should only multiply 36 first by 3, and then the product 108 by 4, in order to have the whole product of the multiplication of 12 by 36, which is consequently 432.

36. But if we wished to multiply $5ab$ by $3cd$, we might write $3cd \times 5ab$. However, as in the present instance the order of the numbers to be multiplied is indifferent, it will be better, as is also the custom, to place the common numbers before the letters, and to express the product thus: $5 \times 3abcd$, or $15abcd$; since 5 times 3 is 15.

So if we had to multiply $12pqr$ by $7xy$, we should obtain $12 \times 7pqrxy$, or $84pqrxy$.

CHAP. IV.

Of the Nature of whole Numbers, *or* Integers, *with respect to their* Factors.

37. We have observed that a product is generated by the multiplication of two or more numbers together, and that these numbers are called *factors*. Thus, the numbers a, b, c, d, are the factors of the product $abcd$.

38. If, therefore, we consider all whole numbers as products of two or more numbers multiplied together, we shall soon find that some of them cannot result from such a multiplication, and consequently have not any factors; while others may be the products of two or more numbers multiplied together, and may consequently have two or more factors. Thus 4 is produced by 2×2; 6 by 2×3; 8 by $2 \times 2 \times 2$; 27 by $3 \times 3 \times 3$; and 10 by 2×5, &c.

39. But on the other hand, the numbers 2, 3, 5, 7, 11, 13, 17, &c. cannot be represented in the same manner by factors, unless for that purpose we make use of unity, and represent 2, for instance, by 1×2. But the numbers which are multiplied by 1 remaining the same, it is not proper to reckon unity as a factor.

All numbers, therefore, such as 2, 3, 5, 7, 11, 13, 17, &c. which cannot be represented by factors, are called *simple*, or *prime numbers*; whereas others, as 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, &c. which may be represented by factors, are called *composite numbers*.

40. *Simple* or *prime numbers* deserve therefore particular attention, since they do not result from the mul-

tiplication of two or more numbers. It is also particularly worthy of observation, that if we write these numbers in succession as they follow each other, thus,

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, &c.*

we can trace no regular order; their increments being sometimes greater, sometimes less; and hitherto no one has been able to discover whether they follow any certain law or not.

41. All *composite* numbers, which may be represented by factors, result from the prime numbers above mentioned; that is to say, all their factors are prime numbers. For, if we find a factor which is not a prime number, it may always be decomposed and represented by two or more prime numbers. When we have represented, for instance, the number

* All the prime numbers from 1 to 100000 are to be found in the tables of divisors, which I shall speak of in a succeeding note. But particular tables of the prime numbers from 1 to 101000 have been published at Halle, by M. Kruger, in a German work entitled "Thoughts on Algebra;" M. Kruger had received them from a person called Peter Jaeger, who had calculated them. M. Lambert has continued these tables as far as 102000, and republished them in his supplements to the logarithmic and trigonometrical tables, printed at Berlin in 1770; a work which contains likewise several tables that are of great use in the different branches of mathematics, and explanations which it would be too long to enumerate here.

The Royal Parisian Academy of Sciences is in possession of tables of prime numbers, presented to it by P. Mercastel de l'Oratoire, and by M. du Tour; but they have not been published. They are spoken of in Vol. V. of the Foreign Memoirs, with a reference to a memoir, contained in that volume, by M. Rallier des Ourmes, Honorary Counsellor of the Presidial Court at Rennes, in which the author explains an easy method of finding prime numbers.

In the same volume we find another method by M. Rallier des Ourmes, which is entitled, "A new Method for Division, when the Dividend is a Multiple of the Divisor, and may therefore be divided without a Remainder; and for the Extraction of Roots when the Power is perfect." This method, more curious, indeed, than useful, is almost totally different from the common one: it is very easy, and has this singularity, that, provided we know as many figures on the right of the dividend, or the power, as there are to be in the quotient, or the root, we may pass over the figures which precede them, and thus obtain the quotient. M. Rallier des Ourmes was led to this new method by reflecting on the numbers terminating the numerical expressions of products or powers, a species of numbers which I have remarked also, on other occasions, it would be useful to consider. F. T.

30 by 5×6, it is evident that 6 not being a prime number, but being produced by 2×3, we might have represented 30 by $5 \times 2 \times 3$, or by $2 \times 3 \times 5$; that is to say, by factors which are all prime numbers.

42. If we now consider those composite numbers which may be resolved into prime factors, we shall observe a great difference among them; thus we shall find that some have only two factors, that others have three, and others a still greater number. We have already seen, for example, that

4 is the same as	2×2,	6 is the same as	2×3,
8 - - -	$2 \times 2 \times 2$,	9 - - - -	3×3,
10 - - - -	2×5,	12 - - -	$2 \times 3 \times 2$,
14 - - - -	2×7,	15 - - - -	3×5,
16 - -	$2 \times 2 \times 2 \times 2$,	and so on.	

43. Hence, it is easy to find a method for analysing any number, or resolving it into its simple factors. Let there be proposed, for instance, the number 360; we shall represent it first by 2×180. Now 180 is equal to 2×90, and

$$\left.\begin{array}{r}90\\45\\15\end{array}\right\}\text{ is the same as }\left\{\begin{array}{l}2\times 45,\\3\times 15,\text{ and lastly}\\3\times 5.\end{array}\right.$$

So that the number 360 may be represented by these simple factors, $2 \times 2 \times 2 \times 3 \times 3 \times 5$; since all these numbers multiplied together produce 360 *.

44. This shews, that prime numbers cannot be divided by other numbers; and, on the other hand, that the simple factors of compound numbers are found most conveniently, and with the greatest certainty, by seeking the simple, or prime numbers, by which those compound numbers are divisible. But for this *division* is necessary; we shall therefore explain the rules of that operation in the following chapter.

* There is a table at the end of a German book of arithmetic, published at Leipsic, by Poetius, in 1728, in which all the numbers from 1 to 10000 are represented in this manner by their simple factors. F. T.