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A HANDBOOK OF COMPOSITION

by

John R. Leary

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Contents

Introduction.

It seems a good idea to start by explaining the reason for this book. Over the years there have been many publications on ringing: books which describe in detail the simpler methods; collections of methods as lines or place notations; information on teaching, recruiting, and maintenance; collections of compositions. But information on composition and proof is quite sparse. Some of the current and recent publications are listed in the bibliography, but most of these cover only a small aspect of the subject. This book will try to bring together some of the techniques used in composition, and give examples of how they are used. The task of composition is in two parts: the construction of the composition, and its proof. This book aims to cover both: the former is more difficult to explain, and the latter more tedious. It is not a comprehensive book: such a publication would be heavy reading, long, and largely unread. Rather it is an attempt to tempt the reader into trying to devise some compositions.

Composing is probably the least social side of ringing. It is typically done out of the belfry, and the tools are pencil and paper. As it is so unsociable, perhaps it is worth asking why people compose for ringing at all. Maybe, like mountaineers and Everest, the reason is "because it is there". This might be better expressed as the composer feels that there is something to say which has not been said before – a neat idea – some fresh music – a good combination of methods to splice. Maybe the composer is sufficiently well known to attract commissions: in this case another ringer has had an idea of something which has not been rung before. A third reason might be the path of progress of a local band. For example, perhaps the band have learnt Cambridge Surprise first, and then followed it by Pudsey: they decide to ring a quarter peal of these two methods, but cannot find a composition.

Going back to the first reason, composers who have something new to say are often unconsciously feeling that they don't like existing compositions. In short, they have a preference towards a different style.

Style is a rather intangible aspect of composition. Between well known artists, style can be recognised quite easily, so that a person who is familiar with works of art will have no difficulty in assigning a painting to a particular artist. Because ringing has such a mathematically defined structure, style cannot shine through in quite the same way. Nevertheless, if you look through a collection of compositions, it is possible to see something of the way in which different composers operate.

Along with style there is the question of tradition. It takes time for new patterns of ringing to emerge. One has only to look at the dominance of surprise methods over plain methods or methods with a different treble path; or the fact that Stedman is virtually the only principle rung. Tradition extends into taboos on "87's at backstroke", and into the high regard in which bands hold the "all the work" attribute for spliced compositions. It may well be that the aspiring composer wishes to challenge some of these traditions, but it could be a while before the new ideas become accepted. Other traditions are in the music which pleases the bands and conductors. Fashions here change as well, and this is new ground which a composer may well try to cultivate.

In the interests of brevity, there are quite a few areas which are not covered in this book: because of this, there is a bibliography at the end to provide the interested reader with more sources of information. Composing extents is not covered at all: this includes doubles, minor, and triples. Spliced minor is covered in works by the late Harold Chant, and there is some information on Grandsire and Stedman Triples in the older text books. There are no works on spliced doubles or triples. Nothing is included on compositions of methods with irregular lead heads (non plain bob lead heads).

A plea to composers – to preserve your popularity, do check all compositions carefully before ringing them. These days, computers can be used to give an independent check, and it is probably true to say that composers who use computers are always willing to help someone else who is having a go for the first time. At the moment, though, computers do not really have any style, nor any novel ideas, so this field is open to anyone who wishes to venture into it.

And as a final footnote – this book is full of false compositions, so do not pick one and ring it, without reading the rest of the chapter in which it occurs!

Chapter 1. Building blocks and terminology.

This chapter is about some concepts which are used in ringing generally, but which must be clearly understood before starting on composition. A lot of these are explained in more detail elsewhere (see bibliography), and so the notes here are relatively brief.

1.1 Lead ends, lead heads, etc.

It is important to be clear about the meaning of these terms, and unfortunately, there is some confusion about this. Strictly speaking, the lead head is the change at the start of the lead, i.e. when the treble is leading at backstroke; and the lead end is the change at the end of the lead, when the treble leads at handstroke. The term "lead head" is always used correctly; but "lead end" is sometimes used in the sense of "the change which results at the end of the lead, i.e. the first change of the next lead".

"Course end" and "course head" have corresponding meanings, and corresponding confusion. In this case, the expression "course end" is frequently used to refer to the head of the next course: more so than in the case of "lead end".

1234	LH 1	CH
2143		
2134		
1243	LE 1	
1423	LH 2	
4132		
4123		
1432	LE 2	
1342	LH 3	
3124		
3142		
1324	LE 3	CE
1234		

Fig 1.1 The plain course of Bastow Little Court Minimus. L=lead, C=course, H=head, E=end.

To try to clarify this, look at the example of Bastow Little Court Minimus shown (Fig 1.1), which gives the correct designations: LH1 represents lead head 1, etc. The confusion arises because LH2 is sometimes referred to as a lead end – "The first lead end is 1423". In this book, ends and heads will be used unambiguously.

Stedman and other principles really need a different nomenclature. The correct definitions would be "division end" and "division head", but in practice, Stedman is about the only principle rung, the ends are referred to as "six ends", and nobody talks about six heads. Stedman has a further difficulty in the use of "course heads" and "course ends". The end of a course is the six end of the last six in the course, but it is also almost universal to use this change as the start point for the next course, and thus by implication to use it as a course head. In the chapter on Stedman, we shall use the term course end, although recognising this as the head of the next course. A further oddity is that this implies that the normal start for Stedman is just before a course end: in other words, we start by ringing the last three changes of "course zero".

1.2 Coursing order

In simple terms, the coursing order in a method is the order in which the bells follow each other around, and it is easiest to see in a method with a very basic construction, such as Plain Bob. In this method, the bells lead in coursing order sequence, they go to the back of the change in this sequence, and the bells which a particular bell strikes over are also in the same sequence. If the changes in a plain course of Plain Bob Minor are examined, the truth of what has been said above can easily be seen, but with one problem. If the treble is included in the coursing order, its position in that order changes frequently. The coursing order becomes a much more useful tool if the treble is omitted from it: this has the effect that the coursing order does not change in a plain course of a method.

The coursing order is cyclic in the same way that the work of a method is cyclic – it doesn't really have a start or finish; but coursing orders are usually quoted starting with one particular bell, and omitting that bell. This bell is usually the tenor, as it is often used as the observation bell; and also any other fixed bell is frequently omitted when writing or speaking of coursing orders. For example, in Plain Bob Major, the coursing order is:

. . 3 2 4 6 8 7 5 3 2 4 6 8 7 5 3 2 . .

For tenor observation, we usually quote: "753246", and if (as is quite common), the seventh is also a fixed bell, the coursing order reduces to "53246".

For more complex methods, the coursing order becomes less and less easy to see in the changes. Most of the common surprise major methods show it most clearly in the order the bells arrive at the back of the change. In Bristol Surprise Maximus, quite large sections of the method have the bells running through the coursing order backwards. But the constant factor in all commonly rung methods is that the coursing order is built in to the lead heads.

As the coursing order is fixed within a course, it is a characteristic of that course, and hence can be used to recognise courses. The trivial benefit of this is that the composer can recognise the plain course from the coursing order 53246.

1.3 Place notation.

All ringing is of the form { (from one change generate another change) (ring that change) } repeated. Place notation is a compact description of the process of generating each following change. The way we ring tower bells requires a rule, (which is very nearly inflexible), that no bell can move more than one place in the change at a time. Consequently, the only possibilities are either that a bell stays still between two rows, or that it changes place with either of its neighbours. The place notation system is to write down the positions where a bell stays still ("makes a place"), and to assume that in all of the positions which are not mentioned the bells cross over in pairs. In even-bell ringing, it is possible for no place to be made between successive rows, and this is denoted by "x" or "-". Sometimes a full stop appears in the notation: this is to separate adjacent groups of figures which otherwise could be read as one.

As an example, the place notation for a lead of Childwall Bob Minor is generally given as: "x16x36.12.36; lead end 12". This can be abbreviated further to "x16x3.2.3", on the assumption that an external place is made as appropriate, to leave all the rest of the bells in pairs. As most ringing has the treble fixed and following a symmetrical path, usually only the place notation for the first half of the lead is given. For further information, look in any of the Central Council collections of methods.

1.4 Transposition.

Transposition is the process by which one set of figures is converted into another. The set of figures can be the lead head of a method, a coursing order, a course head, or even just a change. The reason for the transposition is either to convert between these, or to predict or simulate the effect of a block of ringing or a particular call. For example, we have arrived at the following six bell lead head: 142563. To find the change which will result after ringing one plain lead of Cambridge Minor, we transpose by 156342, which is the lead head generated by one plain lead of this method from rounds. (See Fig 1.2).

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Start row:      142563

Taking the bells from
this change in the
order 156342 gives

Resulting row: 163254
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Fig 1.2 An example of transposition.

Often, transpositions have the treble assumed to be at the start of the change, hence the example above would be more normally described as "42563 transposed by 56342 gives 63254". This is sometimes shown with a multiplication sign to denote "transposed by", and hence our example becomes "42563 x 56342 = 63254".

Perhaps the best way to illustrate the use of transposition is by several examples.

1. The transpositions for a plain, bob, and single lead of Plain Bob Minor are 35264, 23564, 32564 respectively. Hence a short touch can be constructed as follows:

	23456	Plain lead;	transpose this by 35264 gives
	35264	Bob lead;	transpose this by 23564 gives
-	35642	Single lead;	transpose this by 32564 gives
S	53426	Plain lead;	transpose this by 35264 gives
	32564	Bob lead;	transpose this by 23564 gives
-	32645	Single lead;	transpose this by 32564 gives
S	23456		

2. The transpositions for plain leads of Plain and Little Bob Major are 3527486 and 6482735 respectively.

2345678	Ring a lead of Plain: transpose by 3527486 to give
3527486	Ring a lead of Little: transpose by 6482735 to give
<u>4263857</u>	Ring a lead of Plain: transpose by 3527486 to give
2345678	

3. The transposition to obtain the coursing order from a lead head of a regular major method is 8753246. Hence, from a lead head 4235678; taking the bells defined by the transposition shows that the coursing order at this point is . . 8752436 . . Similarly, from lead head 6583274, the coursing order is . . 4735682 . . ; or, as coursing order is cyclic, (8)247356.

4. The transposition on coursing order for the effect of a bob in a seconds place method is "bca". It is usually shown alphabetically rather than numerically, as this three bell transposition can operate at any point in the coursing order. (Note: see also section 3.3 for transpositions in n-ths place methods.)

So; from the plain course (coursing order for eight bells 8753246):

a bob at "Wrong" transposes 532 by bca to give 87<u>325</u>46
a bob at "Middle" transposes 246 by bca to give 8753<u>462</u>
a bob at "Home" transposes 324 by bca to give 875<u>243</u>6

5. The transposition on coursing order for a single is usually cba, acting on the same bells as does the bob at the same position. In some methods or compositions this might vary, depending on the type of single used.

There is one further point worth mentioning in connection with transposition. The inverse of a row is that row which is needed to transpose it back to rounds. For example, to transform 36245 back to rounds we would need to transpose by 42563. It can be seen that each is the inverse of the other. Some rows are their own inverses, such as 43265, or all of the lead <u>ends</u> of Plain Bob.

1.5 Algebraic notation of transposition.

For work with the extraction of falseness in surprise methods, which will be discussed in chapter 4, it is sometimes convenient to use an algebraic notation when working with transposition. This was first documented for ringing by Maurice Hodgson ("A symbolic treatment of false course heads"), and is described briefly here. Basically it is a set of rules, similar to algebraic rules, which simplify the handling of concepts which involve a lot of transposition. The rules are set out below.

1. If two rows are represented by **U** and **V**, then "**U** transposed by **V**" can be written as **U.V**, where the full stop is analogous with a mathematical multiplication. However, it is <u>vital</u> to realise that **U.V** is typically not the same as **V.U**: try this by putting **U** = 135246 and **V** = 156234.

2345678	U^0
3527486	U^1
5738264	U^2
7856342	U^3
8674523	U^4
6482735	$U^5 = U^2.U^3$
4263857	U^6
2345678	$U^7 = U^0$

Fig 1.3 Lead heads of Plain Bob Major.

2. Consecutive transpositions by the same row can be represented as powers. For example, **U.U** can be shown as U^2 and **U.U.U** as U^3. **U** itself can also be written as U^1.

3. The effect of consecutive transpositions of these powers can be determined by adding the indices together. For example, $U^2.U^3 = U^5$. This is shown in Fig 1.3, where **U** = 3527486, and the successive powers then represent the lead heads of a plain course of Plain Bob Major.

4. If rounds is represented by **I**, then for any row **U**, **I.U** = **U.I** = **U**. (The reason for using **I** is that this is the notation used by Maurice Hodgson, as it fits more closely with the algebra of the concept).

5. The inverse of a row **U** can be represented by U^{-1}: this would be described algebraically as the reciprocal of **U**. From this, $U.U^{-1} = U^{-1}.U = U^0 = I$

6. Equations involving these algebraic transformations can be manipulated, provided that care is taken not to change the order of a transformation. Specifically, when multiplying both sides by a new factor, it is important that the new factor is applied to either the front or the back of both sides of the equation. As an example, if **W** = **U.V**, we can find an expression for $\mathbf{W}^{-1}$ as follows:

$\mathbf{W} = \mathbf{U.V}$	Multiply both sides by $\mathbf{V}^{-1}$
$\mathbf{W.V}^{-1} = \mathbf{U.V.V}^{-1}$	But $\mathbf{V.V}^{-1}$ = Rounds, hence
$\mathbf{W.V}^{-1} = \mathbf{U}$	Multiply both sides by $\mathbf{U}^{-1}$
$\mathbf{W.V}^{-1}.\mathbf{U}^{-1} = \mathbf{U.U}^{-1}$	But $\mathbf{U.U}^{-1}$ = Rounds, hence
$\mathbf{W.V}^{-1}.\mathbf{U}^{-1} = \mathbf{I}$	Multiply $\mathbf{W}^{-1}$ by both sides
$\mathbf{W}^{-1}.\mathbf{W.V}^{-1}.\mathbf{U}^{-1} = \mathbf{W}^{-1}.\mathbf{I}$	But $\mathbf{W}^{-1}.\mathbf{W}$ = Rounds, hence
$\mathbf{V}^{-1}.\mathbf{U}^{-1} = \mathbf{W}^{-1}.\mathbf{I}$	$\mathbf{W}^{-1}.\mathbf{I} = \mathbf{W}^{-1}$: giving
$\mathbf{W}^{-1} = \mathbf{V}^{-1}.\mathbf{U}^{-1}$	

7. When working with this notation, it is convenient to define certain rows as specific letters, as they are frequently used. On six bells we shall define:

I = Rounds = 23456

$\mathbf{H}^1$ = First lead head of Plain Bob Minor = 35264

From this, $\mathbf{H}^2$, $\mathbf{H}^3$, $\mathbf{H}^4$ are the second, third, and fourth lead heads; and $\mathbf{H}^5 = \mathbf{H}^0 = \mathbf{I}$ = fifth lead head = rounds.

1.6 Notation of calls.

One of the confusing aspects of ringing is that there are a number of ways in which compositions can be notated. For example, a touch or peal can be specified by the positions which one bell (the observation bell) falls into at the calls, or by the intervals between the calls, or by the sequence of bells which do a particular work (e.g. Holt's Original peal of Grandsire Triples notated by the bells before). Usually, comparison of the figures shown with the calls will make it clear what is intended.

Even-bell compositions are invariably notated by the positions of an observation bell, and that bell is usually the tenor. The calling positions in use are as follows:

H	Home	n-ths place, i.e. the tenor returns to its home position.
W	Wrong	(n–1)-ths place, i.e. the tenor is dodging at the back, the wrong way round to come home.
R	Right	An alternative to Home, by analogy with Wrong.
B	Before	Run out: the tenor is before the treble when the bob is called.
O	Out	An alternative to Before.
I	In	Run in. Can sometimes (misleadingly) be used for a single 3rds.
F	Fourths	Make the bob (or single).
M	Middle	(n–2)-ths place. The tenor dodges in the "middle" of the change: on eight or more bells the only other calling position (apart from W and H) where the back bells are all unaffected.
V	Fifths	5ths place at backstroke.

For ten bells, extra calling positions are needed which are designated 6ths and 7ths, or 6 and 7, referring to the position of the tenor at backstroke. For twelve bells, the extra positions of 8 and 9 are also introduced.

The calling positions described above are mostly applied to methods which use 4ths place bobs. Wrong and Home are still used in n-ths place methods to denote calls which cause the tenor to dodge at the back, and In and Before (Out) are used for calls where the tenor becomes 2nds and 3rds place bells. Other calling positions can be referred to by the place bell which the tenor becomes, or by the position of the call in the course. (For an example of the latter, look at peal compositions of Double Norwich Major.)

In some compositions, there are multiple calls at one calling position. These are often shown by a figure indicating the number of calls. For example, "3" in the H column indicates three bobs at Home. These calls are always bobs unless otherwise stated. Another common convention is used when two calls are always used together in a composition: an example of this is calls at In and Fifths in major, which when used together will split the tenors between the calls, but then return them so they are coursing again. Here, it is common to use a column headed "I/V", and to notate the calls by "x" rather than by "-".

For Grandsire, compositions are frequently written out based on which bells do particular work (such as being unaffected, or going in to the hunt). For further details on this, see "Grandsire" in the Jasper Snowdon series. Stedman Triples has its own notation which has arisen because of the way in which peals are constructed. For Stedman on higher numbers, the notation used is to specify the calls by the number of sixes from the beginning of the course, noting that a call at 1 takes effect at the <u>start</u> of the first full six. Chapter 7 should make this clear, or one of the references in the bibliography.

1.7 Calls.

The calls in a method – bobs and singles – are the means by which different blocks of changes are connected together: the blocks are the different courses of the method or methods. Depending on what is being rung, there is a requirement for bobs or singles or both. It's difficult to write down a complete definition of these calls, but the following one is reasonably practical:

> A bob changes the position of three bells in the coursing order; and a single swaps the position of two bells in the coursing order.

Rules and traditions mean that the use of more than two different calls in a method is not really considered to be acceptable, and two calls can only be used when the desired effect cannot be obtained by the use of one call. As an example of "desired effect", consider the introduction of singles into compositions of surprise. Before about the mid sixties, such compositions contained only bobs, but then composers realised that the music could be improved considerably by the use of singles.

The normal construction of bobs and singles is as follows. Bobs in seconds place methods are formed by moving the seconds place two places towards the end of the change, that is to fourths place. In place notation terms, 12 becomes 14. Three bells are affected; those in 2-3-4, and hence these bells change their positions in the coursing order. In sixths or eighths place methods (etc), the bob is normally formed by moving this place two places towards the beginning of the change. In place notation terms, 16 in minor becomes 14; 18 in major becomes 16, etc; and once again, three bells are affected. However, there is a fairly common exception to this rule, which is exemplified by Kent Treble Bob Major. This is an eighths place method, and so by the rule given above, the bob should be 16. But because of the particular lead head order of Kent, using a fourths place bob allows the back four bells to come to the same position at the end of the lead as they were at the beginning. This is often known as the "repeating lead" feature.

First lead of Kent	12345678	Coursing order 8753246
	|	
Following lead end	12436587	
Next lead head after bob	14235678	Coursing order 8752436

Although five bells are affected by this bob, nevertheless, only three bells change their position in the coursing order. This type of bob is invariably used for methods where seconds plaace bell is the pivot bell: on eight bells this includes Kent, Oxford, and Bristol. Also, it is quite commonly used in Maximus on twelfths place methods such as Bristol and Strathclyde. These methods don't have the repeating lead feature like Kent, but the use of a fourths place bob provides for compositions which are more interesting to ring, and also allows for spliced compositions which include Bristol to use only one type of bob.

Singles are almost always formed by making two extra adjacent places at the lead end of the method. In seconds place methods, 12 becomes 1234: in minor sixths place methods 16 becomes 1456; in major eighths place methods, 18 becomes 1678, etc. However, some compositions make use of singles at other positions in the change, to swap a specific pair of bells.

There are very few compositions that use a call which changes the position of more than three bells in the coursing order, for example, using place notation 16 for a call in royal. However, this could represent new ground to be broken.

1.8 Round blocks and Q-sets.

Although bobs and singles are in one sense the smallest building block of compositions, they are frequently used in groupings which themselves form a touch. For example, in a lot of methods a touch can be generated by calling a bob at the end of the plain course, then repeating twice (i.e. calling two further courses, each with a bob at the end). These three bobs affect the same three bells, and so at the third call the bells return to their home place. This composition (and the three bobs which form it) are referred to as a round block ("the bells come round at the end of the block"). Other common round blocks are SS, BSBS, BBSBBS, giving blocks of 2, 4, and 6 courses respectively.

Some methods lend themselves well to composition using round blocks: Yorkshire is such a method, and examining a collection such as "Composition 500" shows that nearly all of the compositions of Yorkshire make considerable use of round blocks. The technique used is to put one round block inside another; for example H, 3W, H, H, where the round block of three bobs at Wrong is put inside the round block of three Homes. This can be extended further: start one round block, such as three Homes; then start another after one call (eg H, 3W ...), then start another (eg H, 2W, SM ...); and then finish off all the blocks in reverse order, ensuring that each block is finished before closing off the next one outside it (eg H, 2W, SM, SM, W, 2H).

Round blocks can include more than one calling position. Some common examples are:

(a) bobs at WH WH, or MH MH.
(b) bobs at WW HH WW HH (in methods such as Kent Treble Bob).
(c) bobs at MBW (8 bells), MIVW (10 bells), etc.

The last of these is often used in Rutland Major as a means of eliminating most of the falseness (see also section 4.5)

Sometimes the term "Q-sets" is used. This is one of the expressions which doesn't have a really clear definition. Basically, the idea is that if a bob affects (transposes) three bells, and three bobs are rung which affect the same three bells, these bells will return to their original positions. For example, if bells 532 in the coursing order are affected by a bob (transposition bca), this will give 325; a further bob will give 253, and a third bob will return to 532. These three bobs form a Q-set, in that they form a logical and complete group within themselves.

The expression Q-sets is not often used with singles, but a similar principle applies. If a single is rung which affects (swaps) two particular bells, then the complementary single which swaps them back can be considered as the other member of the Q-set.

In surprise minor ringing, the standard extent is often described as "Call the tenor W, H, W; 3 times", or "Call a bob every time the tenor is unaffected, except when it is dodging with one other bell" (e.g., if the other bell is the 5, the same extent results). Another way of describing this extent is "Call three Q-sets, where one bell is common to all Q-sets". Here the Q-sets are named by the two bells which are unaffected, and so the standard extent consists of Q-sets on 62, 63, 64; with the 6 being common to all three Q-sets. In minor compositions, this concept is very important, and it can be shown that if one member of a Q-set is bobbed, then the other two members must also be bobbed.

9 courses

W	H
-	3
-	3
-	3

27 courses

W	M	H
-	-	3
-		3
-		3

3 part

36 courses

W	M	H
S	S	3
S	S	3
	S	3

4 part, single half way and end

29 courses

W	M	H
	2	
2	2	
2	2	
2	2	
2	3	3
-	-	3
-	-	3
-	-	3
-	-	3

Fig 1.4 Some examples of longer round blocks.

Round blocks can be linked together to give larger round blocks, some of which can be long enough for a peal. Some examples of these are shown in Fig 1.4. The 36 course block is designed for use with plain methods, and would normally be started by a bob at home (i.e. starting with the ninth course). This makes use of the fact that a round block can be started at any point: the resulting block will still be a round block. If this is done, then this block generates all of the courses needed for 144 roll-ups (see section 1.11). The 29 course block deserves study. It is actually two blocks joined together, but the process of joining them makes it necessary to omit one of the courses. The two parts fit together like a jigsaw, in that the parts of courses omitted from the first 15 courses are used in the second 15 courses – write it out and see for yourself.

1.9 The nature of the rows.

On any number of bells, all of the changes that exist can be divided into two types. These types are called in-course and out-of-course, or plus and minus, or positive and negative. For example the 24 changes on four bells can be divided as shown in Fig 1.5.

One type		Other type	
1234	3124	1324	3214
1342	3241	1243	3142
1423	3412	1432	3421
2143	4132	2134	4312
2431	4321	2341	4123
2314	4213	2413	4231

Fig 1.5 The 24 four bell changes, divided into two types.

The set of changes which contains rounds (labelled "One type" in Fig 1.5) is by convention called in-course, plus, or positive. Once the type of one change has been defined, then all the remaining changes are also categorised. The rule which divides the changes into the two sets comes from the number of pairs of bells which must be swapped to produce one change from another change:

If an even number of pairs is swapped, the two rows are of the same type.
If an odd number of pairs is swapped, the two changes are of opposite type.

It is quite easy to see this in the four bell changes set out above. If any pair of bells is swapped in any change, the resulting change is found in the other block. For example, take the change 1423. This occurs in the block labelled "one type": this block is defined as the in-course block, as it contains rounds. Six possible pairs can be swapped (because for this purpose the bells do not have to be adjacent in the change), and each of the resulting changes occurs in the other, out-of-course block.

In addition to individual changes being referred to as positive, negative, in-course, out-of-course, etc, it is quite common to refer to a block of changes, such as a lead of a method, as being "in-course" or "out-of-course", or "from the in-course block", etc. Consider Plain Bob Minor: Fig 1.6 shows two leads written out in full, with each individual row marked as + or –. Although each lead contains both positive and negative changes, the left hand lead is referred to as an in-course lead, and the other is referred to as an out-of-course lead.

