296 pieces, at S 1 $10.72\frac{1}{4}$ per piece?——£ 28 0 9.86.

161. In 7 cheeses, each weighing 1 cw 2 qrs 5 lb; How many allowances for sea-men may be cut, each weighing 5 oz 7 dr?——$3563\frac{15}{87}$.

162. 572 lb 11 oz 5 dw. 7 gr at L 7 18 9 per lb?——£ 4547 13 11 3.

163. What mony, at $3\frac{1}{2}$ per cent, will clear L 38 10, in $1\frac{1}{4}$ year?——880 *l*.

164. In 81034 runlets of brandy, each 18 gallons; How many gross of bottles, each $\frac{8}{9}$ of a quart?——45581 *gross*, 7 *dozen*, 6 *bottles*.

165. What number is that, to which if $\frac{3}{10}$ of $\frac{18}{7}$ of $\frac{241}{213}$ be added, the total will be 1?——$\frac{3048}{7455}$.

166. In 731 dozen bottles of wine, each $1\frac{5}{7}$ pint; How many hhds?——29 *hhds*, 52 *gall*, $5\frac{5}{7}$ *pints*.

167. A person was possest of a $\frac{3}{5}$ share of a copper mine, and sold $\frac{3}{4}$ of his interest therein for 1710 l; What was the reputed value of the whole property, at the same rate? ——3800 *l*.

168. 653 lb 9 oz 3 dwt 5 gr, at L 15 16 $8\frac{3}{4}$ per lb? £ 10353 5 10.

169. Two men, A and B, barter: A has nutmegs, which cost him 7 s 8 d per lb: but, in barter, will have 9 s 6 d per lb. B has cinamon, which cost him 8 s 8 d per lb. How must he rate his cinamon, to make his gain, in barter, equal to that of A?——*S* 10 8 3.

170. Sold $8\frac{1}{2}$ cw of steel, at 12 d per lb; How much flemish mony, at 33 s 8 d per pound sterling, am I to receive for the same?——£ 80 2 $6\frac{96}{240}$.

171. What

171. What number is that, from which if you deduct $\frac{1}{13}$ of $\frac{7}{8}$, and to the remainder add $\frac{1}{16}$ of $\frac{17}{19}$, the sum will be 3? —— $2\frac{9691}{7600}$

172. What is the duty of 496 lb, at $1.03\frac{1}{4}$ d per lb?—— £ 2 2 7.50.

173. If I lend a man 650 l for 22 months, How long ought he to lend me L 953 6 8, to be even with me?—— 15 *months*.

174. If 48, taken from 120, leave 72; and 72, taken from 91, leave 19; and 7, taken from thence, leave 12: What number is that, out of which, when you have taken 48, 72, 19, and 7, there remain 12?——158.

175. A can do a piece of work in 10 days; B, alone, in 13. Set them, both, about it, together: In what time will it be finisht?————$5\frac{15}{23}$ *days*.

176. A has $\frac{1}{2}$ of a ship; B, $\frac{1}{4}$; C, $\frac{1}{16}$; D, $\frac{3}{16}$. The master clears 120 l; How-much must each owner have?—— *A*, *l* 60 .. *B*, 30 .. *C*, 7 10 .. *D*, 22 10.

177. Two merchants, A and B, barter, A had 13 cw 3 q 10 lb of sugar, worth $6\frac{1}{2}$ d per lb; for which B gave him 27 cw 2 q 20 lb of figs. How did B rate his figs?—— *D* 3 1.

178. In what time will the interest of L 49 3 equal the proceed of L 19 6, at use 47 days at any rate of interest? ——$18\frac{45}{180}$ *days*.

179. What is the duty of 296 pieces, at S 1 $10.72\frac{1}{4}$ per piece? —— £ 28 0 9 86.

180. A merchant bought 13 cw 3 q 21 lb of sugar, at $5\frac{1}{4}$ d per lb; and sells it again for $6\frac{1}{2}$ d per lb. How much did he gain by the whole?—— £ 8 2 7 1.

181. If 30 men can perform a piece of work in 11 days: How-many will accomplish another 4 times as big, in one fifth of the time?————600 *men*.

