long multiplication : the Gelosia and Diamond Grid methods

Lattice multiplication has been around for a long time. Many sources report that the method was invented in the 9th century by a mathematician / astronomer / geographer called al-Khwarizmi, (variously described as either Persian or Iraqi) and was later brought to Europe by Fibonacci. The Arabic term for the method, *shabakh,* has the same meaning as the Italian term for the method, *gelosia*, namely the metal grille or grating (lattice) for a window; this fact is sometimes quoted to support this account of the history. However, nowhere in their writings does either of these two mention or use lattice multiplication (although Fibonacci does describe a method which is vaguely like it). Lacking direct evidence, this version of the history is probably best regarded as completely spurious. We do, however, have written evidence showing clearly that lattice methods, of one sort or another, were in use in Indian, Arab, European and Chinese mathematics in the 12th, 13th, 14th and 15th centuries respectively. Not surprisingly, the method, in one form or another, has come to be known by a variety of names : lattice multiplication, the Gelosia method, the Italian method, the Chinese method, Chinese Lattice, sieve multiplication, Shabakh etc).

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the Gelosia method

Although based on grid multiplication, the lattice method has an extra level of sophistication : it cleverly writes the separate products in such a way as to line up digits with the same place-value. This allows for speedier calculation of the final answer. The Gelosia method is perhaps the best known lattice method, so let’s have a look at how it works in practice :

It’s probably easiest to get the hang of the method by looking at a straightforward 2-digit by 2-digit multiplication. Let’s take for our example 87 x 23.

Farming times (grid method), has things set out in this way :

x	80	7
20	1600	140
6	480	42

80	7	x
1600	140	20
480	42	6

– although this way round gives you exactly the same products in exactly the same places.

Using this method for any 2-digit by 2-digit long multiplication, you'll find that the products are always formed from one or two digits, followed by either no zeros or else by one, two or three zeros.

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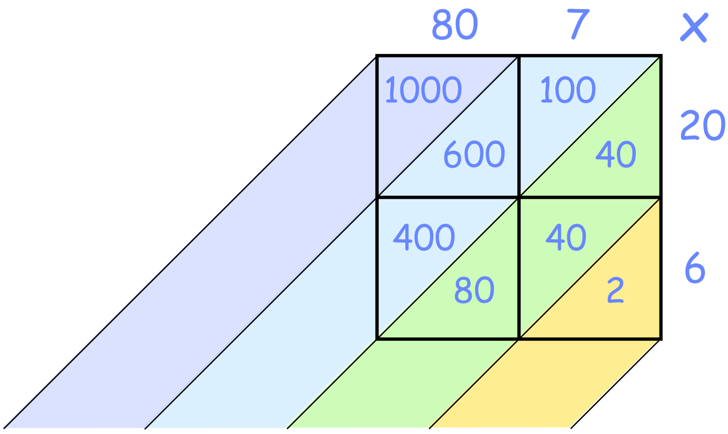
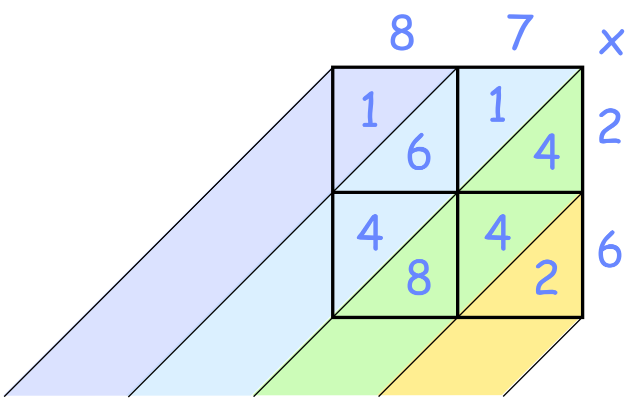
Suppose we choose to write each product as two components, based on their different place-value :



Perhaps you can already see that doing this conveniently lines up diagonal bands which contain the thousands, hundreds, tens and units components of our answers. And of course, this makes it easier to do the final adding up which will give us the answer we're after.

This is the basic principle of the Gelosia method. In practice, however, since we know the place-value of digits in any particular diagonal band, we can record the answers which go in the different halves of each box using just single digits :



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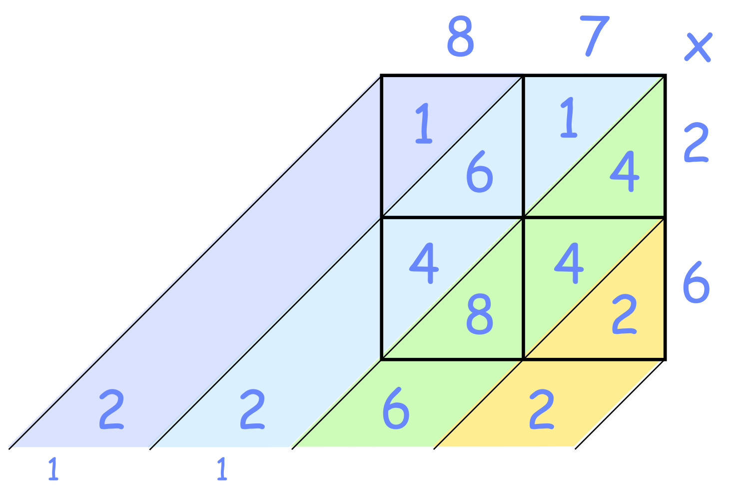
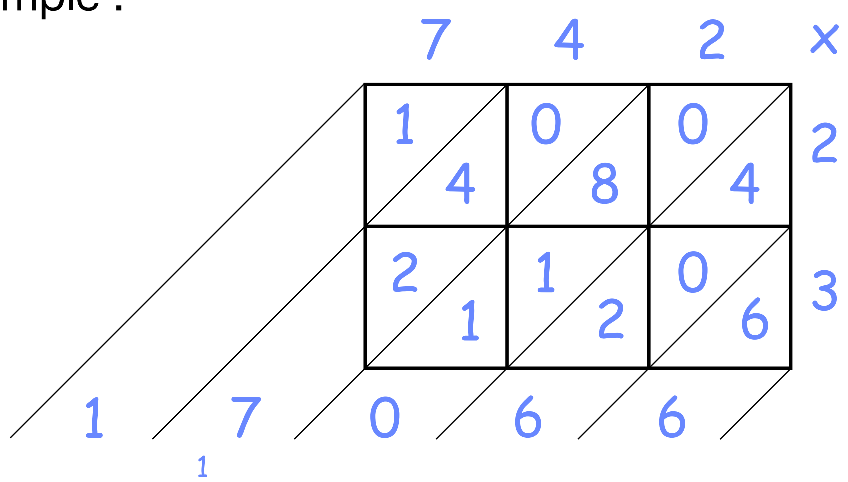
Now all we need to do to get our final answer is to add up the numbers in each diagonal band ('carrying' where necessary). It's just like doing any addition involving thousands, hundreds, tens and units – except that you're working with sloping columns rather than vertical ones.