123456	+	143256	–
214365	–	412365	+
241635	–	421635	+
426153	+	246153	–
462513	+	264513	–
645231	–	625431	+
654321	–	652341	+
563412	+	563214	–
536142	+	536124	–
351624	–	351642	+
315264	–	315462	+
132546	+	134526	–
135264	+	135462	–

Fig 1.6 Two leads of Plain Bob Minor, with the parities shown.

In-course and out-of-course are often very useful in proving compositions. This is explained further in the other chapters.

1.10 Symmetry.

Symmetry is quite important in composition and proof. Nearly all ringers have an appreciation of symmetry in methods such as Cambridge. They see that thirds place bell can be reversed upon itself, in other words, the line can be rung backwards; and that all of the remaining place bells form pairs where one of the pair is the other of the pair rung backwards.

This type of symmetry is called mirror symmetry: if the path of the 2 is drawn for a course of a seconds place method, the bottom half of the line is a reflection of the top half, and the point of reflection (plane of reflection) is exactly half way through the course, where the 2 makes the half lead place. If you view this line from the bottom edge of a piece of paper, and prop a mirror along the half way line, you can see the bottom half of the line and its reflection in the mirror; and this is exactly the same pattern as looking at the whole line without the mirror.

There are two other types of symmetry in methods, one fairly common, and the other very rare. Ringers sometimes speak of double methods having double symmetry, exemplified by Double Bob, Double Oxford, Double Norwich, Superlative, and Bristol. These methods, as well as having two mirror planes, also have two centres of inversion. If you draw out a line of Double Oxford Bob Minor, pin it to the desk by a drawing pin where the treble runs through the 3-4 places, and spin the paper round so that it is upside down, the blue line still looks the same.

It is theoretically possible to have a method which has two centres of inversion, but no mirror planes, although no one to my knowledge has yet rung one. As an example, write out a course where the first half of each lead is Double Oxford, and the second half of each lead is Plain Bob.

The last possible method symmetry is screw symmetry. This is achieved if a double method is rung above the treble in the first half of the lead, and below the treble in the second half of the lead; and a different double method is rung in the remaining two quarters. For example, using Double Oxford and Double Bob Minor gives a method for which the place notation of a full lead is x14x16x56x36x16x12. If you write out a line of this method, and then look at it from the back of the paper, the line appears the same. All methods with two mirror planes and two centres of inversion have screw symmetry as well; but as described above, it is possible to design methods which have only the screw symmetry.

1.11 Music.

With seven bells or less, the composer is not greatly concerned with the musical qualities of peal compositions, on the grounds that all of the changes have to be rung anyway. But with changes on eight bells or more, there is a choice to be made about which changes should be included. Put another way, the composer has to decide how the composition is to be made acceptable.

A fairly common yardstick for music is the count of combination roll-ups, often known as "cru" (and the plural is probably "crus"). The term was first coined for major methods, and is a count of all changes which have 78 at the end of the change, with the bells in 56 being two of 4, 5, and 6. It is easily seen that the maximum possible is 144: 24 combinations of the four bells at the front, with 6 possible combinations of the bells in 56. The merit of this approach is that it allows a convenient yardstick of the quality of a composition, and a means by which two compositions can be compared.

But different ringers have different ideas about what constitutes "music". Some prefer changes ending in -3678 to those ending in -5478, and so the number of crus does not tell then all they wish to know. Others may prefer changes where the tenors are split, giving changes ending in -7568 and -8765: once again, these are not counted as crus.

The count of crus becomes even less important when composing for 10 and 12 bells. For example, a royal peal is the length of 14 courses of surprise, which will have a maximum number of crus of 112. But it is quite common for composers to include the course with course head 1645237890. This certainly generates no cru, but the changes where the five smallest working bells come together at the back of the change are of the style -23456, thus forming a little bell roll-up.

1.12 Style

It might be considered that remarks about style are out of place in this book — certainly such comments do not really fit into a chapter on definitions and terminology. But as we are going to show the means by which compositions are contructed, it is worth while trying to see what makes a composition which other people will ring. Some of the possible reasons are shown in Fig 1.7.

* Easy to call - safe
* Difficult to call - a challenge
* The composer's name
* No other composition available
* Desired music
* Easy to ring
* Difficult to ring
* Specific length

Fig 1.7 Possible reasons why compositions are rung.

The difficulty of the calling is a simple feature to understand. A composition of Plain Bob Major can be very easy to call, such as the 5056 by JR Pritchard ("Major Compositions", 1981). Ease of calling means that it is suitable for a novice conductor or an inexperienced band. Such compositions usually have high symmetry - three, four, or six parts. On the other hand, compositions can be difficult to call - perhaps deliberately, or because of including some other feature such as the music. An example here is the 5069 of Stedman Cinques by RW Pipe (see "Compositions of Stedman Caters and Cinques").

If the choice of composition in a particular field is limited, it probably means either that no-one wants to ring this method or group of methods, or that no-one has thought of the idea before. Assuming that the former is not the case, then there may be a market for compositions here.

The question of what music to include is always difficult to answer. To obtain a large number of crus in a major composition, quite often a three part composition with part heads of 23564 and 23645 will suffice as well as anything else. Part heads of 34256 and 42356 are not so successful here, because if (for example) the first part generates some –4578 roll-ups (required), the other parts will give –2578 and –3578 roll-ups (not required). However, the three part design with 23564 as the part head would not be the ideal structure of a composition which was designed to include different combinations of 5678 at the back of the change, such as 7568 or 8765.

In Stedman on nine bells and higher numbers, it is common to try to include some or all of the following: musical changes (Queens, Tittums, back change, near misses, i.e. rounds with only one pair of bells crossed), handstroke home blocks, tittum blocks. Here, style shows as (a) what the composer has left out, (b) what extra has been included, and (c) how the music is joined together.

In surprise royal compositions, it is very common to generate the required 14 courses by leaving the back four bells substantially unaffected. The problem which then remains is what to do in the space of those 14 courses. The tendency these days is to include three courses each of –567890 and –657890 roll-ups, then to connect these together as elegantly as possible, making use of combinations of the little bells to enhance the music.

As well as the number of crus and "musical" changes, there are other features of compositions which may or may not be thought desirable to include, particularly for compositions of spliced. Firstly, the attribute "all the work" refers to spliced compositions where every working bell rings every place bell of all methods at least once in the peal. The opposite of this is the effect generated by short course peals. For example, consider a composition of Rutland and Yorkshire where every course is called RYR: in this case, 7 and 8 ring only one place bell each of Yorkshire, and only two place bells each of Rutland. So the ringers of 7 and 8 only need to learn three place bells to ring the whole peal.

For complex spliced compositions, the all-the-work attribute is quite difficult to achieve, and it was quite a breakthrough when Norman Smith realised that this feature was generated automatically by a seven part peal of major, and so composed his famous series in 13 to 23 methods. In this composition there are seven parts, all called identically, and each bell starts off each part in a different place. It is easy to realise that all bells ring all place bells of the first method: but as the transposition from the beginning of each part to the start of any particular method is the same (because all of the parts are identical), then all bells ring all place bells in all other methods as well.

Another attribute for spliced compositions is "each lead different". This refers to the fact that all of the place bells, taken over all methods, are different; and it means that a person ringing the peal gets no free rides. For example, in Norman Smith's series mentioned above, all of the standard eight methods are included: these include Cambridge, Yorkshire, Superlative, and Lincolnshire, all of which have the same line for thirds place bell. This means that this composition cannot have the footnote "each lead different".

Chapter 2. Composing with Plain Bob Major.

Having set the scene by an examination of the tools of the trade, it's time now to put some of the ideas and concepts into practice. We shall start with Plain Bob Major, on the grounds that we can look at how to achieve the changes required without too much worry about the falseness. Two other reasons – Plain Bob is quite a practical thing to compose, particularly quarter peals, as it is frequently rung; and also we can begin to explain how to cut down on the amount of writing required.

2.1 Proof of Plain Bob Major.

The requirement of proof is that all of the changes in the touch (peal, quarter peal) are different. This can only be satisfied rigorously if every change is tested for duplication against every other change. Taking as example the shortest possible length for a quarter peal of Plain Bob Major, which is 1264 changes, the first change must be tested against the other 1263 changes, the second change must be tested against 1262 changes (as it has already been tested against the first change), and so on. Thus the total number of checks to be made is 1263+1262+1261...+1, which is 798,216 (½ of 1263x1264). To do this manually, and assuming that we could test one pair of changes per second would take over 200 hours. This is obviously not practical – there must be an easier way!

In a half lead of Plain Bob Major, there are eight changes, and an essential difference between them is that the treble is in a different place in each one. (Thus, trivially, the changes within a half lead cannot repeat with each other). A moment's thought will show that any given row can occur in one and only one half lead, and thus can be characterised by the change in that half lead which has the treble at the front.

The corollary of this is that we only need to test all of the rows with the treble at the front for mutual truth. Doing this will automatically prove the truth of the rows with the treble in seconds place (as these are related to the row with the treble at the front by the place notation "x"), the rows with the treble in third's place, (related by "x18") etc. The proof of a quarter peal has now reduced to checking the mutual truth of 1264/8 rows with the treble leading (158 rows; 12,403 checks). These rows are the lead heads and leads ends of the composition.

2.2 Proof with the tenors together.

Consider now all of the lead heads and lead ends of the plain course: these are written out in Fig 2.1, with the treble omitted, and a dot substituted for bells other than 7 and 8. It is easy to see that all of these rows are different, which shows the following.

```
.....78
....7.8
...7.8.
..7.8..
.7.8...
7.8....
78.....
87.....
8.7....
.8.7...
..8.7..
...8.7.
....8.7
.....87
```

Fig 2.1 The skeleton LHs and LEs of Plain Bob.

Provided that both the 7 and 8 continue to ring in their plain course positions, no lead can be false against a lead which has a different position in the course, and the mutual truth of two or more such leads can be demonstrated by checking the lead heads only (as all the lead ends are different from the corresponding lead heads). For example, a lead which occurs as the second lead in a course cannot be false against any lead which is (say) the fifth lead in a course, as the 7 and 8 will be in different places relative to the treble.

The problem is now reduced to checking the mutual truth of all first leads in each course, all the second leads, etc. For a twelve course block, (which is 1344 changes), this is (½ of 11x12) x 7 checks, or 462 comparisons.

It is necessary to find a practical way of doing this. With what has been shown so far, the first stage is to write out all of the lead heads in the composition, divided into seven columns, and then to check each column. This entails quite a lot of transposition to generate the seven digit rows which are the lead heads. Once again, there is an easier way.

In section 1.2, we noted that the coursing order is a characteristic of a course of a method. For any given course, there is one coursing order, and vice versa. Consequently, the leads in a composition of Plain Bob

Major can instead be handled as a coursing order (characteristic of the parent course), together with a lead number (characteristic of the position within that course). Fig 2.2 shows this method of working for the simple touch "Wrong and Home twice". As in this touch both 7 and 8 are fixed, we have followed the normal convention of quoting a five bell coursing order, omitting 7 and 8.

Another benefit of this treatment is that it is easy to generate the coursing orders without reference to the lead heads or course heads to which they refer. In section 1.4, we showed that coursing order could be transposed by "bca" to represent the effect of bobs. Which three bells are affected by the bca transposition depends on the calling position within the course. In the touch above, the two bobs at Wrong affect the first three bells in the five bell coursing order, and the other two bobs (Homes) affect the middle three bells.

	Lead head	C.O.	Lead no
	2345678	53246	1
-	2357486	32546	2
	3728564	32546	3
	7836245	32546	4
	8674352	32546	5
	6485723	32546	6
	4562837	32546	7
-	4523678	35426	1
-	4537286	54326	2
	5748362	54326	3
	7856423	54326	4
	8672534	54326	5
	6283745	54326	6
	2364857	54326	7
-	2345678		

Fig 2.2 Coursing orders from a simple touch of Plain Bob Major.

2.3 Example: construction and proof of a quarter peal of Plain Bob Major.

The scene is now set - let us devise and prove a composition. The first step in composing is to define our requirements for the composition. After all, there are millions of possible compositions – what guidelines shall we use to discard the ones which we don't want? For the sake of a demonstration, we shall work to these requirements:

(a) Calls only at Wrong, Middle, Home.
(b) Both bobs and singles allowed.
(c) As many as possible (at least four courses) of –5678 roll-ups.
(d) As many as possible (at least three courses) of –2478 roll-ups.

Constraining the calls to W, M, and H means that 7 and 8 will be unaffected by any calls, and so the composition must be a whole number of courses. The shortest length we can ring for a quarter peal is thus 1344 changes (12 courses of 112 changes). Most ringers would consider thirteen courses too long for a quarter peal, and a composition of eleven courses is too short.

Move bells to get to –2478 roll-ups

Block to get three courses

Move bells to get back to –5678 roll-ups

Block to get four courses

Fig 2.3 Sketch plan of quarter peal.

Blocks of roll-ups are generated by calls which leave the bells forming each roll-up unaffected. In Plain Bob, these calls must be Homes, as the 7 and 8 are at the back, and the other two bells in the roll-ups are dodging together in 5–6. Three courses can be joined together by three bobs (a Q-set); four courses by a block of BSBS. We can sketch the composition out as in Fig 2.3.

The roll-ups need a bit of thought — where do they occur in the course? Inspection of the figures of the plain course shows that the back four bells only strike together at the back of the change in four places in the course. Two of these are around the course head, the third is two changes after the Wrong, and the fourth is just before the Middle. This means that if we enter the course at the Middle, there are only two roll-up positions left in the course; whereas if we enter it at the Wrong, all four roll-ups will be produced. Also, it can be seen that within one course, all four roll-ups are the same.

In some circumstances, compositions can be produced by trial and error alone, but this is the exception rather than the rule. For Plain Bob Major, this type of approach would be to transpose from lead head to lead head, inserting calls at random, and hoping to achieve the required roll-ups. If this is attempted, it will quickly become obvious that it is very tedious, and difficult to "find" the required roll-ups. A more systematic approach is needed.

We referred above to the roll-ups, noting that in any one course four roll-ups are produced, and these have the back bells the same. We have also referred to the fact that Plain Bob Major can be handled as coursing orders, where there is a one-to-one correspondence between a course and a coursing order. Remember also that the transpositions which are applied to coursing orders to simulate the effect of calls are quite simple (see section 1.4).

Bearing all this in mind, it should be clear that it is worth trying to compose using coursing orders. We can prepare for this by setting out a table where the columns represent the different calling positions, and the rows represent the successive courses. (We might also wish to make a note of the transpositions for each possible call at the head of the columns.) For the proposed composition, three columns are needed, to represent Wrong, Middle, and Home; and the columns should be in this order, as this is the order in which the calling positions occur in the course. If a call is made at a calling position, then either "—" or "S" (for bob or single) is written in that column, together with the coursing order which results after the call has taken effect. The diagram to be used will look something like Fig 2.4.

(bca..)	(..bca)	(.bca.)	← Bobs } Reminders of
(cba..)	(..cba)	(.cba.)	← Singles} transpositions
Wrong	Middle	Home	← Column headings
- NewCO		- NewCO	← First course
	S NewCO	- NewCO	← Second course
etc..			

Fig 2.4 Example diagram showing how to prepare for composing. The first and second courses shown are merely examples, and "NewCO" represents the new coursing order produced by the call at that point.

We need two more pieces of information, and the first is what coursing order should be used at the start. This is the coursing order of the plain course, which is (87)53246. Obviously, to return to rounds at the end of the composition, we need to finish with this coursing order as well. The other piece of information that we need is how coursing orders relate to roll-ups. Consider the plain course: this has coursing order 53246 and generates —5678 roll-ups. It should be clear that to generate the —2478 roll-ups we need to have coursing orders of the form 2...4

The generation of the composition required can now be done by playing with the coursing orders, but it is quite difficult to show the thought process. Fig 2.5 gives one possible solution, and an analysis of the composer's thoughts might be as follows:

1. Move the 2 to the front of the coursing order (i.e. to 5ths place) by using two bobs Wrong.
2. Move the 4 to the end of the coursing order which needs two bobs Middle.
3. Generate three courses of -2478 roll-ups by using three bobs at Home.
4. Return the 5 to its home position by a bob at Wrong.
5. Return the 6: this needs bobs at Home to move it to where a bob at Middle can move it back into 6ths place.
6. Generate four courses of -5678 roll-ups.

Wrong	Middle	Home
- 32546		
- 25346	- 25463	
	- 25634	- 26354
		- 23564
		- 25634
- 56234		- 52364
		- 53624
	- 53246	- 52436
		S 53426
		- 54236
		S 53246

Fig 2.5 First design of quarter peal.

Let us look at this in a little more detail. The first job is to move the 2 to the front of the coursing order. A bob at either Wrong or Home will help: these give coursing orders 32546 and 52436 respectively. In each case, the 2 has moved one place towards the front of the coursing order. (A bob at Midlle would make things worse, as this would give a coursing order of 53462, where the 2 is now at the end of the coursing order). We chose a bob at Wrong, for no other reason than that the Wrong calling position occurs first. To get the 2 to the front of the coursing order requires a further bob at Wrong, and this is the only call which will do what we need.

The next job is to move the 4 to the end of the coursing order (from 25346). No call will move it straight there: in fact the only way that a bell can be moved to the end is by having it in the middle of the coursing order, and then calling a bob at Middle (..Abc becomes ..bcA). The 4 can be moved to this required place by either a Home or a Middle: we chose a Middle as it occurs first. From here another Middle will move the 4 to the end of the coursing order. By continuing in this way, we can construct a composition such as the one shown.

If we sit back and consider this composition for a while, there are ways we can improve it, in the sense of bringing it closer to our requirements. There is also one great problem: it's too short! There are only

11 courses, which is 1232 changes. This is obviously the first problem to solve, and there are two simple ways of doing it. The first is to change the block of 3 Homes for the -2478 roll-ups to a block of 4 (BSBS, which is still a round block). The second is to "single in" a course. This refers to the fact that two singles form a round block, and so a course can easily be added by swapping a pair of bells at a single, then swapping them back a course later. Any calling position which has no call could be used; for example, we could add two singles Middle or two singles Home in the first course.

Wrong	Middle	Home
S 23546		- 25436
	- 25364	- 23654
		S 25634
		- 26354
		S 25364
- 53264	- 53642	
	S 53246	- 52436
		- 54326
		S 52346
		- 53426
		- 54236
		S 53246

Fig 2.6 Second design of quarter peal.

We can solve the problem of the length quite easily, but have we arrived at the target -2478 roll-ups as quickly as possible? Fig 2.6 shows a second attempt at the composition: it makes more use of singles in order to arrive at the chosen roll-ups more quickly. In this way, we can ring more courses of the roll-ups of our choice. We decide that this version of the composition will fit the requirements reasonably well, and so the next problem is to prove the truth of it.

Fig 2.7 is nearly the same as Fig 2.6: the only difference is that the missing coursing orders in each column have been completed. (When there is no call at the calling position, the coursing order doesn't change). To check the composition, it is only necessary to check that there is no duplication between figures in the same column. Checking that all the coursing orders in the Middle column are different shows that the seventh leads of all the courses are different. Checking the Home column shows that the first leads of all courses are different – the last coursing order (53246) actually tests the truth of the first lead of the composition. Checking the Wrong column checks the second leads for mutual truth. However, this also demonstrates the truth of the third, fourth, fifth, and sixth leads of each course: this is because there is no other calling position used, and hence the coursing orders to check for these other leads are exactly the same as those shown in the Wrong column.

Wrong	Middle	Home
S 23546	23546	- 25436
25436	- 25364	- 23654
23654	23654	S 25634
25634	25634	- 26354
26354	26354	S 25364
- 53264	- 53642	53642
53642	S 53246	- 52436
52436	52436	- 54326
54326	54326	S 52346
52346	52346	- 53426
53426	53426	- 54236
54236	54236	S 53246

Fig 2.7 Quarter peal, with all coursing orders added.

The checks we have done have all been successful, in that no duplication has been found; and so the composition is true. Incidentally, this composition contains 14 -2478 roll-ups and 22 -5678 rollups. As each course generates four roll-ups, we can say that we have included 3½ courses of -2478s and 5½ courses of -5678s. This shows that we achieved our original objectives (c) and (d). Doing the checks by coursing order has now needed (½ of (11x12) x 3) checks, which is 198 checks.

2.4 The use of other calling positions.

A considerable number of compositions of Plain Bob Major use four calling positions – those at Wrong, Before, Middle, and Home. This preserves the attribute known as "tenors together", as the 7 and 8 are kept in the plain course positions relative to each other, i.e. adjacent in the coursing order. Calls at Wrong, Middle, and Home leave both 7 and 8 unaffected. Bobs at Before cause the 7 to run in and the 8 to run out, and these bells return to the positions they occupied at the start of the previous lead. The coursing order changes from (87)5324687(53..) to 5324876(53..), which can also be expressed as (87)65324, as coursing order is cyclic. (Thus the transposition for a bob Before is effectively eabcd on the five bell coursing order.) Using a bob Before generates two possible pitfalls, as follows.

If a course is rung which contains a bob Before, and the course is considered to finish when 78 return to their home positions, then this course will contain 8 leads rather than 7. Thus if the length of the composition is calculated in courses of 112 changes (7 leads of 16 changes), then an extra 16 changes will be added for each bob Before. Also, there is a pitfall in checking the proof. A course which only contains a bob Before has two leads headed by 178..... One of these belongs to the starting coursing order, and one belongs to the coursing order at the end of the course. If a course contains a bob Before, the coursing order which pertains to the section from Before to Middle must be written in twice, both before the bob takes effect and after. Fig 2.8 shows a touch which is false, and the falseness would not be detected unless this rule is followed. The leads which repeat are the fourth lead of the first course and the fifth lead of the fifth course: both are headed by 17836245. The length of this false touch is 6x112 + 2x16 = 704 changes.

	Wrong		Before		Middle		Home
-	32546		32546				
		-	63254		63254		63254
S	23654		23654		23654	S	25634
	25634		25634	-	25346		25346
	25346		25346	-	25463		25463
	25463		25463				
		-	32546		32546	-	35426
-	54326		54326		54326	-	53246

Fig 2.8 A false touch of Plain Bob Major.

The examples shown so far have kept the tenors together, but there are circumstances where the composer may wish to split the tenors, in other words, to use calls which move 7 and 8 from the relative positions they occupy in the plain course. In Plain Bob Major, a useful calling is to call a pair of bobs at V and F (Fifths and Fourths, the second and third lead ends of the course). This has the effect of transposing the coursing order from (7)53246 via 537246 to (7)24653; it reduces the length of the course to five leads; and the tenors are not coursing for the lead between the two calls. There are three reasons why we might want to do this. The first is to change the length of the composition, by the introduction of a five lead course. The second is to provide a different route to a particular coursing order. Thirdly, we may use such a calling to avoid some falseness which otherwise would occur. Part of the art of good composition is to make each call have more than one purpose: if the calling V/F is introduced for no other reason than to change the length of the course, the effect will probably be seen as ugly or ungainly, but if it also serves the purpose of a quick move from one desired point to another, then the impression will be more favourable.

So far, all of our arguments on truth have made the assumption that the tenors are not split, so let us now see how to deal with alternative callings. In section 2.2, we showed that providing 7 and 8 are kept fixed, then all of the skeleton lead heads and lead ends of the plain course are different, and thus there can be no repetition of the half leads which they represent. The problem now is to find the effect of allowing the 7 to be "uncoupled" from the 8. Fig 2.9 shows the skeleton leads heads and lead ends again, but this time with the 7 omitted. Inspection shows that each row is duplicated, implying that those two blocks of 8 rows can run false.

```
......8
......8
.....8.
....8..
...8...  A
..8....  C
.8.....
8......
8......
.8.....
..8....  D
...8...  B
....8..
.....8.
```

Fig 2.9 The skeleton rows from Plain Bob Major.

Further inspection, aided by the use of pencil and paper, soon shows that the falseness we have identified only relates to ringing a complete lead backwards. In Fig 2.9, the rows marked A and B have the same skeleton, and hence could be false. Rows C and D are related to rows A and B by the transposition 3254768 (this is the transposition from a lead head of Plain Bob Major to the following lead end). Hence, for two leads (heads) to be false, but not be identical, the transposition between those lead heads must be 3254768.

In coursing order terms, this corresponds with the coursing order being reversed. For example, the plain course coursing order is (8)753246: this is false against the course with coursing order (8)642357. Try writing out a lead with this coursing order: you will find that (a) the changes are found in the plain course, (b) they are grouped in the same lead of the plain course, but (c) the lead is rung in the reverse order.

We can see now that the test for replicated coursing orders is not quite the whole story: we must also check for the reverse of a coursing order appearing. The latter check is harder to apply, because we need to be careful of where the reversed coursing orders occur in the course. If the first lead of the course reappears rung backwards, it will again be the first lead of a course, as the tenor is in 8ths place at both the lead head at the start of the first lead and the lead end at the end of the same lead. But if for example the third lead of a course reappears in reverse order, it will then be as the fifth lead of a course. This is exemplified in Fig 2.9, where the lead AC can reappear as the lead BD.