182. If a gentleman, having 50 s to pay among his labourers for a day's work, would give, to every boy, 6 d; to every woman, 8 d; and to every man, 16 d. The number of boys, women, and men, was the same. What was the number of each?———— 20.

183. A person, dying, left his widow 1780 l, and 1250 to each of his 4 children. He had been $25\frac{1}{2}$ years in trade; and had cleard (at an average) 126 l a-year. What had he to begin with?——— £ 4189 10.

184. A

184. A gentleman had 7 l 17 s 6 d to pay among his labourers. To every boy he gave 6 d; every woman, 8 d; and to every man, 16 d; and there were, for every boy, three women; and, for every woman, two men: What was the number of each? 15 *boys*, 45 *women*, 90 *men*.

185. What is the duty of 729 skins, at d1.89$\frac{3}{8}$ per skin? ——— £ 5 15 0.54$\frac{3}{8}$.

186. A merchant, in Flanders, delivers 500 l flemish, to receive the same again at London; the exchange at 35 s 6 d flemish per pound sterling. How much must he receive? —— £ 281 13 9 2.

187. Part 1500 acres of land; give B 72 more than A; and C, 112 more than B. What will each have? —— *A*, 414$\frac{2}{3}$ . . *B*, 486$\frac{2}{3}$ . . *C*, 598$\frac{2}{3}$.

188. Admit a tax of 39 l is layd on a town, for the building of a bridge; and the value of the town-rent is 900 l per annum. What shall a man pay towards it, whose income is worth 100 l per annum? ——— £ 4 6 8.

189. What is the duty of 729 skins, at D1.89$\frac{3}{8}$ per skin? —— £ 5 15 0.54$\frac{3}{8}$.

181. A tradesman increast his estate, annually, a third part, abating 100 l which he spent in his family; and, at the end of 3$\frac{1}{4}$ years, found that his estate amounted to L3179 11 8. What had he to begin-with? —— 1480 *l*.

191. Suppose A has an estate of 53 l per annum, and pays 5 s 10 d to a subsidy; What shall B pay; whose estate is worth 100 l per annum? —— *S* 11 0$\frac{4}{53}$.

192. What quantity of water will you add to a pipe of mountain-wine, value 33 l; to reduce the first cost to 4 s 6 d the gallon? ——— 20$\frac{2}{3}$ *gallons*.

193. What is the duty of 649 skins at D 0.65$\frac{5}{8}$ per skin? —— £ 1 15 5.92$\frac{5}{8}$.

194. If 136 l were to be divided between two men; so as the lesser share may have such proportion to the greater, as 2 to 5; What must each man have? —— *The one* £ 38 17 1 2$\frac{6}{7}$ . . *The other*, 97 2 10 1$\frac{1}{7}$.

195. What is the duty of 127$\frac{3}{4}$ dozens, at S 13.28 $\frac{7}{8}$ per dozen? —— £ 8 2 9.13$\frac{6}{8}$

196. There is the sum of 1000 l to be divided among 3 men; in such manner, that, if A have 3 l, B shall have 5 l, and C 8 l. How much must each man have? ——— *A must have* £ 187 10 . . *B*, 312 10 . . *C*, 500.

197. If,

197. If, by selling hops at L 3 10 per cw, the planter clears 30 per cent; What was his gain per cent, when the same goods sold at 4 pounds, and a crown?——£ 57 17 $1\frac{5}{7}$.

198. Shipt, for Jamaica, 550 pair of stockings, at 11 s 6 d per pair; and 460 yards of stuff, at 14 d per yard: in return for which, I had 46 cw 3 qrs of sugar, at 24 s 6 d per cw; and 1570 lb of indigo, at 2 s 4 d per lb. What remains due to me of my adventure?——£ 102 12 11 2.

199. What is the duty of 479 cw 3 qu 26 lb, at S 3 $3.63\frac{3}{4}$ per cw?——£ 79 5 $5.29\frac{1}{4}$.

200. A merchant at Cadiz, receives 1500 ducats, to pay the same, by his correspondent, at London; the exchange $58\frac{1}{2}$ pence, per ducat. How much does it amount to?——£ 365 12 6.