answer: 2262

The method is easily adapted to accomodate long multiplication calculations involving larger numbers, for example :



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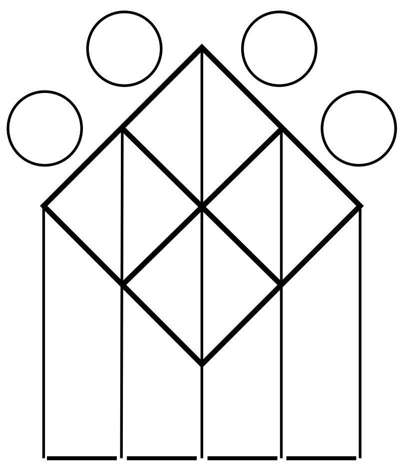
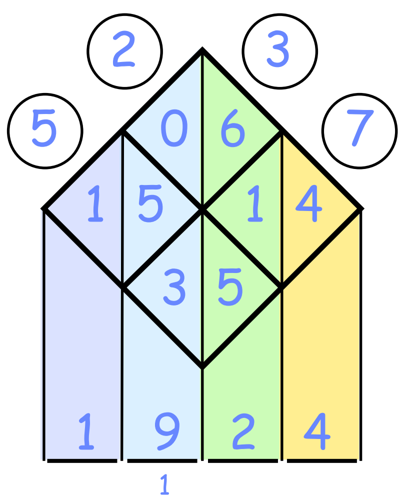
the Diamond Grid method

Whilst most pupils find grid multiplication both easy to understand and easy to carry out, they do not generally seem to find the Gelosia method a particularly attractive one. Some show a passing interest in the method but for most, the need to add up columns of numbers diagonally is unappealing. About four or five years ago, I had the idea of taking the underlying grid involved in lattice multiplication and rotating it through 45º. Used specifically for 2-digit by 2-digit multiplications, this form of lattice multiplication quickly became popular with pupils, chiefly because it is so quick and easy to operate (and of course because the ‘unnatural’ process of diagonal addition is done away with). I called this method the 'Diamond Grid' method, a name which pupils seemed to like.

Here’s the basic grid, followed by some worked examples. Once pupils have seen the Gelosia method, they usually need no further explanation of how (and why) this method works.





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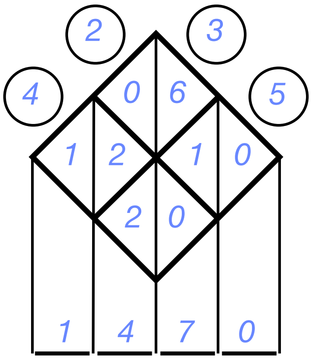

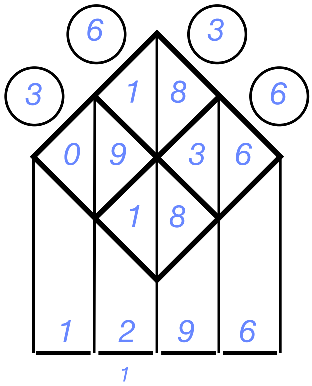

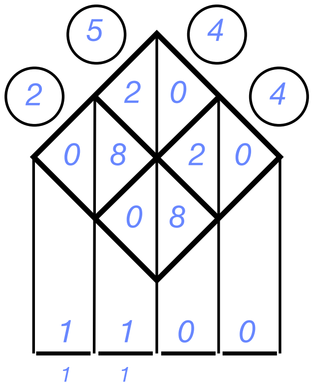

footnotes *:*

1 : Why the name 'Diamond Grid'? Obviously, the original square is still a square even after being rotated through 45° but in the interests of finding a suitably engaging name, I gave in to the common habit of pupils to call any rhombus (or square standing on end) a 'diamond'.

2 : The particular 'diamond grid' shown here is clearly suitable only for 2-digit by 2-digit long multiplication. But as this is the variety of long multiplicaton which pupils are most often asked to perform, it seems to me worth having it.

3 : I should mention that the pupils I taught and who cheerfully took on board the various ideas outlined here were of above average ability. They found it easy enough to appreciate the Gelosia method as a clever development of grid multiplication. For these pupils, the Diamond Grid method was just a more attractive version of Gelosia for 2-digit by 2-digit multiplication. In practice, less able pupils might also find the Diamond Grid method easy to learn and to carry out – but I personally would not teach it to pupils who might not understand how and why it works, preferring to retain it as as an interesting extra for more able pupils.

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