Returning to the problem of proving compositions with V/F calls, the bob at V changes the coursing order from 7..... to ..7... ; and the bob at F returns the 7 to its home place, i.e. a coursing order of 7..... The intermediate lead with coursing order ..7... cannot be false against any changes with the tenors together (as the 7 is in a different place in the coursing order); and cannot be false by ringing the lead backwards, as this would require a coursing order of ...7.. Thus the odd leads between V and F need checking only against each other to ensure that this type of split-tenors section is true.

As a point of interest, because the only falseness risk is that of finding a reversed coursing order, provided a composition only uses coursing orders with the patterns 7..... .7.... ..7... ; then no reversed coursing order can possibly occur. This means that one way of constructing a 40320 of Plain Bob Major is to compose a true 13440 with the tenors completely unaffected, then to expand each course into three courses, by inserting three bobs at V.

2.5 The use of in-course and out-of-course in proof.

It is possible to make considerable use of knowing whether the changes are in-course or out-of-course. To investigate this, we shall first go back to Plain Bob Minor. We saw in section 1.9 that all rows can be assigned a parity (+ or −), and that this parity can be extended to refer to blocks of changes. A lead of Plain Bob Minor has the same parity at both the lead head and the lead end: if these changes are (+) we refer to the lead as an in-course lead, otherwise we call it out-of-course. The join between two plain leads does not change the parity, as the place notation 12 allows an even number of pairs to cross. This is also true for a bob lead (notation 14), but the opposite is true for a single. Here, the place notation 1234 leaves only one pair of bells to cross, and so the lead after the single must be of opposite parity to the lead before the single. Several things now follow. Firstly, a touch with no singles will contain only in-course leads. From this, therefore, without singles the maximum length obtainable is only 360 changes, as none of the out-of-course leads can be rung. The benefit for proof is that the in-course block is independent of the out-of-course block, and hence can be proved separately. A further fact is that a true touch containing only bobs can be doubled in length by substituting a single at any point in the touch, then repeating the touch. The inserted block has the same calling as the original (and hence is true within itself); and as explained above, it must be true against the original as the parity is opposite.

A similar argument can be applied to Plain Bob Major, but we must be cautious. The lead heads and lead ends are opposite parity, so at first glance it seems that the logic we have used cannot be applied. But nevertheless, we can see that using only plain leads and bob leads will keep all lead heads positive and all lead ends negative, and we can also determine that a single will reverse this, i.e. lead heads will then be negative and lead ends positive. It is possible to follow this argument further, and thus determine that the falseness which corresponds with ringing a lead backwards can only occur on the opposite side of a single. In other words, it is impossible to ring a lead backwards (i.e. to reverse the coursing order) without the use of an odd number of singles.

However, it is much more useful to apply the in-course and out-of-course designations to the coursing orders. We will define an in-course coursing order as one which relates to an in-course course, or one which has an in-course course head. For example, course head 4326578 is in-course, and has coursing order (87)63425. Now, the effect of bobs on the coursing order is to leave the parity unchanged; and the effect of singles is to swap the parity. What we originally noted for six bell <u>changes</u> can now be applied to eight bell <u>coursing orders</u>; namely that the in- and out-of-course blocks can be considered independently.

But we must be careful to think this through correctly. We know that (a) falseness is present only if coursing orders are the same, or if a coursing order is completely reversed; and now we know that (b) reversed coursing orders can only appear on opposite sides of a single.

If we consider the 8 to be the observation bell, in other words we start all coursing orders at the 8, then a six bell coursing order remains (such as 753246). From this point, we can prove a composition in three ways:

(a) If, as is quite common, it is a "tenors together" composition, we know that the coursing order cannot be reversed (as it would have to be of the form .....7). Hence there is no risk of reversed leads, and the in-course block(s) can be proved independently of the out-of-course block(s), by checking coursing orders.
We can also do this if the 7 is always in one of the first three positions of the six bell coursing order.

(b) Otherwise, the movement of the 7 can allow a reversed coursing order to appear. We can take all coursing orders with the 7 in the last three positions, and reverse the coursing orders (transpose by fedcba). This has the effect of checking these changes in reverse order. The composition is checked as in (a) above; but beware of the problem of which <u>lead</u> in each course is being rung.

(c) We can check the composition as it stands, checking for identical coursing orders on the same side of the single, then for reversed coursing orders on the opposite sides of the single.

2.6 Examples of proof utilising in- and out-of-course.

We will first show how the quarter peal in Fig 2.7 can be checked, making use of in-course and out-of-course. To do this, it is often most practical to use red and blue pens to distinguish the parities, but with the limitations of printing this book in black and white, the in-course coursing orders are shown in bold, and the out-of-course coursing orders are shown displaced. The quarter peal is reproduced again as Fig 2.10

Using rule (a) above, we can now check each column in two parts: firstly the in-course COs, then the out-of-course COs. The total amount of checking done to prove the truth is now 6 + 28 checks in column 1, and 10 + 21 checks each in columns 2 and 3, giving a total of 96 checks. This is the most economical way to check this composition.

	Wrong		Middle		Home
S	23546		23546	-	25436
	25436	-	25364	-	23654
	23654		23654	S	**25634**
	25634		**25634**	-	**26354**
	26354		**26354**	S	25364
-	53264	-	53642		53642
	53642	S	**53246**	-	**52436**
	52436		**52436**	-	**54326**
	54326		**54326**	S	52346
	52346		52346	-	53426
	53426		53426	-	54236
	54236		54236	S	**53246**

Fig 2.10 Quarter peal by coursing orders, with parities distinguished.

To demonstrate the use of the other two possibilities, Fig 2.11 shows an example touch of Plain Bob Major. This is certainly not an elegant touch, nor is it musical, but it illustrates the presence of a reversed coursing order. In-course and out-of-course coursing orders are distinguished by bold and normal print.

W	F	B	I	M	H
- **732546**			(**732546**)		
			- **473256**		
		S 673254		- 673542	S **674532**
		S 274536	(274536)		
			- 327456		
			- 532746		
			- 453276		
- 432576					
S **452376**	- **237645**			S 237546	
	S **754632**			- **754326**	- **753246**

Fig 2.11 A touch of Plain Bob Major, written out by coursing orders, which is false because of the presence of a reversed lead.

The coursing order which appears reversed is 673254. This appears in the Before column, and is the reverse of 452376 which appears in the Wrong column. Note that the reversed coursing orders typically do not appear in the same column. There is only one pair of leads which is false: the first is headed by 14582637, which occurs a lead after the first single Before, and the second by 15428367, which occurs a lead after the single Wrong.

Chapter 3. Composition and proof for other plain major methods.

We have looked in detail at Plain Bob: it is now time to consider other plain major methods. Little Bob and Double Norwich Court Bob are probably the next most frequently rung methods, then perhaps St. Clement's. Apart from that, very few of the possible plain major methods are rung, as most bands prefer to move to the heady delights of surprise. But it is worth a quick look at other plain major methods – we will take these three commoner methods first, and then investigate a rarer method — Double Sandringham Bob — to look at some problems with roll-ups.

In common with Plain Bob, we can check the truth of the inside of a lead of any other plain method by considering only the lead heads. This is because any internal change always bears the same relationship (transposition) to the nearest lead head or lead end. (Incidentally, this is only true if the lead has mirror symmetry at the half lead – this is the normal symmetry). Also, just as for Plain Bob, the only falseness is when a lead is rung backwards, and this can be found by checking for reversed coursing orders.

Thus the problems of checking the truth are identical with those of Plain Bob. The differences show in the construction of the compositions.

3.1 Composing with Little Bob Major.

Firstly, don't forget that each lead is only 8 changes long! This means that compositions need twice as many calls, and so the composer who wishes to create an elegant composition has a harder task to avoid boredom of the conductor and the band. Secondly, the calls Wrong, Middle, and Home appear in the same order in the course, but with different spacing: this means that compositions which only use these three calling positions can be proved exactly as shown in section 2.3.

Thirdly, the Before is at the fifth lead end of the course, but after a bob here, the ringing continues as if from the second lead head. Comparing this with Plain Bob, rather than one lead needing careful checking in the middle of the course, there are three leads; and also the Wrong and Middle calling positions are in these three leads. Another way of looking at a Before is that it omits four leads, including the course head. To look at some of the problems of this, try writing out the touch Middle, Before, Wrong; and make sure that you can prove that it's false.

The calling V/F is less use in Little Bob, but a commonly used calling is In and Fifths (I/V). These two bobs occur at the first two lead ends in the course; they split the tenors at the In but bring them back together at the Fifths; and the course is only three leads long. The coursing order changes from ..246875324.. to ..26847532.. at the In; and then to ..26875432.. at the Fifths. Considering both calls together, the effect on the coursing order is to transpose from 53246 to 54326, which is the same effect as two bobs at Home.

3.2 Composing with St. Clement's Bob Major.

The points to note here are that the Middle occurs first (at the first lead end), then the Before (lead end 3), then the Wrong (lead end 6). A bob Before removes a lead from the course, and so multiple bobs Before are in separate courses, and the composition is shortened by 16 changes per Before.

The I/V calling is also useful in St. Clement's: it gives a six lead course where the M, W, and H calling positions are still available, and the I and V calls are at the second and fourth lead ends.

Another possible calling is S3/SV (Single where the tenor makes thirds, then single at Fifths). This calling changes the coursing order from ..24687532.. via ..28647532.. to ..28746532.. The overall effect is to transpose from 53246 to 46532; the course is five leads long with the two calls being made at the second and third lead ends, and the calling positions M, W, and H are still available.

3.3 Composing with Double Norwich Court Bob Major.

This method is a rarity – it is one of the very few major methods commonly rung which has sixths place bobs. Other eighths place methods such as Kent and Bristol are usually rung with fourths place bobs (see section 1.7). Regarding the proving, this has no effect: the logic shown in chapter 2 still applies. The differences come in the notation of the composition, and in the effect of the calls on the coursing order. For the sixths place bobs, the transposition for a bob is "cab" rather than "bca". The calls are usually notated by the lead end number of the calling in the course. A bob at 5 causes 78 to dodge behind; the course head is two leads early (hence it is a five lead course), and the transposition for this is "bcdea".

3.4 Composing with Double Sandringham Bob Major.

You may rightly say that this is an odd method – nobody rings it! This is true, but the reason for including it here is that it is a plain method which generates unusual roll-ups in the plain course. In Plain Bob, we saw that in a plain course there are four –5678 roll-ups generated, and these correspond to the treble ringing in 1sts, 2nds, 3rds, and 4ths place. Consequently, to ring all 24 of the –5678 roll-ups it is only necessary to join six courses together (using BBSBBS at Home). However, there are methods where the plain course is not so well behaved. For plain methods this is the exception rather than the rule, but for surprise methods it is normal that the eight possible roll-up positions in a course will not all be –5678 roll-ups. We shall examine this further when we start on surprise; but let us now see the problem and how to deal with it before we have the added difficulty of false course heads.

12345678	A
21435768	
24137586	D
42315768	
24351786	
42537168	
24357618	
23456781	
32547681	
35246718	
53426178	
35241687	
53214678	B
35126487	
31524678	C
13254768	
13527486	

Fig 3.1 A plain lead of Double Sandringham Bob.

Fig 3.1 shows the first lead of Double Sandringham Bob. It is a seconds place method, with place notation 58.14x36x58.14.78 Inspection of this lead, and consideration of the other leads in the course, shows that (a) the lead heads are in the same order as in Plain Bob, but (b) the roll-ups come in different leads. The first lead contains one –5678 roll-up (A), and two –4678 roll-ups (B,C). The last lead of the course contains one –5378 roll-up, which is the third change of the lead (corresponds with D).

Suppose now that we wish to compose a quarter peal with the same attributes as the quarter of Plain Bob Major which we composed earlier. As it is the same first lead head, we could ring the same composition. But because of the way that the roll-ups are formed in the course, this composition will only generate 4 –2478 roll-ups and 6 –5678 roll-ups. In this case, we need to reconstruct the composition, bearing in mind that the most efficient way to generate –5678 roll-ups is to have coursing order ...56 in the first lead of the course: this will generate two roll-ups in the course. The "normal" choice, which is to have the coursing order 5...6 will only generate one rollup.

Wrong	Middle	Home
S 23546		- 25436
		- 24356
- 43256		
S 23456		
- 34256		
- 42356		
S 32456	- 32564	S 36524
S 56324		
- 63524		
- 35624		
S 65324		
- 53624	- 53246	

Fig 3.2 A quarter peal of Double Sandringham Bob.

With this knowledge, we can construct a suitable composition. This will be characterised by blocks of calls at Wrong rather than Home: these can be used to retain the coursing orders ...24 and ...56, which in turn will maximise the roll-ups we want. Fig 3.2 shows a possible composition, and it contains 10 –2478 and 12 –5678 roll-ups. It is easy to appreciate that to collect all of one particular roll-up needs parts of eighteen different courses. Because of this fact, it is more of a challenge to compose a peal of Double Sandringham Bob than Plain Bob. As the roll-ups occur in the first and last leads of the course, there is good reason to use short courses with calls at V and F, although the way that the bells are transposed by this pair of bobs is not too helpful for the roll-ups. If the peal contained all five lead courses, there would be the length available to include 63 courses.

Chapter 4. Surprise major and false course heads.

Methods which have a treble bob hunt put a new difficulty in the composer's way: that of false courses. While looking at Plain Bob and other plain major methods, we saw that the course headed by 3254768 was false against the plain course, as it is merely the plain course rung backwards. If we now take a surprise method such as Yorkshire, there is still the possibility of ringing a course backwards, but this is trivial when compared with the problems of what are termed false courses.

The subject of how to determine the falseness of a treble bob hunt method is one of the most complex in ringing. Readers who find this chapter very heavy going might like to read chapter 5 first, and then come back and delve into the theory later. Two methods for looking for falseness are presented. One of these is extremely general, and should highlight all of the aspects of the problem. The other is specific to the extraction of in-course, tenors-together falseness, and therefore gives a practical route into the subject for simpler compositions.

In order to save space, the following abbreviations will be used:–

CH, LH	Course head, lead head.
FCH, FLH	False course head, false lead head.
CO	Coursing order.
A,B,C..	Specific rows or changes.
a,b,c..	Positions in the lead where changes A,B,C occur.

A of X	at	a of Y	I
A of X	at	b of Y	
A of X	at	c of Y	
A of X	at	d of Y	R
B of X	at	a of Y	
B of X	at	b of Y	I
B of X	at	c of Y	R
B of X	at	d of Y	
C of X	at	a of Y	
C of X	at	b of Y	R
C of X	at	c of Y	I
C of X	at	d of Y	
D of X	at	a of Y	R
D of X	at	b of Y	
D of X	at	c of Y	
D of X	at	d of Y	I

Fig 4.1 The sixteen possible duplicates between two leads of surprise, for one position of the treble.

4.1 Reasons for the existence of false courses.

False courses arise for the following reason. Ignoring for the moment the parity of the rows, and considering first a plain major method, falseness can occur if (eg) the 2nd row of one lead turns up as the 15th row of another lead: this can only occur if the whole lead is rung backwards, and therefore all changes are false. However, in methods with a treble bob hunt, the possibilities of repetition are more numerous. Let us take a lead of a surprise major method, and examine all rows with the treble in one position, for example, in seconds place: these are the rows numbered 2, 4, 29, and 31 in the lead. We shall denote the rows by ABCD, and their positions by abcd. Fig 4.1 shows the sixteen possibilities of repetition between two leads, which are denoted by X and Y. This figure is a condensed version of statements like "Row B of lead X appears at position d of lead Y".

A of X	at	(b or c) of Y
B of X	at	(a or d) of Y
C of X	at	(a or d) of Y
D of X	at	(b or c) of Y

Fig 4.2 The four different falsenesses between two leads.

The possibilities marked "I" correspond with leads X and Y being identical; and those marked "R" correspond with lead X being the reverse of lead Y. These eight are trivial falseness, and in this case all 32 changes of lead Y are false against lead X.

The remaining eight possibilities can be split into four groups of two. Consider "A of X at b of Y" and "A of X at c of Y". The leads Y in these two cases are the reverse of each other, because position c occurs at the same distance from the lead end as does position b from the lead head. Consequently, the lead Y which is false against lead X is the same in both cases, but it is rung in the reverse order. The possibilities for falseness are now reduced to those shown in Fig 4.2.

Change	Parity	RowNo	Row	Posn.
12345678	+	1		
21346587	–	2	A	a
12436578	+	3		
21463758	–	4	B	b
– –				
81647352	+	29	C	c
18674532	–	30		
81764523	+	31	D	d
18765432	–	32		

Fig 4.3 The first four and last four changes of the first lead of Shepperton Surprise Major.

It will help now to use a real method, and examine this in more detail. We will use Shepperton Surprise Major, because the falseness created with the treble in seconds place is quite complex, and hopefully we can thus investigate all aspects of this falseness. Shepperton is a 2nds place method, with place notation 34.56.3.6.5x2.36.2x4.3.6x6.7, and the first lead head is 18674523. Fig 4.3 shows the first four and last four changes of the first lead in the course. By comparison with Fig 4.2, we need to look for four lead heads Y, such that (e.g.) 21346587 occurs at position b in that lead. The reverse of this lead Y will contain the same row 21346587, but at position c.

If we write 21346587 as the fourth row of a lead, and then work backwards, we arrive at the lead head 12638457: this is shown in Fig 4.4. It will help here to go to the algebraic notation describe in section 1.5, otherwise we will need to write out a lot of part leads to arrive at the FLHs. Some experimentation and thought will show that the FLH (1)2638457 is $\mathbf{A.B^{-1}}$: that is, row A transposed by the inverse of row B. By comparing with Fig 4.2, the other three FLHs can easily be generated in the same way, and these are shown in Fig 4.5.

12638457	
21634875	
12364857	
21346587	b

Fig 4.4 Working backwards from row A at position b.

Now, this procedure has found four false lead heads, but normally we use false course heads. Consequently each of these rows needs to be transposed in such a way as to bring the tenor to eighths place. To do this, we use the required lead head of the plain course of Plain Bob: the first FLH in Fig 4.5 needs to be transposed by 6482735, the second by 4263857, and the other two are the course head anyway. This gives the FCHs shown as the right hand column. In terms of the algebraic notation, we can use H^x to denote transposition by a suitable lead head from the plain course to return the tenor to eighths place, thus, $\mathbf{FCH = FLH.H^x}$.

Occurrence of falseness	Formula	False LH	False CH
A of X at (b or c) of Y	$\mathbf{A.B^{-1}}$	2638457	4372568
B of X at (a or d) of Y	$\mathbf{B.A^{-1}}$	2467385	6234578
C of X at (a or d) of Y	$\mathbf{C.D^{-1}}$	5273468	5273468
D of X at (b or c) of Y	$\mathbf{D.C^{-1}}$	3562748	3562748

Fig 4.5 Extraction of FLHs and FCHs by formula.

Each FCH shown in Fig 4.5 relates to a course for which one lead generates a row which is found in the first lead of the plain course (the Home lead). There must also be a further six courses corresponding to each of these four FCHs, to contain the leads which generate rows found in the second, third, etc leads of the plain course. For each FLH in Fig 4.5 we can find the other six by transposing each of the lead heads of the plain course by the FLH, and then returning the tenor to eighths place. Remembering that we use H^0, H^1, H^2, etc to denote the lead heads of Plain Bob, we can show this process for the FLH 2638457 in Fig 4.6.

Let the first FLH (2638457) be F

$H^0.F$ = 2638457	$H^0.F.H^x$ = 4372568	(x=5)
$H^1.F$ = 3456278	$H^1.F.H^x$ = 3456278	(x=0)
$H^2.F$ = 5274386	$H^2.F.H^x$ = 7532648	(x=6)
$H^3.F$ = 7382564	$H^3.F.H^x$ = 2634758	(x=2)
$H^4.F$ = 8563742	$H^4.F.H^x$ = 4237568	(x=3)
$H^5.F$ = 6745823	$H^5.F.H^x$ = 7562438	(x=1)
$H^6.F$ = 4827635	$H^6.F.H^x$ = 5632748	(x=4)

Fig 4.6 Generation of FCHs corresponding with the other six leads of the course.

Also, we need to do this for the other three FLHs in Fig 4.5, and thus generate a total of 28 FCHs. These are shown in Fig 4.7. Each one of these courses contains one row which occurs in the plain course, and it is a row with the treble in seconds place.

4372568	5763428	3752648	5274638
5632748	2457368	5426378	4632578
7562438	3426758	2473568	7352468
4237568	5472368	5436728	3562748
2634758	5326748	5273468	4637258
7532648	5473628	5364728	7432568
3456278	6234578	6427358	2536748

Fig 4.7 All FCHs resulting from the treble in seconds place in Shepperton.

4.2 The appearance of in-course and out-of-course falseness.

Examination of the 28 FCHs in Fig 4.7 shows that all are in-course. This is because of our choice of method. Fig 4.3 shows that in Shepperton, rows A and B are both negative, and so $\mathbf{A.B^{-1}}$ and $\mathbf{B.A^{-1}}$ will both be positive. Similarly, $\mathbf{C.D^{-1}}$ and $\mathbf{D.C^{-1}}$ are both positive; and hence all FCHs found are positive. But we noted that the false courses corresponding with "A of X at b of Y" and "A of X at c of Y" are in fact the same courses, but rung in the reverse order. Knowing one end of the course, we can find the other by transposing by 3254768, which as it is a negative row will also reverse the parity.

To put this another way, in Fig 4.7 we have identified 28 FCHs, by defining one end of each course; and as it happens, this is the in-course end. Obviously, each course must have "the other end"; this will be out-of-course, and can be found by transposing by 3254768.

We must now decide which end of each course we shall quote as the FCH, and this depends on how we intend to use the information. If the aim is to devise a composition which uses bobs only, then all CHs will be positive rows, and hence our set of FCHs should all be expressed by the in-course end of each course. However, if we need to check a composition which contains singles, but which keeps the tenors together, then (a) we need to take note only of FCHs which are of the form .....78, but (b) we need to include both in-course and out-of-course rows of this form, noting that some will be false course heads and some will be false course ends.

Taking the group of 28 FCHs which we found for Shepperton (Fig 4.7), if we are composing with tenors together, we should only include in this table (a) FCHs of the form .....78, and (b) FCHs of the form ....7.8, after transposition by 3254768 to turn them into the corresponding out-of-course FCH. By doing this, Fig 4.7 reduces to the 12 FCHs shown in Fig 4.8. (For clarity, the FCHs are kept in the same columns as in Fig 4.7.) As an example, the out-of-course FCH 6523478 is obtained by transposing the in-course FCH 5632748 by 3254768.

3456278	6234578	5426378	4632578
-------	-------	-------	-------
6523478	4362578	4563278	5326478
6243578	3562478	3546278	5263478

Fig 4.8 The 12 FCHs of those shown in Fig 4.7 which have the tenors coursing. Those above the dotted lines are in-course: those below are out-of-course.

4.3 The grouping of false course heads.

Looking back over the previous section, it can be seen that the presence of any one of the 28 FCHs automatically implies the presence of the other 27. The first four are generated as a consequence of the mirror symmetry of the lead, and these then become a set of 28 by virtue of our requirement to find all false courses rather than false leads. Thus this set of 28 form a false course head group, or FCH group, or falseness group.

On 8 bells, there are 360 possible courses, and these 360 divide into 28 falseness groups, although not all of these groups contain 28 members. As an example of this, try extracting the falseness for Shepperton for the rows where the treble leads. The procedure described above can be used, but it is found that all of $\mathbf{A.B}^{-1}$, $\mathbf{B.A}^{-1}$, $\mathbf{C.D}^{-1}$, $\mathbf{D.C}^{-1}$ give the same FLH (2436578), and so the FCH group contains only 7 members, not 28.

The FCH groups are denoted by letters, which were chosen historically rather than logically. Firstly, letters ABCDEFGHIKLMNOPRSTU denote the 19 groups which contain one or more in-course FCHs with the tenors together. (This is because surprise compositions originally contained only bobs, and the tenors were never affected). Secondly, letters abcdef denote six further groups which have one or more out-of-course FCHs with the tenors together (but no such in-course FCHs). Thirdly, there are three groups denoted by XYZ which have no members where the tenors are together.

Mostly, when the FCHs are presented in these groups, only 60 FCHs are shown: these are the 60 different in-course course heads with the tenors together. From this presentation comes the description of "clean proof scale" or cps. This does not mean "this method has no falseness"; the meaning is in fact "there are no false courses for this method which are in-course and have the tenors together". The corollary is that in such cases all of the falseness is in the groups represented by the letters abcdefXYZ.

Three appendices deal with these falseness groups, and the contents of these appendices are described further in section 4.12.

For Shepperton, we have worked through the extraction of the group of 28 FCHs which arises with the treble in seconds place; and we have given the information that there is a group of 7 FCHs for the treble in 1sts place. These groups are denoted by the letters N and B respectively. Now that we have recognised that the FCHs will always occur in groups, we need to extract only one FCH for each of the other six treble positions, and by using the information in Appendix 4, from that one FCH we can determine the relevant group. This can be done from the changes of the first half lead of the method, and the working for this is shown in Fig 4.9.