201. Lent 109 guineas, at 4 per cent: which, by the 18th of august (1740) was raisd, by the interest, to as many moidores, wanting 2 s 6 d. On what day did the bond bear date?——*July* 7, 1733.

202. If a tower be 384 feet high from the foundation, and a sixth part be under the earth; and an eighth part under the water; How much in height is visible?——272 *feet*.

203. A merchant at London receives, from his correspondent abroad, his account current: the balance of which is 756 dollars; the exchange at $53\frac{7}{8}$ pence per dollar: What does it amount to?——£ 169 4 1 2.

204. What is the duty of 22 cw 1 qr 15 lb, at 6 s 8 d per pound; paying 5 per cent, and 5 per cent off?——£ 39 13 10.6c.

205. A carrier receivd 50 shillings for the carriage of 3 cw 3 qrs 21 lb, 137 miles. How much ought he to receive at that rate, for the carrying 2 cw 1 qr 21 lb, 279 miles?——£ 3 2 1.

206. A merchant would lay-out, in spices, 560 l, at the following prices; to wit, cloves, at 4 s per lb; mace, at 7 s; cinamon at 3 s; nutmegs, at 12 s; and pepper, at 2 s per lb. And he would have an equal quantity of each sort. What is that quantity?——400 *lb of each sort*.

207. The computed distance between London and York is 150 miles. Now, if a man sat out from London, and walk every day toward York 20 miles; How long will it be, before he gets to his journeys end?——$7\frac{1}{2}$ *days*.

208. If 40 acres of grass can be mowd by 9 men, in 7 days;

days; How many acres may be mow'd by 24 men, in 28 days?——*476 acres 2 rods 24 poles.*

209. What is the neat duty of $96\frac{1}{2}$ cw at 21 per cw; paying subsidy at 5 per cent, and 5 per cent off; impost at 2 s 6 d per cw, and $6\frac{1}{4}$ per cent off?——£ 20 9 6 $26\frac{1}{4}$.

210. If 48 pioneers, in 12 days, can make a trench 24 yards long; In how many days will 162 pioneers make a trench 108 yards?——*16 days.*

211. Bought 127 pieces of cloth, for which I deliverd 3589 ells of Holland at 7 s 11 d per ell english; What cost a piece of that cloth?——£ 11 3 8 $2\frac{94}{127}$.

212. The account of a certain school is as follows: to-wit, $\frac{1}{16}$ of the boys learn geometry; $\frac{3}{8}$ learn grammar; $\frac{3}{10}$ learn arithmetic; $\frac{3}{20}$ learn to write; and 9 learn to read. What was the number of each?——5 *geometers,* 30 *grammarians,* 24 *arithmeticians,* 12 *writers,* 9 *readers.*

213. Four merchants A, B, C, and D, make a stock. A put-in 227 l; B, 349 l; C, 115 l; and D 439 l. In trading they gaind 428 l. What was each merchant's share of the gain?——*A:* 85 19 6 3 .. *B:* 132 3 9 .. *C:* 43 11 1 3 .. *D:* 166 5 6 1.

214. What is the neat duty of 35 cw 3 qrs 24 lb, at 3 s 4 d per lb; paying subsidy at 5 per cent, and 5 per cent off: impost at 10 per cent, and $6\frac{1}{4}$ per cent off?——£ 94 16 6.20.

215. Two men, A and B, join their stocks. A had 544 l 19 s 9 d; B had 213 l 5 s. They gaind, in trading, 578 l 14 s 9 d. What was each man's share of the gain?——*A:* 357 11 6 2 .. *B:* 221 3 2 1.

216. I have layd-out, for a merchant, 638 l 17 s 3 d; he allows me $2\frac{3}{4}$ per cent. Before that, I ow'd him 17 s 9 d. How much is he indebted to me?——£ 471 10 10 1.

217. Bought a tun of wine for 78 l 17 s; At what price must I sell it per quart, to gain 5 l 10 s by the whole; when there were 22 gallons leakt-out?——22 *d.*

218. What is the neat weight of 976 dozen, at 6 l per dozen; paying old subsidy and new subsidy, each 5 per cent; and 5 per cent off; and $\frac{1}{3}$ subsidy at L 1 13 4 per cent; and 5 per cent off?——£ 649 0 9.60.

F I N I S.

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