12345678 A	$A.C^{-1}$ = 2436578	$A.C^{-1}.H^{0}$ = 2436578 Group B
21346587 B	$B.D^{-1}$ = 2638457	$B.D^{-1}.H^{5}$ = 4372568 Group N
12436578 C		
21463758 D		
24136785 E	$E.G^{-1}$ = 2348756	$E.G^{-1}.H^{5}$ = 7462538 Group d
42316875 F	$F.J^{-1}$ = 4325678	$F.J^{-1}.H^{0}$ = 4325678 Group B
24138657 G		
24316875 J		
42361857 K	$K.M^{-1}$ = 4325678	$K.M^{-1}.H^{0}$ = 4325678 Group B
42638175 L	$L.N^{-1}$ = 4265378	$L.N^{-1}.H^{0}$ = 4265378 Group c
24361857 M		
23468175 N		
32486715 P	$P.R^{-1}$ = 8235467	$P.R^{-1}.H^{3}$ = 6754238 Group Y
34268751 Q	$Q.S^{-1}$ = 8235467	$Q.S^{-1}.H^{3}$ = 6754238 Group Y
43627815 R		
46372851 S		

Fig 4.9 Extraction of the remaining FCH groups of Shepperton.

4.4 Extraction of falseness by the "blue line system".

We shall now look at a means of extracting falseness which only relates to FCHs with the tenors together. This was first published by John Segar, and the principle is to check pairs of rows which have the treble in the same position for the presence of coursing pairs. Rather than explain this in words any further, we shall show the method of working using an example.

Fig 4.10 shows what are known as the "proving rows" for Shepperton. Each row shows the position of the treble, the parity; and the positions of the other bells in the order 7864235. It is a condensed way of showing the positions of the seven possible coursing pairs 78, 86, 64, 42, 23, 35, 57; and this is why the "7" column is repeated. Because coursing order is cyclic, and is the same for each lead of the plain course, the proving rows are the same, but relate to the whole course of the method, not merely the first lead.

The proving rows can be generated in two ways. Firstly, each column represents the positions that the bell at the head of the column falls into as it rings the line of the method. Alternatively, each proving row can be generated from the previous one, by using the place notation. If the notation is "x", then the bell pairs 12, 34, 56, and 78 are crossed, wherever they occur in the proving row: for this purpose the treble column must be included (Example: generation of row 7 from row 6). If the notation is (e.g.) 38, then these bells are written in the same place, and the other pairs (12, 45, 67) are crossed wherever they occur (Example: generation of row 4 from row 3).

Now we examine a pair of rows of the same parity with the treble in the same position; for example rows 2 and 4. A FCH with the tenors together is signified if a pair of adjacent figures which occurs in the first row also occurs in the second row. In our example, "68" occurs in both rows. This can be interpreted as "there are two rows in the plain course with the treble in 2– where 78 fall into position 6 and 8 respectively", and it signifies the presence of an in-course, tenors-together FCH.

	H	M	F	I	B	V	W	
1+	7	8	6	4	2	3	5	7
2–	8	7	5	4	1	3	6	8
1+	7	8	5	3	2	4	6	7
2–	6	8	4	3	1	5	7	6
3+	6	7	5	2	1	4	8	6
4–	7	6	5	1	2	3	8	7
3–	8	5	6	2	1	4	7	8
4+	7	6	5	2	1	3	8	7
5–	8	6	4	1	2	3	7	8
6+	7	5	3	1	2	4	8	7
5+	8	6	4	2	1	3	7	8
6–	7	5	4	3	1	2	8	7
7+	6	4	5	3	2	1	8	6
8–	6	5	4	2	3	1	7	6
7–	5	6	3	1	4	2	8	5
8+	4	6	2	1	5	3	7	4
8–	3	5	1	2	6	4	7	3
7+	2	4	1	3	6	5	8	2
8+	1	3	2	4	5	6	7	1
7–	1	2	3	5	4	6	8	1
6+	2	1	3	4	5	7	8	2
5–	3	1	2	4	6	8	7	3
6–	4	2	1	3	5	7	8	4
5+	3	2	1	4	6	8	7	3
4–	3	1	2	5	6	7	8	3
3+	4	1	2	6	5	8	7	4
4+	3	2	1	5	6	7	8	3
3–	4	1	2	5	7	6	8	4
2+	5	1	3	4	8	6	7	5
1–	4	2	3	5	8	7	6	4
2+	3	1	4	5	7	8	6	3
1–	3	2	4	6	8	7	5	3

Fig 4.10 Proving rows for Shepperton.

The proving rows specify the positions of the bells in reverse coursing order sequence: we now need to transpose the rows so that they relate to course heads. Fig 4.11 shows the lead heads of Plain Bob Major, and the associated proving rows, remembering that the proving rows specify the positions of 7864235 in that order. These proving rows are all rotations of the same row 7864235. Thus the problem of obtaining a course head from a lead head, which arose in the last section, is resolved merely by rotating the proving rows until the pair which represents the positions of 78 comes to the end of the proving row.

Lead head	Proving row
2345678	7864235
3527486	5786423
5738264	3578642
7856342	2357864
8674523	4235786
6482735	6423578
4263857	8642357

Fig 4.11 Lead heads and proving rows for Plain Bob Major.

Thus 8754136 gives 7541368
6843157 4315768

The two proving rows now represent the positions of 6423578 at the corresponding two rows, in particular leads of the course. The proving rows can be transposed by the inverse of 6423578 = 4536278, in order to find the positions of 2345678 at these positions.

Thus 75413(68) gives 41537(68) X
43157(68) 15374(68) Y

As these rows now show the positions of 2345678 at each of these rows in the lead, the transposition to move from one of these to the other is the FCH. So, to get Y from X requires transposition by 34562(78), and to get X from Y requires transposition by 62345(78). These were shown in Fig 4.8 to be two of the four in-course FCHs for the treble in seconds place. The other two FCHs are generated by using the same procedure on the two proving rows with the treble in 2+, (which are at the end of the lead).

4.5 The incidence of the falseness.

The two procedures detailed above have both led to the falseness groups for a method. The first procedure will generate all possible FCHs, whereas the second is more suited to looking for FCHs with the tenors together. The information is in the form of a list of false courses of the method, and is most useful when constructing a composition which is in full courses (see the next chapter, also section 1.8). But there are two reasons why we may not wish to use full courses. The first is that the method may have such a large number of false courses that to use only complete courses means that insufficient true courses are available; and the second is if by doing this we cannot get to the musical changes we would like.

Shepperton is an example of the first reason. The falseness groups for this method are BNcdY, (see Fig 4.9), and a glance at Appendix 1 shows that, even if we keep the tenors together and use only bobs, each course used means five more courses that we cannot use. So as a first approximation, out of the 120 possible courses, there will only be about 20 mutually true courses.

The second problem is more difficult to visualise. It arises where the musical changes of a course are in leads which are relatively true, but the rest of the course contains falseness. As an example, in Rutland Major the roll-ups are all in the first, second, sixth, and seventh leads of each course, but the (tenors-together in-course) falseness is in the middle three leads (see Appendix 6). Consequently, if we restrict a composition to full courses, we have sacrificed musical leads which in themselves are true. Incidentally, this is why a lot of compositions of Rutland contain large numbers of bobs Before: a course containing a Before is six leads long, and omits the lead which is involved with all the falseness.

In view of these two reasons, we need to determine the incidence of the falseness, that is, to determine which are the leads in the plain course and the false course which contain the replicated changes. We shall start with the second method described – John Segar's "Blue line proof" – as it is the easier.

4.6 Incidence of falseness from the Blue line proof.

In section 4.4, we showed that for the proving rows with the treble in 2–, the pair 6–8 being in both rows signifies the presence of a FCH, as these rows represent two locations in the course where 7 and 8 fall into the same positions. Consider the meaning of the first proving row, which is 7864235. Each adjacent pair of figures in this row denotes a position occupied by 78 in the first row of a lead of the course. We can write this out longhand as follows, describing each lead by the calling position at the start of the lead.

78 ring in 7–8 in the first row of lead 12345678: the Home lead
78 ring in 8–6 in the first row of lead 14263857: the Middle lead
78 ring in 6–4 in the first row of lead 16482735: the Fourths lead, etc.

This is purpose of the lettering at the head of the columns in Fig 4.10. The information about the incidence of the falseness is contained in the column headings of the columns where the duplicated pairs appear, as the pairs represent the positions of 78 in <u>that lead</u> of the course. Looking at the same example again (proving rows 2 and 4, treble in 2–), the indicator pair 6–8 is in the W column of row 2, and the H column of row 4.

Thus	41537(68)	W lead
	15374(68)	H lead

gives the information that W of 23456 is false against H of 34562 (reading downwards), and also H of 23456 is false against W of 62345 (reading upwards). We can now use this system to determine all of the falseness, and its incidence, and the start of this procedure is shown in Fig 4.12. The proving rows from Fig 4.10 which have duplicated pairs are shown in the left hand column. The right hand columns show these rows after rotation to bring the duplicated pair behind, followed by the column heading which relates to the pair. It is left to the reader to do the necessary transpositions and read off the FCHs with their incidence.

	H M F I B V W		
1+	7 8 6 4 2 3 5 7	6423578	H
1+	7 8 5 3 2 4 6 7	5324678	H
1–	3 2 4 6 8 7 5 3	5324687	B
1–	4 2 3 5 8 7 6 4	6423587	B
2+	5 1 3 4 8 6 7 5	7513486	B
2+	3 1 4 5 7 8 6 3	3145786	V
2–	8 7 5 4 1 3 6 8	7541368	W
2–	6 8 4 3 1 5 7 6	4315768	H
4+	7 6 5 2 1 3 8 7	3876521	I
4+	3 2 1 5 6 7 8 3	5678321	M
4–	7 6 5 1 2 3 8 7	3876512	I
4–	3 1 2 5 6 7 8 3	5678312	M
5+	8 6 4 2 1 3 7 8	3786421	I
5+	3 2 1 4 6 8 7 3	4687321	M
5–	8 6 4 1 2 3 7 8	3786412	I
5–	3 1 2 4 6 8 7 3	4687312	M

Fig 4.12 Proving rows for Shepperton, where indicator pairs are found, rearranged by treble position.

4.7 Incidence of falseness by the algebraic method.

In this procedure for determining the falseness, the incidence information is contained in the "x" in H^x, where we have used this to symbolise a lead head from the plain course. An example will make this clear. We started by looking at the falseness for the treble in seconds place, generated by the formula $\mathbf{A.B^{-1}}$. This gave a course which contains a row which also occurs in the first lead of the plain course. This was extended in Fig 4.6 to cover the other six leads of the plain course. In Fig 4.6, the third line of the table reads:

$H^2.F = 5274386 \quad H^2.F.H^x = 7532648 \quad (x=6)$

In this, the indices "2" and "x" (where x is 6) are the information about where the falseness occurs, and we need to think clearly about the meaning of these indices. They represent the lead heads of Plain Bob Major: Fig 4.13 shows these lead heads, the corresponding indices, and the names by which the leads are known. In the line shown above, the "2" denotes which lead of the plain course is transposed by the FCH; and hence this "2" shows that it is the V lead of the plain course which is false. However, the (x=6) represents a transposition to <u>return</u> to a course head from a particular false lead. Consequently, the false lead in this course is lead (7 – 6 = 1), i.e. the W lead. This is easily seen from the left hand side of the line, in that the position of the tenor in 5274386 corresponds with the start of the W lead. The translation of the line is thus:–

Lead head	Index	Name
2345678	0	H
3527486	1	W
5738264	2	V
7856342	3	B
8674523	4	I
6482735	5	F
4263857	6	M

Fig 4.13 Lead heads of Plain Bob Major, with indices and names.

V lead of 23456(78) (lead 2) is false against W lead of 7532648 (lead 7–6)

Similarly, we can now tabulate all of the incidence for this falseness. Fig 4.14 is a copy of Fig 4.6 to include all of this information.

$H^0.F.H^5$ = 4372568	(x=7–2)	H of 23456 is false against V of 4372568
$H^1.F.H^0$ = 3456278	(x=7–7)	W of 23456 is false against H of 3456278
$H^2.F.H^6$ = 7532648	(x=7–1)	V of 23456 is false against W of 7532648
$H^3.F.H^2$ = 2634758	(x=7–5)	B of 23456 is false against F of 2634758
$H^4.F.H^3$ = 4237568	(x=7–4)	I of 23456 is false against I of 4237568
$H^5.F.H^1$ = 7562438	(x=7–6)	F of 23456 is false against M of 7562438
$H^6.F.H^4$ = 5632748	(x=7–3)	M of 23456 is false against B of 5632748

Fig 4.14 Incidence of falseness identified in Fig 4.6.

It is easy to see that the algebraic method of determining incidence generates a large amount of information: this is because it has included all of the falseness, rather than only that with the tenors together. For the whole course of a method, there are in general (8 treble positions) x (4 false lead heads) x (7 leads in the course) different false leads, which is 224. This is expected: each change in the plain course can be found in another course.

4.8 Determination of out-of-course, tenors-together falseness.

The blue line system as described above finds FCHs which are in-course and have the tenors together. The system can very easily be used to determine the out-of-course tenors-together falseness. To do this, instead of comparing proving rows which have the same parity, we compare proving rows of opposite parity. Fig 4.15 shows all four proving rows for Shepperton with the treble in seconds place. In section 4.4 we compared rows A and B, and commented that to extract all of the in-course falseness it is also necessary to compare rows C and D. To get the out-of-course falseness we now need to compare rows A and C, and also rows B and D. There is no need to compare A–D or B–C: these only correspond with ringing the lead backwards, and the whole proving row appears in reverse order. For example, between rows A and C, the pairs 1–3 and 7–5 are duplicated, and the falseness that these identify is shown in Fig 4.16. (Comparing proving rows B and D generates four more falseness relationships.)

	H M F I B V W	
2–	8 7 5 4 1 3 6 8	A
2–	6 8 4 3 1 5 7 6	B
2+	5 1 3 4 8 6 7 5	C
2+	3 1 4 5 7 8 6 3	D

Fig 4.15 Proving rows for Shepperton, with the treble in seconds place.

Proving row	Rotated proving row	Transposed by 45362	Column heading	Falseness
87541368	68754(13)	75846	B	B of 23456 v M of 62435
51348675	48675(13)	67854	M	M of 23456 v B of 35462
Also:	41368(75)	36184	M	M of 23456 v W of 65234
	13486(75)	48361	W	W of 23456 v M of 45632

Fig 4.16 Extraction of some of the out-of-course, tenors-together falseness for Shepperton, with the treble in seconds place.

4.9 Extension of these procedures to royal and maximus.

Both of the methods described above can be extended to determine falseness for higher numbers of bells. With the algebraic method, the problem comes in assigning the falseness groups, as these are not fully defined for numbers higher than 8 bells.

Taking the 10 bell stage as an example, there are 20160 different courses, and so a table such as Appendix 4 would be inordinately long. Mostly, composers have maintained the back four bells as fixed bells, and continued with calls which affect only 23456. For this purpose, there are 120 different courses, and these can be grouped in a similar manner to major. The notation for major has been adjusted to encompass royal and maximus, although there are two differences. Some of the major groups split into two when entended to royal and beyond; and also the in-course and out-of-course components do not necessarily occur together. This tabulation, and further explanation, can be found in the CC Publication "Collection of rung surprise" (see bibliography).

The blue line method extends easily to higher numbers, and can be adjusted to cope with varying numbers of fixed bells. For example, to extract falseness for royal with four fixed bells (i.e. 7890), the proving rows are examined to find four bells replicated between the rows. Fig 4.17 shows the first eight proving rows for Cambridge Surprise Royal. The rows with the treble in 3+ can be compared, and they show two groups of four bells repeated: 7908 and 9086. From these, we can determine falseness as before: (the columns below show the rotated proving row, the transposition by 45362, the column heading, and the resulting falseness).

	H M 6 F I B V 7 W
1+	7 9 0 8 6 4 2 3 5 7 9 0
2–	8 0 9 7 5 3 1 4 6 8 0 9
1–	9 0 8 6 4 3 2 5 7 9 0 8
2+	0 9 7 5 3 4 1 6 8 0 9 7
3+	9 0 8 6 2 4 1 5 7 9 0 8
4–	0 9 7 5 1 3 2 6 8 0 9 7
3+	0 8 6 5 1 4 2 7 9 0 8 6
4–	9 7 5 6 2 3 1 8 0 9 7 5

Fig 4.17 The first eight proving rows for Cambridge Royal.

62415(7908)	41256	W	W of 23456 v 7 of 32546
65142(7908)	14526	7	7 of 23456 v W of 32546
24157(9086)	15472	H	H of 23456 v W of 46253
51427(9086)	42175	W	W of 23456 v H of 46253

When using this sytem, the column heading is that which is centrally above the set of four which is duplicated.

4.10 The royal curiosity.

There is a useful peculiarity for some (but not all) royal methods. If an attempt is made to extract in-course falseness for Bristol Surprise Royal by the algebraic system, it will quickly be seen that there is no falseness at all. Every application of a formula such as $A.B^{-1}$ between two rows of the same parity leads to a FLH which is a lead head of the plain course.

This is possible because in royal the lead heads and lead ends are always the same parity: this is also true for 6, 14, 18 bells; but not true for 8, 12, 16 bells, etc. In a royal method, it is possible to arrange the half lead such that each pair of rows with the treble in any one place has one positive row and one negative row. To do this, the place notations between the two rows must be of the form "ab x" or "x ab" or "ab.cdef", etc. Notation such as "x 1250" (found in Cambridge with the treble in 3rds) or "14.58" (found in London no.3 with the treble in 9ths) do not preserve the parity correctly. Because the two ends of the full lead are the same parity, then every pair of rows with the treble in one position and with one parity must be equidistant from the nearest end of the lead; and hence all of the "false leads" are merely leads of the plain course rung backwards.

The corollary of this is that for a method which complies with this rule, any composition with only bobs can be tested for truth as for Plain Bob: there is no need to worry about FCHs. This applies just as well even if the tenors are affected by the calls.

Incidentally, this is the reason why it is possible to have extents of treble bob minor methods with no thought to the internal falseness.

4.11 Extraction of falseness between methods.

The same procedures for determining FCHs and their incidence for single methods can also be used to extract the falseness information for two methods. This is necessary in order to contruct compositions of spliced. In Fig 4.1 at the start of the chapter, we noted that for single methods the combinations marked "I" correspond with leads A and B being identical, and those marked "R" correspond with the two leads being the reverse of each other. This is true if we are extracting falseness for a single method, but not if we are extracting falseness between two methods. In this case, all sixteen combinations can generate falseness: this goes to explain why much more falseness is seen when two methods are to be spliced together (compare the falseness diagrams for Cambridge, Yorkshire, and the two together in Appendix 6 and Appendix 7).

4.12 Explanation of the information presented in the appendices.

The first four appendices give information about the grouping of FCHs for major. Appendix 1 is the table which is usually shown: it gives all of the 120 false course heads with the tenors together, divided into the 25 groups, with each group subdivided into in-course and out-of-course sets. Appendix 2 shows the falseness of the standard eight (plus Shepperton and some other common methods), where the FCH group arising from each of the treble positions is shown. This table emphasises the fact that each treble position generates one and only one group of FCHs, and shows that "any method is as false as any other method". Bristol shows as having eight FCH groups, but (a) they are all out-of-course, and (b) they are all the same. For in-course FCHs, Yorkshire and Rutland both have group B, but for out-of-course falseness, Rutland has three groups (ace) whereas Yorkshire has only one (c). Do remember, though, that looking at falseness in this way is only considering the false courses, and not the incidence of the falseness, in other words, which of the leads in those courses are false.

Three of the methods in this table (Pudsey, Ipswich, and Shepperton) have FCH group letters which do not appear in Appendix 1. There are three groups of FCHs which contain no course head with the tenors together (neither in-course nor out-of-course). These are now designated by the letters X, Y, and Z, although the original designations were X, gamma, and delta.

The use of this presentation of falseness is in composing or selecting a so-called "universal composition". These make use of full courses of the method, so that the incidence of the falseness is not used when checking the proof. Examples can be found in the book Composition 500 (see bibliography).

Appendix 3 is the extension of Appendix 1 to include all groups and all possible course heads, although in this case only the in-course end of each course is shown. Appendix 4 is a cross-reference table into Appendix 3: given a particular course head, it shows to which falseness group that course belongs. For clarity in this appendix, all 720 possible course heads are included.

It is sometimes difficult to visualise exactly what happens in a false course, and so Appendix 5 shows the plain course of Yorkshire Major, together with one of its false courses, written out in full. It is seen that the false changes occur in pairs — this is because the rows occur in pairs related by place notation "x", as Yorkshire is a right place method. It is also seen that "there is not much falseness". What do we mean by the last remark? Simply that although the course headed by 24365(78) is false against the plain course, not many of the changes are duplicated. This points out the problem of composition with treble bob hunt methods - once we have used a particular course, there are quite a lot of courses which cannot be used in full, as the false changes tend to be sprinkled around in many different false courses.

Appendix 6 gives falseness diagrams for all of the "standard eight", and for some other common methods. For Yorkshire, there is also a table of the false leads, which is an alternative presentation of the same information. Comparing these two with the courses of Yorkshire given in Appendix 5 will clarify the meaning of the tables.

In these diagrams, the letters normally used to denote calling positions are used here to specify the lead in the course which is false. H,M,F,I,B,V,W correspond with the tenor being 8,6,4,2,3,5,7 place bell respectively at the start of the lead.

Appendix 7 gives diagrams for the inter-method falseness between six of the "standard eight" Surprise Major methods. Unfortunately, it is not possible in this book to show the inter-methods falseness for Bristol and Pudsey, because of the space it would need. In some of the diagrams, "-P-C-" is shown. This is short for "plain course", and represents the fact that the two leads shown have a common lead end, and hence are false. For example, the F lead of Cambridge and the W lead of Rutland both finish with the course end. A similar problem can occur for a falseness table of Bristol and Yorkshire. These two methods have identical changes at the half leads (both are as in Plain Bob).

Chapter 5. Composing with single surprise methods.

The preceding chapter has discussed the problem of determining where the falseness occurs in methods with a treble bob hunt. We shall put the information to practical use now, and devise some compositions. First, we shall compose by using true and false courses, and then show how the falseness tables are used.

5.1 Construction of a long touch of Yorkshire Major (full courses).

Our first target will be to construct a touch of ten courses of Yorkshire Surprise Major. This will be 2240 changes, and so is very unlikely to be rung, but it should be long enough to show the effect that the FCHs have, without being so long as to be tedious in explanation.

If we keep the tenors together, and use no singles, the only problem of the composition is to avoid using both of two courses where the course heads are related by the transposition 24365(78). For example, we can only use one of courses 65432(78) and 64523(78), and one of courses 25463 and 24536.

M	W	H	23456
		52436	42356
52364	23564	25634	65324
		26354	36524
26543			56423
26435	64235	62345	32465
		63425	43265
63254	32654	36524	56234
		35264	25634
35642			65432
35426	54326	53246	23456

Course heads used

		42356
32654	53624	65324
		36524
56423		
46325	**24365** ◂	**32465** ◂
		43265
23564	62534	56234
		25634
65432		
45236	**34256** ◂	**23456** ◂

Fig 5.1 A proposed ten course block of Yorkshire.

Fig 5.1 shows a proposed composition. The top part of this figure shows the positions of the calls (all bobs) by the presence or absence of a coursing order, and the resulting course heads are shown in the right hand column. (It is usually easier to construct a composition by transposing coursing orders, as most of the required transpositions involve only three characters. However, all coursing orders used need to be transposed into course heads for the truth checking.) In composing this touch, we have tried to be elegant, hence the two part composition, and also to be musical, hence the use of 32465 as a part end. Below the composition, all of the coursing orders used have been transposed into course heads (for this we use the transposition cbdae), and in order to prove the composition, we need to ensure that no two of these are related by the transposition 24365.

It is quite easy to spot that two pairs of course heads are related like this: 24365-23456 and 32465-34256; these are highlighted at the bottom of Fig 5.1. Thus this composition is false to Yorkshire. What can we learn from this?

Firstly, because we have proved each course as if we had used the full course, we can say that this composition is potentially false to any method which has group B falseness. (It might happen to be true in some cases because of the incidence of a particular method's falseness: see section 5.2.)

Secondly, our attempt at being musical was a failure (it's the -6578 roll-ups which are false), and by this we have shown that we cannot have three courses of -5678 roll-ups and three courses of -6578 roll-ups in a group B method if we use only bobs. However, reference to Appendix 1 will show that the six course heads shown in Fig 5.2 are true to group B, and hence can be used to get these six musical courses into a method where group B falseness is present. The trick is that the three course heads ...65 are out-of-course: we could not use these in the composition generated above, as we specified the use of bobs only. As not all of these six course heads are in-course, if we use them we must also check for the out-of-course FCH groups as well. Just because Yorkshire has only group B in-course falseness and these courses are true to group B doesn't automatically mean that they are true to Yorkshire. In point of fact, they are: however, this is because the only other falseness group of Yorkshire is group c, and the six courses are mutually true to this group.

23456	23465
34256	34265
42356	42365

Fig 5.2 Six course heads which are mutually true to group B falseness.

Thirdly, a part of the reason why we have had difficulty with the truth of this composition is because we have used a large number of part courses, and not many full courses. The effect of this is that to demonstrate the truth of the composition, we have actually tested the truth of 22 different courses, which is nearly enough for a peal. The lesson here is that if we intend to check truth in full courses, it pays to compose in full courses also.

M	W	H	23456
53462			43652
53624	36524		56234
	65324		35264
	53624	56234	26354
		52364	32654
52643			62453
52436	24536		54326
	45236		25346
	52436	54326	34256
		53246	23456

Fig 5.3 An alternative ten course block of Yorkshire (true).

Fig 5.3 shows a second attempt at a ten course block. This one makes use of 8 complete courses, and fragments of 4 others, so that only 12 course heads need to be checked for mutual truth.

(You should try doing this check; and show that the composition is true to group B, i.e. no two course heads are related by 24365. For practice, show also that the composition is also true to groups C and K).

Another way of trying to build in truth is by the use of more than two parts. In section 1.10, we mentioned symmetry, but without showing why it is useful. If a composition is in N identical parts, then it is only necessary to check ½(N + 1) parts (rounded up) to be sure of truth. Consider for example a three part composition, with the parts denoted by A, B, and C. If a change in C is false against a change in B, then at the corresponding places there is a change in B that appears in A; and so on.

M	W	H	23456
53462	34562	35642	65432
		36452	46532
36524	65324	63254	23564
		62534	52364
62345	23645	26435	46325
		24365	34625
24653	46253	42563	52643
		45623	65243
45236	52436	54326	34256
		53246	23456

Course heads used (3 parts)

43652 ◄	54632	65432
		46532
56234	35264	23564
		52364
32465	63425	**46325** ◄
		34625

Fig 5.4 A third proposed ten course block, in five parts. Not true to group B falseness.

Fig 5.4 shows a third proposed ten course touch of Yorkshire, arranged as a five part composition. Checking the truth of the course heads against group B falseness shows that this composition is also not true to group B. Below the composition are set out the course heads of the first three parts only. The two course heads highlighted are related by 24365, and show that the fragment of the course used from the M to W of course 1 is false against the 6th course. Inspection of the figures will soon show also that course 3 (M to W) is false against course 8, course 5 against course 10, etc. Thus this composition is not generally true to group B falseness. The point of including this composition is that the lack of truth is demonstrated by considering only three of the five parts, and that the falseness found occurs in the same place in each of the five parts.

Fig 5.5 shows a fourth ten course block, once again in five parts. This one is true to group B, and hence to Yorkshire, and you can demonstrate the truth by checking the first three parts as described above.

M	W	H	23456
53462		54632	64352
	46532		56342
46325		43265	23645
	32465		42635
32654		36524	56234
	65324		35264
65243		62453	42563
	24653		64523
24536		25346	35426
	53246		23456

Fig 5.5 A fourth ten course block, true to group B and to Yorkshire.

5.2 Proof of compositions of methods using the incidence of the falseness.

The section above has shown that it is possible to compose for surprise by examining the mutual truth of full courses, but quite often we must turn to the incidence of the falseness, in other words, whereabouts in each course the falseness occurs.

Course	Leads rung
46325	H V I M W B F
43652	M

Fig 5.6 Leads rung in the potentially false courses of Yorkshire.

Let us go back and examine the proposed composition of Yorkshire given in Fig 5.4 more closely, remembering that we only need to examine the first three parts. Falseness was found between course heads 43652 and 46325; however, not all the leads in these courses are used. Fig 5.6 shows that the composition uses all the leads from the course 46325, but only the M lead from 43652. Turning to the falseness diagram for

Yorkshire in Appendix 6, we can see that falseness occurs between H and F; between V and I; and between W and B. The M lead of the course is true. (We are really saying: the M lead of course 23456 has no falseness in the course 24365.) And so although our check by full courses showed that this composition (Fig 5.4) is false to group B, testing by the incidence of the falseness shows that it is in fact true to Yorkshire.

We shall take one more example of this. In the Ringers' Diary for 1992, p65, there are three quarter peals true to CYSPN, and three true to CSYP – Lincolnshire is excluded. Let us take the first of these, and show that it is false to Lincolnshire. Fig 5.7 shows this composition, and we have used a different way of writing this out ready for checking: the left hand side shows the bobs in the composition, and the right hand side is the course heads which relate to the courses entered at each bob (Transpositions: for B, 35264; for M, 43652; for H, 42356). This different presentation is not done out of perversity; it is an effort to show that there are alternative ways of collating the composition ready for the task of proof. Composers will use whatever seems easiest for them.

B	M	H	B	M	H
-			35264		
	-			25463	
-			56234		
	-	-		26435	42635
-		-	23456		42356
		-			34256
		-			23456

Fig 5.7 A composition of Lincolnshire to check for truth.

Appendix 2 shows that Lincolnshire has two in-course FCH groups, B and L: Appendix 1 shows that group B has one in-course FCH which is 24365, and group L has three FCHs which are 26543, 42563, and 36245. It is quite simple to show that none of the CHs are related by 24365, thus the courses used are mutually true to group B. Inspecting again for the group L falseness shows that various pairs of courses are related by two of the three FCHs. This time it is important to note that some of the transpositions work in one direction only. By this we mean that while 26543 is its own inverse, 42563 and 36245 form a pair where each is the inverse of the other. The four CHs from the composition which are related by a FCH from group L are shown in Fig 5.8.

CH		FCH		CH
25463	x	42563	=	42635
26435	x	42563	=	42356
42635	x	36245	=	25463
42356	x	36245	=	26435

No CHs are related by the FCH 26543

Fig 5.8 Course heads from the proposed composition of Lincolnshire, related by the group L FCHs.

The fact that we have found the four relationships in Fig 5.8 means that the courses used are not mutually true to group L. However, as not all of the leads in these courses are used, the composition still might be true to Lincolnshire, depending on the incidence. Fig 5.9 shows a part of the falseness diagram of Lincolnshire, presented as a table. In order to examine the incidence of the falseness identified in Fig 5.8, we need to check that:-

H of 23456	v	I of 42563
W of 23456	v	F of 42563
F of 23456	v	W of 36245
I of 23456	v	H of 36245

Fig 5.9 An extract from the falseness diagram for Lincolnshire.

(a) If H of 25463 is used, then I of 42635 is not.
(b) If W of 25463 is used, then F of 42635 is not.

For CH 25463, the leads used are M W B F H V; but for CH 42635, the only leads used are H V. Both of checks (a) and (b) above are thus satisfactory. Next we need to check:-

(c) If H of 26435 is used, then I of 42356 is not.
(d) If W of 26435 is used, then F of 42356 is not.

For CH 26435, leads M W B F are used; and for CH 42356, all leads are used (H V I M W B F). Check (c) is satisfactory, but check (d) is not, i.e. the W lead of 26435 is used, and is false against the F lead of 42356. Thus this quarter peal is not true to Lincolnshire.

As we were merely trying to prove truth or falseness, there is no point in going any further. However, if we wished to remedy the situation, in other words to change the composition of the quarter peal to make it true, then we would continue to determine all of the falseness to investigate the extent of the problem. In fact, in this case, this falseness is the only falseness in the quarter peal.

5.3 Composing with repeating lead methods.

Methods such as Kent and Oxford Treble Bob and Bristol Surprise Major are usually rung with fourths place bobs, in order to give the "repeating lead" feature referred to in section 1.7. The benefit of doing this is that it often makes the compositions more musical, as a greater number of changes are included with 7–8 at the back. Sometimes it assists in generating a true composition, if the leads which repeat (the Middle, Wrong, and Home leads) have little or no falseness. Kent is such a method: the falseness table for Kent is given in Fig 5.10. On the other hand, in Belfast Surprise Major, the leads around the course head have FCHs which make it difficult to generate a reasonable number of crus. (See also Appendix 6.)

F of 23456	v	B of 32546
I of 23456	v	I of 32546
I of 23456	v	B of 24365
I of 23456	v	V of 46253
B of 23456	v	F of 32546
B of 23456	v	I of 24365
B of 23456	v	B of 46253
V of 23456	v	I of 46253

Fig 5.10 Falseness table for Kent Treble Bob Major.

One problem which is found when composing for these methods is in adjusting the length of a composition. This is because it is not possible to insert blocks of three bobs. In other words, composition in round blocks and full courses, as was referred to in sections 1.8 and 5.1, is not possible in this case. In general, the solution is to have a fairly clear idea of how many courses are needed from the start, bearing in mind that all bobs where the back bells dodge will add one lead. Hence for a quarter peal of major, we need 4 courses plus 12 added leads: ((4 x 7) + 12) x 32 = 1280 changes.

If a composition design falls short of this, then there are a couple of tricks which can be used to extend the length. Firstly, the round block W-H-W-H can sometimes be inserted, which will add a course and four leads. Secondly, it is possible to "add" or "subtract" the round block M-B-W. Provided that a course can be found which has no bob Before, then bobs at M, B, and W can be added. If the extra M or W causes three calls at this point, then all three are omitted. Alternatively, if there is a bob Before, then bobs at M, B, and W can be subtracted. If there is no bob anyway at M or W, then three bobs are inserted and one removed. Fig 5.11 shows some of the possibilities. The calling to be changed can appear in either column, and the alternative is shown in the other column. Using these alternative callings can add or subtract one or two leads.

M	B	W		M	B	W
1				2	–	1
2					–	1
1		1		2	–	2
1		2		2	–	
2		2			–	

Fig 5.11 Alternative callings for repeating lead methods. Not all of the possibilities are shown.

Fig 5.12 shows four stages in composing a quarter peal of Bristol Surprise Major. No attempt has been made to be musical, and because we are using Bristol which is "clean proof scale", there are no problems with internal falseness. The first quarter peal shown is far too short: the length is three courses plus eight leads (928 changes). To extend it, we have inserted the W-H-W-H round block at the end of the second course. This has made the length right (1280 changes), but the composition is now false (the Middle lead of 4365278 is rung twice). In order to circumvent this, we can use the alternative calling for the first course, which is to "add" calls at M-B-W. This gives three bobs at Middle, so all of these are omitted; and the composition becomes as shown in the third example. Unfortunately, doing this has reduced the length by a lead, and so to restore the length, the M-B-W calling has been added to the third course, and in this case the length is increased by two leads to 1312 changes. You should try writing out these compositions by coursing orders, to see the effect of the inserted calls, and also the introduction and removal of the falseness.

First example

M	B	W	H
2			1
2	–		
1		1	1

Second example

M	B	W	H
2			1
2	–	1	1
		1	1
1		1	1

Third example

M	B	W	H
	–	1	1
2	–	1	1
		1	1
1		1	1

Fourth example

M	B	W	H
	–	1	1
2	–	1	1
1	–	2	1
1		1	1

Fig 5.12 Development of a quarter peal of Bristol Surprise Major.

Composing for Kent Treble Bob follows similar principles, but here there is the added complication of the falseness in the central leads of the course. With other repeating lead methods, a study of the falseness diagram will soon show whether composition will be relatively easy (falseness like Kent – in the centre of the course) or quite difficult (falseness like Belfast – around the course head).

Chapter 6. Composing spliced surprise major.

In the preceding chapter we have looked at the problems of falseness in major methods. Let us now consider how to generate and prove a composition of spliced surprise major. Once again, we need a set of requirements, or an objective to work towards, so let us devise a quarter peal of spliced Rutland, Yorkshire, and Superlative. Because the method names will be used a lot in this chapter, they will be abbreviated to R, Y, and S; and also, course head and coursing order will be abbreviated to CH and CO respectively. We shall try to make the composition an exact two part, and also try to include a reasonable number of –5678 and –6578 roll-ups. We thus need either 20 or 21 leads in each part (giving 1280 or 1344 changes respectively): any more would probably be considered too long for a quarter peal.

6.1 Assembly of the building blocks.

The difference between this composition and the earlier ones we have created is that we have more choice in the structure. For the Yorkshire in the previous section, each lead could only be a plain lead or a bobbed lead. In our proposed quarter peal, each lead can either be plain or bobbed, and also can be R or Y or S. It is a good idea to see what is possible with the plain leads first, and then see how these can be utilised in the composition. Note that although Y and S contain different changes within the lead, the resulting lead ends and lead heads are the same, and so while we consider the structure of the courses, X will be used to signify either Y or S.

Fig 6.1 gives a selection of different spliced courses of R and X. We have not included the courses of 7 leads of R or 7 leads of X – while these can be used, and contain all of the calling positions, they would not be very interesting to ring. This last remark must be examined carefully. In some circumstances, such as a novice band or a novice conductor, a composition with large blocks of the same method would be what is required, but for the most part, bands who are attempting to ring spliced would probably prefer a composition with more variety in the method structure. Fig 6.1 also shows the use that can be made of bobs Before. These give a way of breaking up a full course of (e.g.) R, or obtaining a short course of Y or S.

Methods	Calls			
RXR	M		W	H
XRR			W	H
RRX	M			H
RXXXX	M		W	H
XRXXX			W	H
XXRXX				H
XXXRX	M			H
XXXXR	M		W	H
XX/XX		B		H
RRR/RRR	M	B	W	H

Fig 6.1 Some of the possible spliced courses, with available calls.

For our composition, let us aim for 20 leads per part, and assemble these leads as in Fig 6.2. This also gives a reasonable balance of methods, as we need roughly twice as many X (to split into Y and S) as we do R.

2	of	RXR or RRX or XXR	= 6 leads
2	of	RXXXX etc	= 10 leads
1	of	XX / XX	= 4 leads
TOTAL			= 20 leads

Total per part is 6 of R and 14 of X

Fig 6.2 Proposed usage of courses to get a quarter peal length.

Regarding the structure of the bobs, if we aim to include both –5678 and –6578 roll-ups, we could try a part end of 24365, 43265, or 32465: any of these will give a two part composition. Also, we have used one course of XXXX, which assumes a bob Before after the second lead. This course cannot have a call at M or W.

To get to –6578 roll-ups, we need a coursing order of 6...5 The 6 can be moved to the start of the coursing order by a bob Before (giving CO 65324 from rounds). Then we need to move the 5 to the end of the CO. For this, we could use bobs at HHM or HMM, which lead to COs of 62345 and 63425 respectively. From either of these, we can ring block of three Homes to generate some roll-ups.

Before we design the composition in terms of the methods, it is advisable to stop and remember what we found when composing the 10-course block of Yorkshire. The block in Fig 5.1 was false, because of the courses containing –6578 roll-ups. Yet now we are attempting to compose a spliced composition containing Y, and to include three courses each of –5678 and –6578 roll-ups. It will pay to investigate this particular falseness more closely, to establish where and why it occurs.

In a course of Y, there are five places where roll-ups occur, and between them, they give all of the possible eight roll-ups in the course. (There are eight backstrokes where the treble is in the front four bells, and the tenor is at the back). These are summarised in Fig 6.3. Six are "predictable" roll-ups, in that they are –5678; the other two are not. Ignoring falseness for the moment, the corollary is that three courses with COs 5...6 will generate 18/24 roll-ups, but the remaining 6/24 roll-ups occur one at a time in six more courses. We can see straight away that as a rule of thumb it is more "efficient" to go for 18/24 roll-ups than to seek out the other 6.

2 x -5678 at the course head
2 x -5678 near the end of I
2 x -5678 near the start of W
1 x -4678 near the start of V
1 x -5378 near the end of B

(Letters refer to which lead in the course)

Fig 6.3 Positions of roll-ups in Yorkshire.

The roll-ups around the course head are the first problem, as the falseness diagram shows that the H lead is false against the F lead of 24365. So if we have the first lead of the plain course, we cannot have the lead at the <u>end</u> of the 24365 course; and this lead contains one of the roll-ups we want, i.e. a –6578 roll-up. Also, assuming calls at M,W,H only, a course of Y must start with the H-V-I leads in a block. As we must start with the H-V-I leads of 23456 (the plain course), then we cannot have H-V-I of 24365 (because V is false against I). Thinking of roll-ups, this again precludes the –6578 roll-ups in the 24365 course which are in the I lead. Indeed, six of the seven leads in the (plain) course are false against the 24365 course: the only true lead is the M lead, and this contains no roll-up.

Doing the same type of analysis for R gives us a much more acceptable picture. Six of the eight rollups are in the first and last leads of the course (H and W leads respectively), but the 24365 FCH affects the central three leads in the course (F, I, B).

Putting this together suggests that while we are ringing our musical courses, we would be well advised to have courses of RXR rather than RXXXX. In particular, we can use hardly any of 24365 Y if we use much of 23456 Y (and any courses similarly related).

(Note, this analysis is not complete, as it does not include Superlative. The aim is to show that such an analysis helps to avoid some of the falseness. Also, we are not going to take all of our own advice, as we need a false composition first to demonstrate the point.)

From these thoughts, we can sketch out the composition as in Fig 6.4. In this figure, and some of those that follow, only one part of the two part structure is shown. The oblique lines in the methods signify the positions of the bobs: some composers use a full stop for this.

B	M	H	B	M	H	Methods
65324		63254	-		-	XX / XX /
	63542			-		XXX / XR
	63425	64235		-	-	RX / XXX /
		62345			-	RXR /
		63425			-	RXR /

Fig 6.4 First sketch of composition.

Before starting to prove this composition, we need to decide on how the Y and S will be inserted. For a first guess, we can try substituting Y and S alternately. Doing this gives the arrangement shown in Fig 6.5. In this figure, we have now written out both parts, and converted all COs to CHs ready for checking against the FCH diagrams. The notation used for the methods at the right hand side shows that (taking the first line as an example), from course 23456, we use the H lead of Y, the V lead of S, the M lead of Y, etc.

B	M	H		Leads used from each CH.	
35264		23564	YS / YS /	23456	^{H}Y ^{V}S ^{M}Y ^{W}S ^{B}Y ^{F}S
				35264	^{B}Y ^{F}S
	53462		YSY / SR	23564	^{H}Y ^{V}S ^{I}Y
				53462	^{M}S ^{W}R ^{H}R
	43265	24365	R / YSYS /	43265	^{M}Y ^{W}S ^{B}Y ^{F}S ^{H}Y ^{V}S
		32465	RYR /	24365	^{H}R ^{M}Y ^{W}R
		43265	RSR /	32465	^{H}R ^{M}S ^{W}R
36452		43652	YS / YS /	43265	(included above)
				36452	^{B}Y ^{F}S
	63254		YSY / SR	43652	^{H}Y ^{V}S ^{I}Y
				63254	^{M}S ^{W}R ^{H}R
	23456	42356	R / YSYS /	23456	(included above)
		34256	RYR /	42356	^{H}R ^{M}Y ^{W}R
		23456	RSR /	34256	^{H}R ^{M}S ^{W}R

Fig 6.5 First attempt, with methods selected, and leads written out suitably for proving.

6.2 Checking the composition.

Now comes the task of painstakingly proving each of these leads. For the purpose of this book, we shall dip in to the problem and test the falseness of just one lead, rather than explicitly do all of the necessary work.

Taking the CH 43265, we want to use six leads, one of which is the V lead of S: let us check this lead. Firstly, to check against Y, we must refer to Appendix 7: from this, the falseness of ^{V}S is summarised in the top part of Fig 6.6. (In the rest of this chapter, we have used " ^{V}S " to mean the V (fifths) lead of S, etc.)

All of these are not a problem. For lines 1, 4, and 5 in Fig 6.6, the false course is not used; and for lines 2, 3, and 6, although we make use of the particular course, we do not use the specific lead of Y.

Checking S against R (Appendix 7) gives the falseness shown in the bottom part of Fig 6.6. Again, these are all true. The last line, concerning the same course, and signified by "-P-C-" in Appendix 7, relates to the trivial case that ^{V}S and ^{F}R both have the same lead end.

We must also remember to check for the falseness of S against itself. Appendix 6 shows that ^{V}S is false against ^{I}S of 32465, and ^{V}S of 43265. Remembering that we are testing the V lead of S from course 43265, the falseness diagram shows that this is false against the V lead of S in course 43265 x 43265 = 23456. Unfortunately, this lead is the second lead of the composition: in other words, lead 2 of part 2 is false against lead 2 of part 1.

43265 ^{V}S is false against:-

43265 x 53624 = 63542 ^{F}Y
43265 x 24365 = 42356 ^{I}Y
43265 x 24365 = 42356 ^{B}Y
43265 x 52436 = 64235 ^{V}Y
43265 x 56234 = 65432 ^{V}Y
43265 x 43265 = 23456 ^{V}Y

43265 ^{V}S is false against:-

43265 x 24365 = 42356 ^{M}R
43265 x 52436 = 64235 ^{F}R
43265 x 62534 = 54632 ^{F}R
43265 x 24365 = 42356 ^{I}R
43265 x 52364 = 64352 ^{V}R
43265 x 53624 = 63542 ^{W}R
^{F}R in the same course

Fig 6.6 Specific falseness of the V lead of S against Y and against R.

6.3 A few short cuts.

It is seen that this checking is quite time consuming and tedious. There are a few short cuts available, such as noting that the only leads of R which are used are the H and W leads. Thus when checking the falseness of Y against R, the table given in Appendix 7 reduces to that shown in Fig 6.7. This shows that any M, B, V, or W lead of Y cannot be false against R, and the I lead is only false by the trivial case of arriving at the same place as the H lead of R. This can simplify checking Y against R. Another short cut is in noting that the M lead of Y is not false against any lead of these three methods, therefore all of the M leads of Y are true.

Lead from the plain course of Yorkshire	Lead from false course of R: H	Lead from false course of R: W
23456 H		46325
23456 M		
23456 F	34562	-P-C-
23456 I	-P-C-	
23456 B		
23456 V		
23456 W		

Fig 6.7 An extract from the falseness diagram for Y against R.

The use of an exact two part composition also simplifies the checking. Denoting the two parts by A and B, we need only check A against A and A against B. There is no need to check B against B, as the same leads would be false in part A; nor B against A, for a similar reason. However, even with the short cuts, it still takes quite a time to check.

6.4 Removing the falseness.

The final result of all the checking, after using whatever short cuts are available, is as shown in Fig 6.8. The top part of this figure shows all the false pairs of leads, and the bottom part shows how these relate to the two part structure. It is worth commenting in passing that all of the falseness found relates to the -6578 roll-ups, in that it is the 43265 CH which is false.

^{V}S of 23456 against ^{V}S of 43265
^{W}S of 23456 against ^{B}Y of 43265
^{B}Y of 23456 against ^{W}S of 43265

Lead 2 (S) is false against itself.
Lead 12 (S) is false against lead 13 (Y)

Fig 6.8 Falseness of the proposed quarter peal, described in two different ways.

The first thing which can help us is to note that Y and S are interchangeable, in the sense that they have the same lead end and lead head. Substituting Y for S can thus potentially remove falseness from the middle of a lead of S; however, the newly inserted lead must obviously be tested against the rest of the composition.

We shall start by trying to remove the falseness of lead 2, by changing it from S to Y. The first check is to see whether doing this removes the particular falseness which was found, in other words, to check that ^{V}Y of 23456 is not false against ^{V}Y of 43265. It is not; and when we go on to check this proposed lead against the rest of the composition, no other falseness is found. Thus Y can be substituted here.

We have now deleted one lead of S per part, so let us try to keep the method balance right by substituting S in place of Y at lead 13 to remove the other falseness. Checking first the particular falseness, we look in Appendix 6 to check ^{B}S of 23456 (the new lead) against ^{W}S of 43265. Unfortunately, this is still false. (The reason is that the false changes are the first and second changes of the B lead, and these are the same in both methods.)

What would happen if both of the leads were Y? Appendix 6 shows that ^{W}Y and ^{B}Y are mutually false, but by FCH 24365, rather than by FCH 43265. This suggests that the falseness could be removed by substituting Y at lead 12. Checking for this lead (i.e. ^{W}Y) shows that this does solve the problem, and so we now have a true composition, which is shown in Fig 6.9.

B	M	H	B	M	H	Methods
65324		63254	–		–	YY / YS /
	63542			–		YSY / SR
	63425	64235		–	–	R / YYYS /
		62345			–	RYR /
		63425			–	RSR /

Fig 6.9 Quarter peal composition, after removing the falseness found.

If we look at the composition, it is rather unbalanced: each part contains 6R, 5S, and 9Y. This is because we have changed two of the original leads of S into Y. Before ringing this, it might be worth trying to change two of the leads of Y into S to improve the method balance.

We could try changing the first lead of Y to S; but unfortunately this is false (^{H}S of 23456 against ^{H}Y of 43652). The next guess could be to change the fifth lead. Checking the falseness tables shows that this substitution is true. Another lead which we could try is lead 13. When lead 12 was S, lead 13 was false as either Y or S; but since then lead 12 has been changed to Y. In fact, lead 13 is true as S – in other words, for leads 12 and 13, YX is true, but SX is false.

These two substitutions give the true composition shown in Fig 6.10. This contains 6R, 7Y, and 7S per part, and 17 each of –5678 and –6578 roll-ups. (You might puzzle over where the odd roll-ups come, as we are using COs 5...6 and 6...5 to generate the roll-ups, and these COs generate the roll-ups we want in pairs). There are 23 changes of method: this is lower than it could be, but we lost some of them because of the falseness.

B	M	H	B	M	H	Methods
65324		63254	–		–	YY / YS /
	63542			–		SSY / SR
	63425	64235		–	–	R / YYSS /
		62345			–	RYR /
		63425			–	RSR /

Fig 6.10 Quarter peal composition, after correcting the method balance. This composition is true.

6.5 The "All-the-work" attribute.

"All the work" is usually abbreviated to "atw", and is used to describe compositions where all of the working bells ring all the place bells in each of the methods. In contrast to this, there are some compositions where some of the ringers need to know only one place bell of each method.

Composing an all-the-work composition needs careful planning from the outset, unless the composer is aiming for an (n–1) part composition. In a quarter peal of surprise major, we can theoretically include all the work for six methods (6 methods x 7 leads/method = 1344 changes). But if we examine the quarter peal designed above, it is nowhere near all the work. For example, the tenor only rings 7ths and 8ths place bells of Rutland. Within our design criteria, it would be virtually impossible to achieve all the work. The first problem comes in specifying a two part structure. This means that any bell which returns to its home position at the part head (in our example; 3, 7, 8) must ring all the work in the space of one part. The second problem comes from deciding that we want the composition to be musical as well.

For example, we might try to improve the number of place bells of R rung by ringing the last two courses as RRY/SRR/ but in doing this, we would eliminate four of each of our desired roll-ups. (Apart from this, these courses are false). If we search for the lead of R where the tenor is 2nds place bell, we might use a course called XXRXX, but this course omits the roll-ups at the Middle and the Wrong.

It is easy to appreciate the difficulties, just by glancing through collections of compositions. On eight bells, it can be seen that all the work compositions for peals do not include more than about twelve methods, except for compositions on the seven part plan. Also, the number of crus in such compositions is relatively low.

There is perhaps something to be said for compositions which are "most of the work". This could describe compositions where the composer has made a best effort to include as many place bells as possible, but without sacrificing the music.

6.6 The proof of seven part peals of major.

Reference was made in section 1.12 to the composition style originated by Norman Smith whereby the "all the work" attribute is achieved for eight bells by having a seven part composition, using the leads heads of the plain course as the part heads. We have seen (in section 5.1) that to prove a seven part composition would require that only four of the parts were checked, but there is a significantly easier way.

A seven part composition does not necessarily have to use the lead heads of the plain course as its part heads: for example, a part head of 13456782 will generate a seven part composition. However, if plain course lead heads are used, then the coursing order at the start of each part is as for the plain course. Because of this, the composition can be checked by proving rows. Consider any row X in a part other than the first part. The proving row at the head of the part will be a rotation of 7864235 (the first proving row), and hence the proving row for row X will be a rotation of the proving row corresponding with row X in the first part. A moment's though will show that, if row X in part A is false against row Y in part B, then the proving row for row X in part 1 will be a rotation of the proving row for row Y in part 1. Consequently, all that is required to prove the composition is to check that no two proving rows in the first part only are related by rotation.

As an example of this, Fig 6.11 shows part of a false seven part touch of spliced surprise major. The two main columns show the proving rows of leads 2 and 3, and those marked with asterisks are rotations of each other, and hence signify falseness.

It is easy to see by studying Fig 6.11 that checking for this replication is quite difficult when the rows are presented in this way. For practical use of the technique, it is usually a good idea to devise a system for sorting the proving rows into treble positions, and at the same time to rotate each proving row until a specific number is at the front. Both of these speed up the subsequent checking.

The proposed 7-part composition:

	2345678	Cambridge
-	3578264	Cornwall
	2743658	Cambridge
-	7358264	Bristol
-	5738264	

Proving rows for:-

	Lead 2		Lead 3
1+	4578623	1+	3864257
2+	3687514	2+	4753168
1-	4678523	1-	5643278
2-	3587614	2-	6534187
3+	2678514	3+	5624178
4+	1587623	4+	6513287
3-	2578614	3+	7514286
4-	1687523	4+	8623175
5+	2786413	5-	7613284
6+	1875324	6-	8524173
5-	1786234	5+	7634182
6-	2875143	6+	8543271
7+	1865234**	7-	8534162
8+	2756143**	8-	7643251
7-	3865142	7+	8652341**
8-	4756231	8+	7561432**
8+	3657142	8-	7652341
7+	4568231	7-	8561432
8-	4657321	8+	7461523
7-	3568412	7+	8352614
6+	4578321	6-	8451723
5+	3687412	5-	7362814
6-	2578413	6+	8253714
5-	1687324	5+	7164823
4+	2786315	4-	8265713
3+	1875426	3-	7156824
4-	2785316	4-	6157823
3-	1876425	3-	5268714
2+	1785436	2+	6357814
1+	2876345	1+	5468723
2-	1786435	2-	4578613
1-	2875346	1-	3687524

Fig 6.11 Proving rows for a false seven-part touch of spliced surprise major.

Chapter 7. Stedman.

Stedman is a bit of an oddity in change ringing at the present time, as it is the only principle which is rung frequently in peals. The problems of composition and proof of principles are quite different from those of treble dominated methods, and so a chapter devoted to Stedman will highlight a few new tricks.

Stedman is commonly rung on all odd numbers of bells, and the problems presented at each stage are quite different. Most of this chapter will be devoted to Stedman Caters, on the grounds that this will show nearly all of the tricks referred to above. Stedman Cinques uses nearly the same principles of composition and proof as Caters. Triples is a special case, in the sense that the requirement here (as in minor) is to fit together the jigsaw which forms the extent. But first, we shall take a look at Doubles.

7.1 Stedman Doubles.

The plain course of Stedman Doubles is 60 changes. A moment's thought will show (a) that all of those changes are in-course rows, as two pairs of bells change between each consecutive pairs of rows, and hence (b) that the plain course contains all of the in-course rows. We might pause to check if these 60 changes are mutually true – with so few a manual check for duplicated changes is possible, but let us try to be a little more scientific!

The 60 changes divide into ten "sixes". A "six" in this chapter (from now on written without the quotation marks) is either of the two basic building blocks of Stedman, being the six changes during which a particular group of three bells ring the plain hunt on the front. The plain hunt is either forwards or backwards, and the six is known as quick or slow respectively, corresponding with whether the bell which enters the front at the start of the six rings quick work or slow work. In any six, the bells on the front (a, b, and c) ring in all possible orders, and if we denote the remaining two bells by d and e, then half of the (abc) combinations are followed by (de), and the other half are followed by (ed). Now let us look at it from the point of view of the two bells at the back. If, for a particular six, we pick the two bells which are at the back, then (obviously) the remaining three bells must be at the front. This means that the six is effectively characterised by which bells are at the back. Once we have chosen these bells (d,e), then the six will generate three rows with (de) behind, and three rows with (ed) behind. In the plain course, these rows must all be in-course. The particular three rows of each type are defined exactly, as three of the six possibilities from the plain hunting of (abc) will generate in-course rows, and the other three will generate out-of-course rows. (Try it, on any bells chosen from the five, and see for yourself). Thus it should now be obvious that a six in Stedman Doubles is fully characterised by the two bells which are behind, and the parity of the six.

In the plain course, we can now see that if a pair of bells is chosen to be at the back for a six, then this six will generate all possible in-course changes: three with the back bells in one order, and three with those bells reversed. Hence the problem of proof of the plain course reduces to checking that all of the sixes have a different pair of bells at the back of the change. This is easily seen to be so by inspection. The 60 in-course rows are from the plain course; and the 60 out-of-course rows also make a course which is complete in itself. Thus the problem of generating the extent is only to find a means by which we can enter the out-of-course block, then return to the in-course block where we left it. The fact that we are trying to enter the block of out-of-course changes means that the call required must allow only one pair of bells to cross (so the parity is reversed), and hence that three bells lie still.

7.2 Stedman Triples.

This is a very different area. The task is the same as Doubles – to connect all 5040 changes together using the principle as a building block, with appropriate calls. However, there is a new problem here. Although the length of the extent is an exact multiple of the length of a plain course (i.e. 84 x 60 = 5040), there does not exist a set of 60 courses which between them contain all of the changes.

Unfortunately, in this book there is not the space to discuss this, and so at this point we shall draw a veil over this problem, and suggest that interested composers refer to the excellent text on the subject in "Stedman" (see bibliography). In this work, there is an appendix, written mainly by Sir A. P. Heywood, entitled "Investigations into the construction of peals of Stedman Triples". Here the author traces the development of the extent of Stedman Triples, and shows how the problem can be resolved by the use of Hudson's course ends. These days, there are also many compositions of Stedman Triples based on other plans.

7.3 Stedman Caters – general comments.

Most of this chapter is devoted to the Caters stage of Stedman. This is because this number of bells in Stedman gives a chance to examine in detail some composer's tricks which are not really found anywhere else. Working with Stedman Caters divides into two distinct parts – composition and proof. As the calls come so frequently, there are many more possibilities for composition than normal, and hence the composer has a much more free choice as to which changes are used. Let us start with a look at the construction of touches and building blocks, and then as a separate exercise set about constructing a composition of our choice.

It is normal in Stedman Caters to think in terms of courses, with a course being eighteen sixes. At the end of such a unit, about half of the bells return to the same point, and the other bells are transposed in some way. Usually the fixed bells are the back bells, in a musical combination. For example, in the tittums position, the back bells can be fixed as –6978 or –56978 or –6.978 or –65978. The last gives the first six as –5.7689, and the second six has the tittums sound of –7.8.960. Within such a framework, there are various places where calls can be made without affecting any of the fixed bells. If the back four bells are to be kept fixed, then any call may be made at 4 or 15; and singles may be called at 6, 8, 11, 13. (As mentioned in section 1.6, these numbers refer to the calling positions within the course, where a call at "1" takes effect one change after the end of the previous course: this is the first change of the first full six.) Thus there are 144 ways to call a course which has the back four bells unaffected (3x3x2x2x2x2). To this can be added callings which affect some of the back four bells, but which return them to their original place: here are some examples, starting in the plain course.

(a) 1S,12S crosses 7 and 8 at the first single, but crosses them back again at the second single: similarly for 7S, 18S.

(b) 3S,14S crosses 1 and 7 at the first single and crosses them back at the second; however, if we are only interested in keeping the 7 fixed, then the single at 14 can be replaced by a bob. Thus the overall effect of 3S, 14 is to affect the 7, but return it to its home position, and also to cross 1 and 3.

(c) 3S,4S,11S,14S acts as follows: swap 1–7, swap 2–5, reset 2–5, reset 1–7. This can be varied by substituting bobs for the two singles at 3 and 4, and by noting that a bob at 14 will also return the back bells to their original positions.

(d) 6, 8S, 16 acts as follows: at 6, the 6 takes over the work of the 3 (and 2,3 are disturbed); at 8S, the 6 takes over the work of the 4 (and the 4 is disturbed, but the 9 is unaffected at the back); at 16, the 6 returns to its own place (and 1–4 are disturbed). Again, the effect is that the back five bells are in the same place at the end of the course.

(e) Some of these combinations work together, in that the affected bells do not overlap. For example, 6,8S,16 can be combined with 1S,12S, and 2S,9S to give (with slight modification) 1,2,6,8,9,12S,16. All the back bells return to their home place.

We have managed to do all this within a framework of eighteen sixes, but it is also possible to devise blocks with a different length which keep the back bells fixed. One possibility which keeps the back four bells fixed is to have calls at 5,7,10,12. In this course, each of the big bells turns round in sevenths after leaving the front for the first time, thus omitting two sixes: the course is shortened to sixteen sixes.

Apart from the courses where the back bells are fixed, compositions usually include one or more "turning courses". This phrase is used to denote a course which is designed to change the back bell combination – to "turn" them from one position to another. An example is a course designed to move from tittums to handstroke home. It is quite common to use this course to shuffle the little bells as well, so that they are in a suitable position for calling regular blocks afterwards. A third use of turning courses is in obtaining a particular length of composition: it is possible to arrange any desired length for a quarter or a peal of Stedman, by varying the start position and the finish position. For example, with a normal start, the lengths available are shown in Fig 7.1.

Finish with rounds as:	Length
1st row of slow six	12n + 3
3rd row of slow six	12n + 5
1st row of quick six	12n + 9
2nd row of quick six	12n + 10
4th row of quick six	12n

Fig 7.1 Lengths available for Stedman.

7.4 Design of a quarter peal.

Let us take an example of a quarter peal of Stedman Caters, try to see why it is what it is, and then check the truth of it.

Some quick arithmetic shows that we need 12 courses for a quarter peal, which will give a length of 1296. We decide on the plan shown in Fig 7.2. For the "simple courses", the simplest choice is to use a bob at a place which will affect three bells only (i.e. give a round block of three courses): such as a bob at 15. Also, the design shown can use two very simple turning courses, as the opening course can just be a bob at 1, and course (d) can be a single at 1. The skeleton structure thus becomes as shown in Fig 7.3, left and centre columns. Finishing with a course end of 134265879 brings up rounds three changes later.

	231456789
Turning course (a)	56978
2 simple courses	
Turning course (b)	65978
2 simple courses	
Turning course (c)	65789
2 simple courses	
Turning course (d)	65879
2 simple courses, finishing with	134265879

Fig 7.2 First design of quarter peal.

Looking at this design suggests that the composition can be made a lot simpler (and hence more elegant) if the little bells are formed into a regular pattern for the whole quarter, i.e. in each part the little bells are in the same place at corresponding course ends. This refines Fig 7.3 as shown in the right hand column.

1	15	231456789	231456789
- ?		.abc56978	123456978
	-	.cab56978	1423
	-	.bca56978	1342
?		.def65978	123465978
	-	.fde65978	1423
	-	.efd65978	1342
?		.ghi65789	123465789
	-	.igh65789	1423
	-	.hig65789	1342
S ?		123465879	123465879
	-	142365879	1423
	-	134265879	1342

Fig 7.3 Second design for quarter peal.

The problem of the first course is to transpose 1, 2, and 3 to the required position; this can be done (by experiment with pencil and paper) by bobs at 1,5,7,8,9,10,11,12,13; which gives a short course of 16 sixes. The second turning course (b) needs to cross 5 and 6, together with the "normal" transposition of 234; this can be achieved by singles at 2,7,9 to cross 56, and a bob at 15 to transpose 234. The third turning course (c) needs to turn ..978 to ..789, while transposing 234 as before: a possible solution is 2,9S,12S,15. The composition thus becomes as shown in Fig 7.4.

	15	231456789	Parity
(a)		123456978	+
	2	134256978	both +
2s 7s 9s	-	123465978	mixed
	2	134265978	both -
2 9s 12s	-	123465789	mixed
	2	134265789	both -
1s	-	123465879	mixed
	2	134265879	both +

(a) is 1,5,7,9,10,11,12,13

Fig 7.4 Third design of quarter peal.

7.5 Proof of the quarter peal.

So much for composition: we now have the problem of how to prove this offering. Let us go back to the notes about Doubles, and try to get some clues. In Doubles, two pairs of bells are changed between consecutive rows, and the only exception to this is at the singles. Consequently the changes stay in-course until a single is called, and are then out-of-course until a second single is called. The same is true in Caters. Four pairs of bells change between each pair of rows, both in the method itself and also at bobs. Because of this, all of the changes will be positive rows; and this will continue until a single is called. At a single, three pairs of bells cross, and the changes become out-of-course until a further single is called.

This can be used to advantage in compositions with only a few singles. Looking at the proposed quarter peal composition, courses 1,2,3,11,12 are completely in-course, and therefore must be completely true against courses 5,6,8,9 which are completely out-of-course (See Fig 7.4). The other three courses are a mixture, but the changes they contain can be divided into in- and out-of-course. It is worth while looking at these division points, as in this composition they are a great help in proving the truth.

(a) The opening course is all positive, and can be considered to "end" after the bob at 12 when the back five bells come into the –56978 position.
(b) The –56978 position is all positive, and continues until the single at 2 in the fourth course.
(c) From 2S to 9S in course 4 is a mixture of parities, and needs further investigation.
(d) From 9S in course 4 the back bells are in the –65978 position, and all the changes are positive until the bob at 2 in course 7.
(e) From 2 to 12S in course 7, the parities are mixed, and the course needs further investigation.
(f) From 12S in course 7, the back bells are in –65789, and the parity is negative: this continues until the 1S in course 10.
(g) At this point, the parity changes to positive, and the back bells are fixed in –65879 until the end of the quarter peal.

We can thus see that in this composition none of the changes from a –65789 course end can repeat with any changes from a –65879 course end – this is because of the parities of these blocks. However, we must also check that for each of the two course end types, the changes within the block of courses are true. (This might seem trivial, but nevertheless we should show that it is the case).

In Doubles, we noted that a six could be characterised by the pair of bells at the back together with the parity of the six. The same applies to Caters: the six is defined by the three pairs at the back of the change, together with the parity. The six digit row formed by the bells in places 4 to 9 inclusive is known as the "characteristic" or "K" of the six, and only needs the parity added to define the six changes fully. (See the top part of Fig 7.5.)

```
+   231456789    P
+   324165879
+   342618597    S   K is 618597+
-   436281597
-   346825179    B   K is 825179-
-   438652197
-   483561279        K is 561279-

    634825179    }
    364281597    }   This six is
    346825179    }   false against
    436281597    }   the second
    463825179    }   six above.
    643281597    }
```

Fig 7.5 Examples of characteristics, and a false six.

However, there is a pitfall. If the K's are taken in each case as the last row of the six, then consider what happens if we start as in Fig 7.5, but later the slow six is rung which is shown at the bottom of that figure. The K of this six is 281597–, which does not appear in the top part of the figure, but it is easy to see by inspection that the changes are the same as those of the six after the single. Obviously, we need to beware of ringing the six with the three pairs of bells in the K reversed. In other words, if the parities agree, a K of abcdef is false against a K of badcfe. The two K's of abcdef and badcfe can be considered as complementary.

There are two ways to allow for this in proving. The first way is to search for each K as it stands, and also as its complement. The second way is to define a convention for the K's, such as "each K must be written with the larger of the two bells in 89 last". The second way is usually more efficient. The K's for the plain course thus become as shown in Fig 7.6.

Six end	K
231456789	
342618597	165879
346829175	281957
483967251	692715
489735612	735612
874591326	591326
875142963	419236
718256439	256439
712683594	865349
167329845	329845
163974258	974258
691435782	347528
694518327	518327
956842173	481237
958267431	624713
529783614	783614
527391846	391846
235174968	174968
231456789	456789

Fig 7.6 K's of the plain course.

To prove the truth of a block of three courses joined by three bobs at 15, such as courses 10, 11, and 12, we need to do two things. Firstly, check that all the K's in the plain course are different. They are, which proves that the plain course is true! Secondly, check that all 54 K's which result from the plain course plus the other two courses which can be joined to it by three bobs at the same place in each course are different. This could be done by writing out all 54 K's and mutually checking them, but it is easier to prove as follows. If falseness occurs, it must be at a place where the six unaffected bells form the K for the two false sixes. At any other place, one or more of the three bells affected by the bobs must be in the K, and hence as these bells are rotated between the three courses the K's must be different. For example, if the bobs affected 789, course 1 might contain a K of 617238: courses 2 and 3 would then have as corresponding K's 618239 and 619237. These are different, and hence falseness cannot occur. But if 789 were all in the frontwork at the same time, the K's would be the same as the other bells are fixed.

The proof of the block of three courses depends on the fact that when a bob affects three bells at the back, those three bells are never all in the frontwork together. (This is in contrast to Erin, which explains why (a) compositions of Erin do not have courses with only one bob, and (b) there is a trivial touch of Erin which is to call a bob when the 2 makes the bob.)

The foregoing discussion has proved quite a lot of the composition. For example, all of the second half of the composition is true, after the single at 12. This is either because of the parity check, or because of the mutual truth of a block of three courses as described above. In the same way, courses 2 and 3 are mutually true, as are courses 5 and 6.

What about the rest of the composition? The remainder of the checking can be divided into three sections.

(a) Proving the -56978 block (courses 2 and 3) against the -65879 block (courses 10, 11, 12), as all these are positive changes.
(b) Proving the -65978 block against the -65789 block, as all these are negative changes.
(c) Proving the "odd bits" against themselves, each other, and the rest of the composition. "Odd bits" includes course 1 up to the bob at 12 (because after this point the bells are in a part of the -56978 course), course 4 from 2S to 9S, and course 7 from 2 to 12S.

Six ends	K's	K's	Six ends
....56978	.56978	.65879	65879
...6.7589	6.7589 **A**	.56789 **E**	...5.7698
..67.8.95	.7.859 **B**	.7.968	..57.9.86
.7.869.5.	68.9.5 **C**	59.8.6	.7.958.6.
.789.56..	9.56.. **D**	.856..	.798.65..
79.58...6	58...6	69...5	78.69...5
795...86.	..8..6	..9..5	786...95.
9.7.56..8	.56..8	.65..9	8.7.65..9
9..67.58.	765..8	756..9	8..57.69.
.69..87.5	..87.5	..97.6	.58..97.6
.6.89..57	89..57	98..67	.5.98..67
68...597.	..95.7	..86.7	59...687.
68.5.7..9	5.7..9	6.7..8	59.6.7..8
8567...9.	.7...9	.7...8	9657...8.
857.69...	6..9..	5..8.. **F**	967.58...
5.897.6..	97.6..	87.5.. **G**	6.987.5..
5.9.8.7.6	.8.7.6	.9.7.5	6.8.9.7.5
..5.9.867	.9.867	.8.957	..6.8.957

Six ends	K's	K's	Six ends
....65978	.65978	.65789	65789
...5.7689	5.7689	.56879	...5.8697
..57.8.96	.7.869	.8.967	..58.9.76
.7.859.6.	58.9.6	59.7.6	.8.957.6.
.789.65..	.956..	.756..	.897.65..
79.68...5	68...5	69...5	87.69...5
796...85.	..8..5	..9..5	876...95.
9.7.65..8	.65..8	.65..9	7.8.65..9
9..57.68.	756..8	856..9	7..58.69.
.59..87.6	..87.6	..98.6	.57..98.6
.5.89..67	89..67	97..68	.5.97..68
58...697.	..96.7	..76.8	59...678.
58.6.7..9	6.7..9	6.8..7	59.6.8..7
8657...9.	.7...9	.8...7	9658...7.
867.59...	5..9..	5..7..	968.57...
6.897.5..	97.5..	78.5..	6.978.5..
6.9.8.7.5	.8.7.5	.9.8.5	6.7.9.8.5
..6.9.857	.9.857	.7.958	..6.7.958

Fig 7.7 Characteristics for the four main positions of the back bells. The two in-course positions are shown first, followed by the two out-of-course positions.

7.6 The use of skeleton courses.

Let us compare the K's resulting from the -56978 block with those from the -65879 block, but writing out the courses and K's in skeleton form, using numbers for 56789 (which are fixed bells), and dots for the other four bells. The K's for these skeleton courses are shown in the top centre part of Fig 7.7, and it is quite quick to check these for any duplication. As all of these K's are different, it proves that the changes from any course headed by -56978 can never repeat with changes from a course of the form -65879: this is true irrespective of the parity of the rows.

This trick with skeleton courses can also be applied to checking the -65978 block against the -65789 block, and the K's for these positions are given in the bottom part of Fig 7.7.

7.7 Checking the turning courses.

To prove the remainder of the quarter peal, we must write out all of the K's for the turning courses, which are courses 1, 4, and 7. Although course 10 is also a turning course, all of this course has already been proved, as all of the sixes in it are either a part of the -65789 block or a part of the -65879 block: this is because the bells are moved from one position to the other by means of a single call. Fig 7.8 shows the skeleton K's for courses 1, 4, and 7. Several parts of these courses have been proved already, in that some K's are a part of one of the other four blocks which have been examined in detail. The other K's need to be checked.

	231456789	.56789 +	E		134256978		Part of		134265978		Part of
-	342617589	6.7589 +	A		321647589	6.7589 +	} 56978	-	321547689	5.7689 -	} 65978
	346728195	.7.859 +	B	S	326715498	.7.589 -			325716489	7.6.89 -	
	473869251	68.9.5 +	C		273569184	65.9.8 -			273658194	56.8.9 -	
	478935612	9.56.. +	D		275938641	.968.. -			276839541	.859.. -	
-	794586312	85.6.. +			792854316	85...6 -			782964315	96...5 -	
	795641823	6..8.. +			798421563	..5..6 -			789421653	..6..5 -	
-	967158423	5..8.. +	F	S	947185236	.85..6 +			847195236	.95..6 -	
	961872534	87.5.. +	G		941573862	758..6 +			841573962	759..6 -	
-	689215734	..57.. +		S	459318726	..87.6 -	} Part	S	458319726	..97.6 +	
-	682597134	95.7.. +			453892167	89..67 -	} of		453982167	98..67 +	
-	856721934	7..9.. +			584236971	..96.7 -	} 65978		594236871	..86.7 +	
-	857169234	6..9.. +	} Part		582647319	6.7..9 -	}	S	592648317	6.8..7 -	} Part
-	518972634	97.6.. +	} of		865721493	.7...9 -	}		965821473	.8...7 -	} of
	519283746	.8.7.6 +	} 56978		867159234	5..9.. -	}		968157234	5..7.. -	} 65789
	125394867	.9.867 +	}	-	618972534	97.5.. -	}	-	619782534	78.5.. -	}
	123456978	.56978 +	}		619283745	.8.7.5 -	}		617293845	.9.8.5 -	}
					126394857	.9.857 -	}		126374958	.7.958 -	}
					123465978	.65978 -	}		123465789	.65789 -	}

Fig 7.8 Six ends and characteristics for courses 1, 4, and 7, in that order. Note that in course 1, we have included the six with K 456789: this is really the last six of course zero, but it still needs checking.

The first 12 sixes of course 1, which are all positive K's, must be checked against:-

(a) each other.
(b) two K's from course 4.
(c) three K's from course 7.
(d) the -56978 K's.
(e) the -65879 K's.

If this is done for these skeleton K's, no falseness is detected for the checks designated (a), (b), or (c). However, check (d) finds four false sixes - those labelled ABCD, which can be found among the K's for courses 2 and 3, the -56978 block. (See Fig 7.7). Check (e) finds three false sixes (EFG), which repeat against K's found in the -65879 block.

Course 1		Courses 2,3		Courses 10,11,12	
.56789	E			.56789	E
617589	A	6.7589	A		
.71859	B	17.859	B		
68.915	C	6819.5	C		
.965.1	D	9.56.1	D		
51.8..	F			51.8..	F
87.5..	G			87.5..	G

Course 1	Course 10	Course 11	Course 12
456789 *E	456789 *	356789	256789
158423 *F	158234	158423 *	513824
872534 *G	785324	872534 *	874523

Fig 7.9 (Top) K's for the falseness found in course 1, with the position of the treble included. (Bottom) The same K's with all bells shown.

We need to think much more carefully. Fortunately, in this composition, the treble also is fixed for the last eleven courses, and so we can make our skeleton K's for these potentially false courses even more characteristic by adding in the treble. If we do this for the seven pairs of potentially false K's, the result is as shown in the top part of Fig 7.9. In this figure, the dots now represent one of the three bells 2, 3, or 4. This shows that there is no falseness between course 1 and courses 2,3 (the K's denoted by A,B,C,D): but has highlighted the K's marked E,F,G for even more scrutiny.

It is now time to give up this time saving idea of skeleton courses, and write out the K's concerned in full. These are given at the bottom of Fig 7.9, where we have written out the K's for all of the relevant courses separately.

Our worst fears are founded. Three false sixes have been found; those with the K's 456789, 158423, 872534. Worse than that – the sixes with the K of 456789 both contain rounds – one is at the start of the composition, and one is in the tenth course! This error (or howler) is caused by not noting correctly that when Stedman is brought round in the handstroke home position, the rounds is not at the end of a course: it is actually in the first six of the next course. This can perhaps best be seen by writing out Stedman with the traditional start (see Fig 7.10), but starting from the row 413265879. Calling position 1 is just after the start, but rounds occurs three changes into the next six. The row which is written as the course end is 134265879.

413265879
143628597
134265879
312456789
132547698
123456789

Fig 7.10 The normal start for Stedman, but from a different row.

This is probably the best place to put in the warning about turning courses. They are always the Achilles' heel of a traditional Stedman composition: it is quite easy to check for the truth of a block of changes where a number of bells are fixed; but because turning courses are designed to affect the fixed bells, there is quite a high risk of falseness. In this example, seven of the twelve sixes which form the first turning course have shown the potential of falseness.

It is also worth noting in this composition that as rounds does not occur until after the twelfth course end, we should also prove the first six of course 13: this is the one which contains rounds, and it should be carefully checked against the first six of the quarter peal. An example of the possible pitfall is exemplified by the touch 1,2,3S,7,8,9,10,12,14,17S: write out the first and last sixes of this touch in full to see the problem.

	Course 1		K's; parity	
	231456789	E	.56789	+
-	342617589		6.7589	+
	346728195		.7.859	+
	473869251		68.9.5	+
	478935612		9.56..	+
-	794586312		85.6..	+
S	795643821		6..8..	-
-	967358421	F	5..8..	-
	963872514	G	87.5..	-
-	689235714		..57..	-
-	682597314		95.7..	-
	856721943		7..9..	-
S	857169234		6..9..	+
-	518972634		97.6..	+
	519283746		.8.7.6	+
	125394867		.9.867	+
	123456978		.56978	

Fig 7.11 Revised calling and K's for the first course.

7.8 Removing the falseness.

How can we get round the falseness? First, let us remove the falseness between courses 1 and 11. As one of the courses concerned is a turning course, we can make use of the fact that there are often many different callings for a turning course which have the same effect. Inspection of the figures for course 1 (Fig 7.8) shows that bells 1 and 3 can be crossed by a single at 6, and then crossed back by omitting the bob at 11, and ringing a single for the bob at 12. The effect of this is shown in Fig 7.11. Doing this changes the parity of all the sixes between the two new singles; and hence the false K's marked F and G are now negative K's. In this way we can avoid the falseness we found, even though the skeleton K's using the back five bells are the same. However, the new calling now contains six K's with negative parity, which must be checked against the out-of-course block: this is done below.

The second problem is the early arrival of rounds in the tenth course: this is embarassing, but not insuperable. As we saw earlier, the touch 1S, 12S is a round block. Hence the single at 1 in the tenth course (which crosses 7 and 8) can be replaced by a single at 12, as this crosses the same pair of bells (see Fig 7.4). The first eleven sixes of course 10 now belong to the (out-of-course) –65789 block, and can thus be proved as a part of it. Of the course headed by 134265789, the first eleven sixes are now rung at the start of course 10, and the sixes numbered 12 to 14 are rung in course 7. For the course headed by 134265879, which was the one which caused the trouble, we now ring only sixes 12 to 14 in course 10, sixes 15 to 18 in course 12, and six 1 (which has the rounds) in course 13. The false six has now been removed.

Now, to continue checking the turning courses. The eighth and ninth sixes of course 4 (positive K's) must be checked against:

(a) Each other.
(b) Six K's from course 1. Already checked.
(c) Three K's from course 7.
(d) The –56978 K's.
(e) The –65879 K's.

For all of these checks, no falseness is found. The tenth to the twelfth sixes of course 7 are also positive, and must also be checked in the same way, against:

(a) Each other.
(b) Six K's from course 1. Already checked.
(c) Two K's from course 4. Already checked.
(d) The -56978 K's.
(e) The -65879 K's.

Checks (b) and (c) have already been done, and checks (a) and (d) are satisfactory. However, check (e) shows that all of the K's we are examining in course 7 also appear in the -65879 block. Once again, we need to look at the full K's, and these are shown in Fig 7.12.

Six no.	K for this six in the courses numbered: -7-	-10-	-11-	-12-	-13-
10	319726	N.R.	219746	419736	N.R.
11	982167	N.R.	984167	983167	N.R.
12	328617	N.R.	248617	438617	N.R.

(N.R. signifies not rung in the -65879 block

Fig 7.12 Full K's for the duplication found between course 7 and the skeleton K's for courses 10 to 13.

"Not rung" in the column for course 13 signifies that although there are some changes from the -65879 block rung in course 13, rounds occurs before we get to the tenth six. "Not rung" for course 10 is a narrow escape: in course 10, we actually enter changes from the -65879 block after the new single at 12; before this, the changes are part of the 65789 block.

At this point, all of the positive changes have been tested and proved true; it only remains to check the out-of-course pieces of the turning courses. From the revised version of course 1 (which is shown in Fig 7.11), there are six K's to check, against:

(a) Each other.
(b) Five K's from course 4.
(c) Seven K's from course 7.
(d) The skeleton K's of the -65978 block.
(e) The skeleton K's of the -65789 block.

2	7	9	12	15	231456789
		(a)			123456978
				2	134256978
S	S	S		-	123465978
				2	134265978
-		S	S	-	123465789
				2	134265789
			S	-	123465879
				2	134265879

(a): 1,5,6s,7,9,10,12s,13

Fig 7.13 Revised (and true) quarter peal of Stedman Caters.

All these are true. In a similar manner, the five out-of-course K's from the centre of course 4 and the seven remaining K's from the centre of course 7 are all proved to be true.

To summarise, Fig 7.13 shows the revised composition. This is true: proved by hand as above; and also proved by computer, although you must be trustful on that score!

7.9 More on skeleton courses.

In the proof of the quarter peal, we showed first that three courses connected by three bobs at the same position will always be mutually true. After this, we used skeleton K's to demonstrate the truth of the -56978 block against the -65879 block. While this procedure fulfilled our need, it is not a complete story.

The argument presented did not address the problem of proving a longer block in any one position, such as the -56978 position. It might be inferred from the work on the skeleton K's that while the back five bells are fixed, then all of the 24 possible courses will be mutually true. However, this is easily shown to be incorrect, by considering two course ends such as 432156978 and 324156978. The last sixes in these two courses contain the same changes, but in a different order. Also, consider the course ends 432156978 and 312456978: these courses are false because the first sixes in each course contain identical rows (K's are 627589).

In Fig 7.14, the first and second sixes from the -56978 course are shown. The top six has the K 6.7589, and has none of the fixed bells in the frontwork: the bottom six has the K .7.859, and has one of the fixed bells in the frontwork. In the top six, the four missing bells can be completed in 24 ways, but these fall into 8 groups of 3, where the same changes are found within each group of 3. The groups correspond with a set of three bells being fixed on the front, with a fixed parity. For example, the sixes headed by 123465798, 231465798 and 312465798 are one such group of three, and all contain the same six changes.

On the other hand, in the bottom six, the four missing bells can be completed in all 24 different ways, and the resulting 24 sixes are all mutually true.

Consequently, if we are careful in the design of the skeleton courses, it is possible to prove large blocks of courses by making them conform to particular skeleton patterns. Fig 7.15 shows the skeleton six ends for a course in the tittums position with the bell in seconds place fixed as well as the bells in 789 (but not this time fixing bells in 56). It is seen that fixing these bells provides that in all 18 sixes there is at least one of the fixed bells at the front. We can also see that all of the K's from these six ends are different; although we must be careful to check for the complementary K's (see section 7.5). It is interesting to note that only the bell in seconds place will do: if any of the other bells apart from 789 is used, then at least one six in the course will have no fixed bells in the front work.

```
... .65798
... 6.7589
... .65798
... 6.7589
... .65798
... 6.7589

..6 .7.859
.6. 7.8.95
6.. .7.859
6.. 7.8.95
.6. .7.859
..6 7.8.95
```

Fig 7.14 Two consecutive skeleton sixes from the -56978 course.

By doing this, we have shown that no matter how we complete the five missing bells, all courses with the back three bells in a fixed position and the bell in seconds place also fixed are mutually true. This is equivalent to having proved a 120-course block of Stedman Caters (12960 changes). Calling positions 4, 5, 11 (S only), and 16 are available to move the remaining five bells as required.

Obviously the 120 courses of handstroke home with a bell fixed in seconds place are also mutually true. Further work (which is left to the reader) will soon show that these changes are true against the tittums position, that is to say that if the same bell is kept fixed in seconds place, then all 240 of the .x....978 and .x....879 courses are true.

This is the reason that so many of the older compositions of Caters keep a bell fixed in seconds place through nearly all of the peal.

```
.2. ...978
2.. ..7.89
2.. 7.8.9.
.72 8.9...
.78 92....
79. .8.2..
79. ...8.2
9.7 ....28
9.. .72.8.
..9 2.87..
..2 89...7
.8. .2.97.
.8. ..72.9
8.. 7...92
8.7 ..9.2.
..8 972...
..9 28.7..
.2. .9.8.7
```

Fig 7.15 Skeleton six ends for the 978 position, with 2 fixed as well.

7.10 Stedman Cinques.

The principles outlined above can also be applied to the proof of Stedman Cinques. The notable difference is that in Cinques, alternate rows are positive and negative, except when a single takes effect. This implies that there is nothing to stop duplicate rows appearing on opposite sides of the singles. We must rethink our strategy or convention used for checking the K's, and there are two possible ways to proceed.

Firstly, note that for each six, the first row (six head) and the last row (six end) will always have opposite parities. Until a single is called, it is the six ends which are positive: after an odd number of singles, the six heads are positive. We can devise a convention that we shall always write down whichever of these is the positive row. If this is done, then the two sixes for which the K's are related by the transposition badcfehg are the pair which contain the same "roll-ups"; but these will have the alternate set of six combinations at the front. An example of two such sixes is shown in Fig 7.16. Using this procedure, the checking of a composition reduces to checking the mutual truth of the "in-course K's" of each six, where these are defined to be the K's of the in-course ends of all the sixes. In the example shown, this would be 65872143 for the top six, and 56781234 for the bottom six.

```
E09 56781234  -
E90 65872143
9E0 56781234
90E 65872143
09E 56781234
0E9 65872143  +

90E 56781234  +
09E 65872143
0E9 56781234
E09 65872143
E90 56781234
9E0 65872143  -
```

Fig 7.16 Two example sixes which have the same "roll-ups".

This is quite different from Caters, where the problem is that a six can reappear in reverse, but it is difficult to spot this because the changes at each end of the six are the same parity (see section 7.5). However, in Caters, there is the benefit that the in-course and out-of-course sections can easily be split, and proved independently.

The other way to proceed is as follows. We can decide to use only the K's for the six ends. If we do this, some will be positive and some negative, and we need to record this information along with the K's. The checking now needs to include a search for the complementary K, which is the K related by the transposition badcfehg, and also is of opposite parity.

This second procedure makes it easier to prepare the rows for checking (as we always use the six-ends), but harder to check (in that the search needs to be more comprehensive). Also, in a composition which uses blocks of courses with a number of bells fixed, such as a long tittums block of the form ......78E90, this procedure makes it easier to use skeleton courses as was used for the example quarter peal of Caters.

In common with Caters, it is possible to devise a skeleton course for Cinques where careful choice of the fixed bells makes it possible to create blocks of ringing where only the course ends need checking. Once again, the key to this is that the bell in seconds place must be fixed, and hence there are a lot of available compositions of Stedman Cinques with this characteristic. It is left to the reader to find out how many other bells must be fixed, and also how many different back bell positions are mutually true to each other.

In order to show an example of a sensible length, we have used the fact that Stedman Cinques behaves the same as Stedman Triples: alternate rows are positive and negative, and so the reasoning described above is equally applicable. Fig 7.17 shows a short touch of Stedman Triples, which is designed to be false. The touch itself is shown as the left hand column. The centre column shows the K's for the in-course ends of all the sixes. To generate these, all of the K's are copied across, but those between the two singles are first transposed by badc. For clarity, these are shown in **bold**. The falseness is detected as the K 6271 appears twice.

	Six ends	K's for the in-course end of each six	K's of all the six ends, with parities
	<u>2314567</u>		
-	3425167	5167	5167 +
	3456271	6271 **	6271 + **
-	4632571	2571	2571 +
	4627315	7315	7315 +
	6741253	1253	1253 +
-	6712453	2453	2453 +
	7265134	5134	5134 +
	7253641	3641	3641 +
	2374516	4516	4516 +
S	2345761	**7516**	3267 +
	3526417	**4671**	2567 +
-	3564217	**2471**	5367 +
-	5432617	**6271** **	3467 +
	5421376	**3167**	4567 +
S	4153267	3267	
-	4132567	2567	**5761** -
-	1245367	5367	**6417** -
-	1253467	3467	**4217** -
	2314567	4567	**2617** - **
			1376 -

Fig 7.17 An example of a false touch of Stedman Triples, with two methods for checking it.

The third column shows the K's of all the six <u>ends</u>, with the in-course rows kept separate from the out-of-course rows. (The out-of-course section has been moved to the end for clarity.) To check this, first confirm that no K is repeated within the in-course block; then similarly check that there is no duplication within the out-of-course block. Lastly, check that no K in the in-course block is related to one in the out-of-course block by the transposition badc. Doing this locates the falseness, as the K's 6271 + and 2617− are related by this transposition.

Incidentally, this touch is also false for another reason: you should look carefully at it to discover this falseness. As a hint, compare the length of the touch, which is 112 changes, with the information given in Fig 7.1.

Bibliography.

This is a selection of books which will provide further examples and information. Obviously, it is by no means a complete list. "CC Publication" refers to books published by the Central Council of Church Bell Ringers.

Examples generally.

1. Composition 500, 501, 502; Quarter 500; Standard 70. Compiled by John Longridge, published by Papyrus.
2. The Ringing World Diary, published each year.
2. Major Compositions. CC Publication, 1981.

Minor compositions.

1. Minor methods. CC Publication. This concerns plain minor methods, and includes extents of these.
2. Spliced minor collection. CC Publication, 1986. Many extents of minor, including all types of hunt path. Roughly divided into the type of splice.
3. Method splicing, part 1, Minor methods; by H Chant, published by J Hilton. Now out of print, but most of the information was reproduced in a series in the Ringing World, from August 1974 to August 1976.

False Course Heads.

1. Collection of rung Surprise. CC Publication. This contains details of the FCH groups of all methods included, but not the incidence of the falseness.
2. Change Ringing, by WG Wilson, published by Faber and Faber, 1965. Gives a method for extracting FCHs, and determining the incidence of the falseness.
3. Blue Line proof, by J Segar. A pamphlet which describes another method for extracting FCHs.
4. Symbolic treatment of False Course Heads, by M Hodgson (1962). A mathematical approach to FCHs, which defines accurately the relationships between FCHs in the same group.

Stedman.

1. Stedman, by Rev CPD Davies. Published in 1903 in the Jasper Snowdon series. Includes a full description of the composition and proof of Stedman Triples, also the historic development of Stedman compositions.
2. Compositions of Stedman Caters and Stedman Cinques. CC Publication.

Grandsire.

1. Grandsire, by J. Armiger Trollope. Published in 1948 in the Jasper Snowdon series.

Collections of methods.

There are various collections of methods published by the Central Council, which cover doubles methods, minor methods, surprise methods, principles, etc. These are updated from time to time.

Appendix 1 False course heads in groups.

The course heads written above the double horizontal line are in-course: those written below that line are out-of-course. Note that groups a-f have no in-course members, and some of groups B-U have no out-of-course members. Group A is not shown. It contains the remaining in-course FCH, which is 23456, and represents the trivial case of the plain course being false against itself.

B	C	D	E	F	G	H	I	K	L	M	N
24365	25634	32546	32465	45236	56423	53462	54632	65432	26543	23564	34562
		46253	43265	32654	63542	63425	65324	53624	42563	23645	62345
									36245	25463	46325
										26435	54263
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
25436	42365	53426	25364	26345		56243		46352			62435
32456	34265	63452	24635	24563		62543		52346			53264
23654		24356				46523		64253			43625
43256						36542		34526			35462
								64325			65234
								54362			45632
											52634
											35624

O	P	R	S	T	U	a	b	c	d	e	f
52643	54326	45623	52364	24536	34256						
36524	64352	56234	34625	25346	42356						
65243	56342	35642	64235	36452	43652						
46532	64523	62534	45362	43526	63254						
				62453	52436						
				26354	35426						
				53246	35426						
				24653	42635						
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
63524				32564		23465	26534	35246	34652	36425	54623
53642				32645		23546	25643	42536	45326	52463	56324
56432				46235		26453		42653	62354	43562	65342
65423				45263				36254	54236	63245	64532

Appendix 2. Falseness groups of major methods.

	Falseness resulting from each of the treble positions								Groups included	
Method	1	2	3	4	5	6	7	8		
Cambridge	B	B	D	D	e	e	E	E	BDE	e
Yorkshire	B	B	c	c	B	B	c	c	B	c
Lincolnshire	B	B	c	c	e	e	L	L	BL	ce
Superlative	E	E	d	d	d	d	E	E	E	d
Pudsey	c	c	B	B	d	d	Y	Y	B	cdY
Rutland	B	B	c	c	e	e	a	a	B	ace
London	B	B	D	D	d	d	d	d	BD	d
Bristol	c	c	c	c	c	c	c	c		c
Glasgow	E	B	c	c	d	d	E	E	E	cd
Belfast	D	c	B	B	B	c	E	D	BDE	c
Cornwall	a	a	a	a	c	c	c	c		ac
Ashtead	c	c	a	a	a	a	c	c		ac
Uxbridge	B	B	a	a	B	B	c	c	B	ac
Cassiobury	c	c	B	B	B	B	c	c	B	c
Ipswich	B	B	c	c	a	a	Z	Z	B	acZ
Lindum	E	E	d	d	K	K	L	L	EKL	d
Shepperton	B	N	d	B	B	c	Y	Y	BN	cdY

Appendix 3. All (360) in-course course heads, divided into their falseness groups.

GROUP A

2345678
=======

GROUP B

2354768
2436578
3256748
3274568
3452768
5234768
5372648
=======

GROUP C

2367458
2463758
2537468
2563478
4327658
4362758
5327468
=======

GROUP D

3254678
3524768
3654728
4253768
4625378
7254368
7543628
=======

GROUP E

2573648
2647358
3246578
3275648
3427568
3476528
3572468
3672548
4236758
4326578
5263748
5276348
7236548
7365428
=======

GROUP F

3247658
3265478
3547268
3725468
4265738
4523678
6243758
=======

GROUP G

2746538
2754638
3674258
3764528
5642378
5764238
6257348
6354278
6375248
6457238
6734258
6752438
7256438
7435628
=======

GROUP H

2475638
2645738
2735648
2745368
4673528
4735268
5346278
5743268
6342578
6345728
6425738
6542738
7345268
7526348
=======

GROUP I

2567348
2673458
4367528
4732658
5427638
5463278
5637428
5746328
6475328
6532478
7326458
7462358
7635248
7642538
=======

GROUP K

2437658
2543768
4325768
4527368
4563728
4623758
4652738
4725638
5362478
5724368
6453728
6543278
7523468
7534268
=======

GROUP L

2376548
2654378
3574628
3624578
4256378
7253648
7354628
=======

GROUP M

2356478
2357648
2364578
2374658
2546378
2643578
2674538
2756348
4375628
4763258
6374528
6527438
7325648
7356248
=======

GROUP N

2457368
2473568
2536748
2634758
3426758
3456278
3562748
3752648
4237568
4372568
4632578
4637258
5273468
5274638
5326748
5364728
5426378
5436728
5472368
5473628
5632748
5763428
6234578
6427358
7352468
7432568
7532648
7562438
=======

GROUP O

3457628
3546728
3625748
3652478
4275368
4653278
4657328
4752368
4753628
4765328
5264378
5624738
5672438
5762348
6437528
6524378
6534728
6547328
7234658
7243568
7436258
7453268
7524638
7564328
7624358
7625438
7643258
7653428
=======

GROUP P

5432678
5634278
5734628
5742638
6435278
6452378
7452638
=======

GROUP R

3564278
3724658
4257638
4537628
4562378
4762538
5623478
5726438
6253478
6473258
6537248
6754328
7423658
7654238
=======

GROUP S

3462578
3472658
3576248
3726548
4276538
4536278
4567238
4572638
5236478
5237648
5723648
6273548
6423578
6723458
=======

GROUP T

2346758
2347568
2365748
2375468
2453678
2465378
2534678
2635478
3567428
3627458
3645278
3745628
4267358
4352678
5324678
5347628
5437268
5462738
5674328
5732468
6245378
6432758
7245638
7263458
7342658
7456328
7634528
7652348
=======

GROUP U

2547638
2743658
3425678
3526478
3527648
3542678
4235678
4263578
4273658
4365278
5243678
5736248
6325478
6472538
=======

GROUP a

2765438
3245768
3257468
3264758
3754268
6254738
6347258
=======

GROUP b

3267548
3276458
3475268
3742568
4736528
5246738
5647238
5673248
6235748
6572348
6735428
6742358
7426538
7465238
=======

GROUP c

2435768
2456738
2734568
5342768
5374268
6352748
6745238
=======

GROUP d

2476358
2574368
2637548
2653748
4356728
4532768
4627538
4726358
5376428
5423768
6573428
7324568
7362548
7563248
=======

GROUP e

2467538
2564738
2736458
2753468
3465728
3467258
3642758
3657248
3746258
3756428
3762458
3765248
4357268
4672358
5247368
5267438
5367248
5627348
6237458
6247538
6274358
6275438
6324758
6372458
7235468
7264538
7463528
7536428
=======

GROUP f

4526738
4573268
4635728
4675238
4723568
5476238
5643728
6523748
6725348
6732548
6743528
7425368
7542368
7546238
=======

GROUP X

2576438
2657438
2763548
2764358
4376258
4576328
4756238
6327548
6357428
6574238
6724538
6753248
7364258
7623548
=======

GROUP Y

2675348
3647528
3675428
7246358
7265348
7346528
7645328
=======

GROUP Z

5467328
7632458
=======

Appendix 4. All 720 possible course heads, together with the FCH group to which they belong.

234567 A	243567 D	253467 T	263457 F	273456 c	523467 K	532467 T	542367 d	562347 R	572346 N
234576 D	243576 c	253476 U	263475 N	273465 O	523476 B	532476 U	542376 d	562374 I	572364 S
234657 a	243657 B	253647 E	263547 T	273546 L	523647 S	532647 N	542637 N	562437 H	572436 K
234675 T	243675 U	253674 N	263574 R	273564 H	523674 C	532674 N	542673 R	562473 O	572463 f
234756 T	243756 U	253746 C	263745 S	273645 e	523746 E	532746 C	542736 S	562734 e	572634 N
234765 B	243765 K	253764 N	263754 d	273654 T	523764 S	532764 E	542763 I	562743 b	572643 R
235467 a	245367 T	254367 B	264357 M	274356 O	524367 U	534267 D	543267 P	563247 f	573246 T
235476 B	245376 U	254376 K	264375 N	274365 U	524376 T	534276 c	543276 F	563274 N	573264 K
235647 M	245637 F	254637 M	264537 a	274536 H	524637 e	534627 H	543627 K	563427 P	573426 D
235674 F	245673 c	254673 O	264573 H	274563 D	524673 b	534672 R	543672 N	563472 K	573462 P
235746 E	245736 N	254736 N	264735 E	274635 e	524736 e	534726 L	543726 T	563724 d	573624 U
235764 M	245763 O	254763 U	264753 e	274653 G	524763 d	534762 T	543762 f	563742 I	573642 d
236457 M	246357 E	256347 C	265347 b	275346 e	526347 N	536247 K	546237 f	564237 G	574236 O
236475 E	246375 C	256374 S	265374 d	275364 e	526374 E	536274 U	546273 T	564273 O	574263 P
236547 B	246537 T	256437 b	265437 L	275436 T	526437 O	536427 O	546327 I	564327 O	574326 H
236574 T	246573 L	256473 e	265473 T	275463 G	526473 M	536472 N	546372 S	564372 f	574362 K
236745 C	246735 S	256734 I	265734 e	275634 M	526734 X	536724 e	546723 X	564723 b	574623 O
236754 b	246753 e	256743 E	265743 X	275643 Y	526743 e	536742 S	546732 Z	564732 X	574632 I
237456 F	247356 N	257346 S	267345 I	276345 E	527346 N	537246 U	547236 N	567234 M	576234 O
237465 M	247365 N	257364 E	267354 e	276354 X	527364 C	537264 B	547263 K	567243 O	576243 H
237546 T	247536 R	257436 d	267435 e	276435 X	527436 U	537426 c	547326 R	567324 b	576324 e
237564 a	247563 H	257463 e	267453 M	276453 Y	527463 N	537462 F	547362 N	567342 R	576342 N
237645 b	247635 d	257634 e	267534 Y	276534 G	527634 E	537624 T	547623 f	567423 O	576423 G
237654 L	247653 T	257643 X	267543 G	276543 a	527643 I	537642 d	547632 S	567432 T	576432 f

324567 B	342567 U	352467 c	362457 L	372456 T	623457 N	632457 e	642357 S	652347 N	672345 S
324576 a	342576 T	352476 D	362475 H	372465 R	623475 M	632475 e	642375 N	652374 f	672354 Z
324657 E	342657 C	352647 U	362547 c	372546 F	623547 d	632547 U	642537 K	652437 O	672435 I
324675 M	342675 N	352674 K	362574 O	372564 N	623574 b	632574 O	642573 H	652473 G	672453 X
324756 M	342756 E	352746 B	362745 T	372645 d	623745 e	632745 E	642735 N	652734 O	672534 f
324765 F	342765 N	352764 U	362754 e	372654 S	623754 I	632754 X	642753 e	652743 M	672543 T
325467 D	345267 K	354267 U	364257 e	374256 b	624357 N	634257 H	643257 K	653247 I	673245 X
325476 A	345276 B	354276 T	364275 e	374265 d	624375 F	634275 L	643275 T	653274 R	673254 f
325647 T	345627 N	354627 N	364527 T	374526 L	624537 T	634527 D	643527 P	653427 f	673425 G
325674 B	345672 U	354672 O	364572 G	374562 T	624573 L	634572 H	643572 O	653472 O	673452 O
325746 a	345726 M	354726 F	364725 M	374625 e	624735 M	634725 a	643725 H	653724 R	673524 O
325764 T	345762 O	354762 c	364752 Y	374652 X	624753 e	634752 G	643752 O	653742 b	673542 b
326457 T	346257 S	356247 N	365247 O	375246 M	625347 R	635247 O	645237 P	654237 O	674235 b
326475 a	346275 E	356274 N	365274 U	375264 N	625374 T	635274 c	645273 D	654273 H	674253 O
326547 F	346527 d	356427 R	365427 H	375426 a	625437 H	635427 G	645327 f	654327 K	674325 T
326574 M	346572 e	356472 H	365472 D	375462 H	625473 a	635472 T	645372 K	654372 P	674352 f
326745 L	346725 e	356724 d	365724 e	375624 E	625734 G	635724 Y	645723 G	654723 T	674523 c
326754 b	346752 X	356742 T	365742 G	375642 e	625743 Y	635742 X	645732 f	654732 O	674532 R
327456 B	347256 C	357246 E	367245 X	376245 e	627345 d	637245 e	647235 d	657234 b	675234 O
327465 T	347265 S	357264 C	367254 E	376254 I	627354 S	637254 T	647253 U	657243 e	675243 G
327546 M	347526 b	357426 T	367425 G	376425 Y	627435 e	637425 Y	647325 R	657324 I	675324 X
327564 E	347562 e	357462 L	367452 a	376452 G	627453 E	637452 M	647352 N	657342 d	675342 I
327645 b	347625 I	357624 S	367524 X	376524 e	627534 X	637524 G	647523 O	657423 X	675423 Y
327654 C	347652 E	357642 e	367542 Y	376542 M	627543 e	637542 e	647532 I	657432 b	675432 R

423567 U	432567 B	452367 F	462357 T	472356 f	723456 U	732456 d	742356 I	752346 K	762345 f
423576 T	432576 K	452376 P	462375 K	472365 N	723465 O	732465 b	742365 R	752364 T	762354 X
423657 C	432657 E	452637 T	462537 D	472536 P	723546 e	732546 N	742536 f	752436 P	762435 O
423675 E	432675 S	452673 f	462573 P	472563 K	723564 e	732564 M	742563 O	752463 O	762453 b
423756 N	432756 S	452736 K	462735 U	472635 d	723645 X	732645 I	742635 R	752634 H	762534 G
423765 N	432765 C	452763 N	462753 d	472653 I	723654 E	732654 e	742653 b	752643 O	762543 O
425367 c	435267 T	453267 d	463257 N	473256 R	724356 O	734256 R	743256 N	753246 S	763245 Z
425376 D	435276 U	453276 d	463275 S	473265 I	724365 c	734265 T	743265 f	753264 N	763254 S
425637 L	435627 e	453627 S	463527 K	473526 H	724536 G	734526 H	743526 O	753426 K	763425 f
425673 T	435672 d	453672 I	463572 f	473562 O	724563 T	734562 a	743562 G	753462 H	763452 T
425736 H	435726 e	453726 N	463725 N	473625 e	724635 Y	734625 G	743625 O	753624 N	763524 I
425763 R	435762 b	453762 R	463752 R	473652 b	724653 X	734652 Y	743652 M	753642 e	763542 X
426357 U	436257 N	456237 R	465237 H	475236 O	725346 H	735246 N	745236 K	754236 K	764235 X
426375 B	436275 C	456273 N	465273 K	475263 f	725364 L	735264 F	745263 P	754263 K	764253 I
426537 c	436527 U	456327 N	465327 O	475326 G	725436 D	735426 T	745326 O	754326 P	764325 O
426573 F	436572 N	456372 K	465372 P	475362 O	725463 H	735462 L	745362 H	754362 D	764352 G
426735 T	436725 E	456723 S	465723 I	475623 X	725634 a	735624 M	745623 O	754623 f	764523 R
426753 d	436752 I	456732 f	465732 O	475632 b	725643 G	735642 e	745632 T	754632 G	764532 Y
427356 K	437256 N	457236 I	467235 e	476235 b	726345 T	736245 S	746235 I	756234 R	765234 T
427365 U	437265 E	457263 S	467253 N	476253 R	726354 e	736254 d	746253 d	756243 N	765243 f
427536 O	437526 O	457326 f	467325 O	476325 M	726435 G	736425 X	746325 b	756324 d	765324 b
427563 N	437562 M	457362 T	467352 H	476352 O	726453 e	736452 e	746352 e	756342 U	765342 O
427635 e	437625 X	457623 Z	467523 f	476523 T	726534 Y	736524 e	746523 b	756423 I	765423 R
427653 S	437652 e	457632 X	467532 G	476532 O	726543 M	736542 E	746532 X	756432 O	765432 c

Appendix 5 The plain course of Yorkshire Surprise Major, and a false course.

The plain course:

12345678	15738264	18674523	14263857	13527486	17856342 K	16482735
21436587	51372846	81765432	41628375	31254768	71583624 L	61847253
12463857	15327486	18756342 G	14682735	13245678	17538264	16874523
21648375	51234768	81573624 H	41867253	31426587	71352846	61785432
26143857	52137486	85176342	48162735	34125678	73158264	67184523
62418375	25314768	58713624	84617253	43216587	37512846	76815432
26148735	52134678	85173264	48167523	34126857	73152486	67185342
62417853	25316487	58712346	84615732	43218675	37514268	76813524
64271835	23561478	57821364	86451723	42381657	35741286	78631542 M
46728153	32654187	75283146	68547132	24836175	53472168	87365124 N
46271835	32561478	75821364	68451723	24381657	53741286	87631542 O
64728153	23654187	57283146	86547132	42836175	35472168	78365124 P
46782513	32645817	75238416	68574312	24863715	53427618	87356214
64875231	23468571	57324861	86753421	42687351	35246781	78532641
68472513	24365817	53728416	87654312	46283715	32547618	75836214
86745231	42638571	35274861	78563421	64827351	23456781	57382641
68472531	24365871	53728461	87654321	46283751	32547681	75836241
86745213	42638517	35274816	78563412	64827315	23456718	57382614
87642531	46235871	32578461	75864321	68423751	24357681	53786241
78465213	64328517	23754816	57683412	86247315	42536718	35872614
87456123 A	46382157	32745186	75638142	68274135	24563178	53827164
78541632 B	64831275	23471568	57361824	86721453	42651387	35281746
78456123 C	64382157	23745186	57638142	86274135	42563178	35827164
87541632 D	46831275	32471568	75361824	68721453	24651387	53281746
85714623	48613257	34217586	73516842	67812435	26415378	52318764
58176432	84162375	43125768	37158624	76184253	62143587	25137846
85716342	48612735	34215678	73518264	67814523	26413857	52317486
58173624	84167253	43126587	37152846	76185432	62148375	25134768
51876342	81462735	41325678	31758264	71684523 I	61243857	21537486
15783624	18647253	14236587	13572846	17865432 J	16428375	12354768
51738264	81674523 E	41263857	31527486	71856342	61482735	21345678
15372846	18765432 F	14628375	13254768	17583624	16847253	12436587
15738264	18674523	14263857	13527486	17856342	16482735	12345678

The course headed by 12436578

12436578	16748253	18573624	13254867	14627385	17865432 J	15382746
21345687	61472835	81756342	31528476	41263758	71684523 I	51837264
12354867	16427385	18765432 F	13582746	14236578	17648253	15873624
21538476	61243758	81674523 E	31857264	41325687	71462835	51786342
25134867	62147385	86175432	38152746	43126578	74168253	57183624
52318476	26413758	68714523	83517264	34215687	47612835	75816342
25138746	62143578	86174253	38157624	43125867	74162385	57186432
52317864	26415387	68712435	83516742	34218576	47613258	75814623
53271846	24651378	67821453	85361724	32481567	46731285	78541632 B
35728164	42563187	76284135	58637142	23845176	64372158	87456123 A
35271846	42651378	76821453	58361724	23481567	64731285	87541632 D
53728164	24563187	67284135	85637142	32845176	46372158	78456123 C
35782614	42536817	76248315	58673412	23854716	64327518	87465213
53876241	24358671	67423851	85764321	32587461	46235781	78642531
58372614	23456817	64728315	87563412	35284716	42637518	76845213
85736241	32548671	46273851	78654321	53827461	24365781	67482531
58372641	23456871	64728351	87563421	35284761	42637581	76845231
85736214	32548617	46273815	78654312	53827416	24365718	67482513
87532641	35246871	42678351	76853421	58324761	23467581	64785231
78356214	53428617	24763815	67584312	85237416	32645718	46872513
87365124 N	35482167	42736185	76548132	58273146	23654178	64827153
78631542 M	53841276	24371658	67451823	85721364	32561487	46281735
78365124 P	53482167	24736185	67548132	85273146	32654178	46827153
87631542 O	35841276	42371658	76451823	58721364	23561487	64281735
86713524	38514267	43217685	74615832	57812346	25316478	62418753
68175342	83152476	34126758	47168523	75183264	52134687	26147835
86715432	38512746	43216578	74618253	57813624	25314867	62417385
68174523	83157264	34125687	47162835	75186342	52138476	26143758
61875432	81352746	31426578	41768253	71583624 L	51234867	21647385
16784523	18537264	13245687	14672835	17856342 K	15328476	12463758
61748253	81573624 H	31254867	41627385	71865432	51382746	21436578
16472835	18756342 G	13528476	14263758	17684523	15837264	12345687
16748253	18573624	13254867	14627385	17865432	15382746	12436578

Appendix 6. Falseness diagrams for the standard eight surprise major methods, together with some other methods referred to in the text.

Falseness diagram for Cambridge

Lead from plain course (rows); Lead from false course of Cambridge (columns)

	H	M	F	I	B	V	W
H	43265						46253
M							
F			32465	32546			
I			32546		46253	24365	
B				46253			24365
V				24365			32546
W	46253				24365	32546	

Falseness diagram for Lincolnshire

Lead from plain course (rows); Lead from false course of Lincolnshire (columns)

	H	M	F	I	B	V	W
H				42563			
M							
F							36245
I	36245					24365	
B					26543		24365
V				24365		26543	
W			42563		24365		

Falseness diagram for Yorkshire

Lead from plain course (rows); Lead from false course of Yorkshire (columns)

	H	M	F	I	B	V	W
H			24365				
M							
F	24365						
I						24365	
B							24365
V				24365			
W					24365		

Falseness diagram for Pudsey

Lead from plain course (rows); Lead from false course of Pudsey (columns)

	H	M	F	I	B	V	W
H							
M							
F							
I							24365
B							
V							
W				24365			

The falseness of Yorkshire, presented as a table.

H of 23456	is false against	F of 24365
F of 23456	is false against	H of 24365
I of 23456	is false against	V of 24365
B of 23456	is false against	W of 24365
V of 23456	is false against	I of 24365
W of 23456	is false against	B of 24365

Falseness diagram for Superlative

Lead from plain course (rows); Lead from false course of Superlative (columns)

	H	M	F	I	B	V	W
H							
M							
F							
I						32465	
B					32465		43265
V				32465		43265	
W					43265		

Falseness diagram for Rutland

Lead from plain course (rows); Lead from false course of Rutland (columns)

	H	M	F	I	B	V	W
H							
M							
F				24365			
I			24365		24365		
B				24365			
V							
W							

Falseness diagram for London

Lead from plain course / Lead from false course of London

	H	M	F	I	B	V	W
H							
M					32546		
F				24365		46253	
I			24365		24365		
B		32546		24365			
V			46253				
W							

Falseness diagram for Bristol

Lead from plain course / Lead from false course of Bristol

	H	M	F	I	B	V	W
H							
M							
F							
I							
B							
V							
W							
	H	M	F	I	B	V	W

(This table is blank, as there are no false course heads in Bristol which are in-course and have the tenors together: the method is "clean proof scale" or cps.)

Falseness diagram for Kent

Lead from plain course / Lead from false course of Kent

	H	M	F	I	B	V	W
H							
M							
F					32546		
I				32546	24365	46253	
B			32546	24365	46253		
V				46253			
W							

Falseness diagram for Belfast

Lead from plain course / Lead from false course of Belfast

	H	M	F	I	B	V	W
H		32465					43265
M	32465						
F							
I				32546	24365		
B				24365	46253		
V							
W	43265						

Falseness diagram for Shepperton

Lead from plain course / Lead from false course of Shepperton

	H	M	F	I	B	V	W
H	24365						62345
M				24365			
F							
I		24365					
B					24365	54263	
V					46325		
W	34562						

Falseness diagram for Glasgow

Lead from plain course / Lead from false course of Glasgow

	H	M	F	I	B	V	W
H		43265	24365				
M	43265		32465				
F	24365	32465					
I						32465	
B							43265
V				32465			
W					43265		

Appendix 7. Inter-method falseness for Cambridge, Yorkshire, Superlative, Rutland, Lincolnshire, and London.

Falseness between Cambridge and Yorkshire Surprise Major

Lead from the plain course of Cambridge	Lead from false course of Yorkshire: H	M	F	I	B	V	W
23456 H	43652	36524		46253			42635
23456 M							
23456 F		46532	35426	35264			32546
23456 I	46253		32546	34256		24365	24365
23456 B				46253	63542 63254 65243		24365
23456 V				24365		52436 56423 52643	32546
23456 W	46253		32546	24365	24365		42356

Lead from the plain course of Yorkshire	Lead from false course of Cambridge: H	M	F	I	B	V	W
23456 H	63254			46253			46253
23456 M	52643		65243				
23456 F			52436	32546			32546
23456 I	46253		42635	42356	46253	24365	24365
23456 B					63542 43652 46532		24365
23456 V				24365		35426 56423 36524	
23456 W	35264		32546	24365	24365	32546	34256

Falseness between Cambridge and Superlative Surprise Major

Lead from the plain course of Cambridge	Lead from false course of Superlative: H	M	F	I	B	V	W
23456 H	63254			24653			
23456 M							
23456 F			52436				25346
23456 I	36452		42635	42356		24365	
23456 B			24365		43652 54632 54263 65243	24365	43265
23456 V	24365			32465	24365	35426 65324 52643 62345	
23456 W	35264		43526		24365		34256

Lead from the plain course of Superlative	Lead from false course of Cambridge: H	M	F	I	B	V	W
23456 H	43652			62453		24365	42635
23456 M							
23456 F			35426	35264	24365		53246
23456 I	26354			34256		32465	
23456 B					63254 65324 46325 46532	24365	24365
23456 V				24365	24365	52436 54632 36524 34562	
23456 W			24536		43265		42356

Falseness between Cambridge and Rutland Surprise Major

Lead from the plain course of Cambridge		Lead from false course of Rutland						
		H	M	F	I	B	V	W
23456	H				46253	-P-C-		
23456	M						-P-C-	
23456	F				32546			-P-C-
23456	I	-P-C- 45236		24365	24365 24536	46253		32546
23456	B	46253	-P-C- 63542 43265 32654		24365	63542 62453		
23456	V			-P-C- 53246 56423	24365		32465 56423 45236	32546
23456	W	46253		32546	-P-C- 24365 26354	24365		32654

Lead from the plain course of Rutland		Lead from false course of Cambridge						
		H	M	F	I	B	V	W
23456	H				-P-C- 45236	46253		46253
23456	M					-P-C- 63542 43265 32654		
23456	F				24365		-P-C- 43526 56423	32546
23456	I	46253		32546	24365 25346	24365	24365	-P-C- 24365 24653
23456	B	-P-C-			46253	63542 36452		24365
23456	V		-P-C-				32465 56423 45236	
23456	W			-P-C-	32546		32546	32654

Falseness between Cambridge and Lincolnshire Surprise Major

Lead from the plain course of Cambridge		Lead from false course of Lincolnshire						
		H	M	F	I	B	V	W
23456	H				46253			
23456	M							
23456	F							32546
23456	I	46253		32546			24365	24365
23456	B				46253	63542 43265		24365
23456	V				24365		32465 56423	32546
23456	W	46253		32546	24365	24365		

Lead from the plain course of Lincs.		Lead from false course of Cambridge						
		H	M	F	I	B	V	W
23456	H				46253			46253
23456	M							
23456	F				32546			32546
23456	I	46253				46253	24365	24365
23456	B					63542 43265		24365
23456	V				24365		32465 56423	
23456	W			32546	24365	24365	32546	

Falseness between Cambridge and London Surprise Major

Lead from the plain course of Cambridge	Lead from false course of London: H	M	F	I	B	V	W
23456 H	23564 62534	42635	43652	62345	-P-C-		
23456 M			36524		46532	-P-C-	
23456 F				54263	35426	35264	-P-C- 26435 56234
23456 I	-P-C- 46532	46325	24365		45236	34256	
23456 B	53246 54632	-P-C-			25463	32654 24536 56234	63254
23456 V	52436	45236 62534 26354	-P-C- 23645				62453 65324
23456 W		42356	32654	-P-C-	24365	34562	36524

Lead from the plain course of London	Lead from false course of Cambridge: H	M	F	I	B	V	W
23456 H	23645 35642			-P-C- 65243	43526 65324	35426	
23456 M	35264			54263	-P-C-	45236 35642 24653	34256
23456 F	63254	52643		24365		-P-C- 23564	32654
23456 I	34562		46325				-P-C-
23456 B	-P-C-	65243	52436	45236	26435		24365
23456 V		-P-C-	42635	42356	32654 25346 45623		62345
23456 W			-P-C- 25463 45623		43652	36452 54632	52643

Falseness betweeen Yorkshire and Superlative Surprise Major

Lead from the plain course of Yorkshire	Lead from false course of Superlative: H	M	F	I	B	V	W
23456 H	63254	35642 36524 34562			65432		
23456 M							
23456 F		46532 45623 46325	52436			53624	
23456 I			42635 34625	42356		24365	43265
23456 B					43652 35642 32465	24365	43265
23456 V				32465	24365	35426 45623 43265	
23456 W	35264 45362			32465	24365		34256

Lead from the plain course of Superlative	Lead from false course of Yorkshire: H	M	F	I	B	V	W
23456 H	43652						42635 64235
23456 M	62534 52643 62345		65243 56234 54263				
23456 F			35426	35264 52364			
23456 I				34256		32465	32465
23456 B	65432				63254 62534 32465	24365	24365
23456 V			53624	24365	24365	52436 56234 43265	
23456 W				43265	43265		42356

Falseness between Yorkshire and Rutland Surprise Major

Lead from the plain course of Yorkshire	Lead from false course of Rutland: H	M	F	I	B	V	W
23456 H			24365		-P-C-		46325
23456 M						-P-C-	
23456 F	34562				24365		-P-C-
23456 I	-P-C-	64235	24365		46532		
23456 B		-P-C- 63425 64235		24365			
23456 V			-P-C-	24365		53462 52364	
23456 W			36524	-P-C-	24365	52364	

Lead from the plain course of Rutland	Lead from false course of Yorkshire: H	M	F	I	B	V	W
23456 H			62345	-P-C-			
23456 M				45362	-P-C- 53462 45362		
23456 F	24365			24365		-P-C-	52643
23456 I					24365	24365	-P-C-
23456 B	-P-C-		24365	65243			24365
23456 V		-P-C-				63425 34625	34625
23456 W	54263		-P-C-				

Falseness between Yorkshire and Lincolnshire Surprise Major

Lead from the plain course of Yorkshire	Lead from false course of Lincolnshire: H	M	F	I	B	V	W
23456 H			24365 26354				64235
23456 M							
23456 F	24365 24536			52364			
23456 I	36524	62453				24365	
23456 B					63425 56423		24365
23456 V				24365		53462 63542	
23456 W		53246	46532		24365		

Lead from the plain course of Lincs.	Lead from false course of Yorkshire: H	M	F	I	B	V	W
23456 H			24365 25346	52643			
23456 M				36452			43526
23456 F	24365 24653						65243
23456 I			34625			24365	
23456 B					53462 56423		24365
23456 V				24365		63425 63542	
23456 W	45362				24365		

Falseness between Yorkshire and London Surprise Major

Lead from the plain course of Yorkshire		Lead from false course of London						
		H	M	F	I	B	V	W
23456	H	23564	42635	43652 52436 35426	46325	-P-C- 32654 35642		
23456	M	34625			42635 35264 42356 34256		-P-C-	45362
23456	F			45623 45236	34562	35426 43652 63254	35264	-P-C- 26435
23456	I	-P-C- 46532 24365		24365	32654	45236	34256	35426
23456	B	34256 35264	-P-C-			25463	32654 65432 52436 46532 35642 45362	63254
23456	V	52436	45236 63254 53624 36524 34625 45623	-P-C- 23645				42356 42635
23456	W	43652	42356	32654	-P-C- 45236	24365		36524 24365

Lead from the plain course of London		Lead from false course of Yorkshire						
		H	M	F	I	B	V	W
23456	H	23645	52364		-P-C- 65243 24365	42356 42635	35426	63254
23456	M	35264				-P-C-	45236 43652 53624 52643 52364 56234	34256
23456	F	63254 35426 52436		56234 45236	24365		-P-C- 23564	32654
23456	I	54263	35264 42635 34256 42356	62345	32654			-P-C- 45236
23456	B	-P-C- 32654 62534		52436 63254 43652	45236	26435		24365
23456	V		-P-C-	42635	42356	32654 65432 35426 65243 62534 64235		
23456	W		64235	-P-C- 25463	52436	43652	34256 35264	52643 24365

Falseness between Superlative and Rutland Surprise Major

Lead from the plain course of Superlative		Lead from false course of Rutland						
		H	M	F	I	B	V	W
23456	H				64235	-P-C- 43652		42635 64235 62534 46325
23456	M			65243		52643	-P-C-	
23456	F	35264 52364 34562 56234		35426	52364			-P-C-
23456	I	-P-C-	64235	32465	34256			
23456	B	65432	-P-C- 64235		24365	63254 56234	24365	
23456	V		24365	-P-C- 52436 62534	24365		52364	53624
23456	W				-P-C- 42356	43265	52364	

Lead from the plain course of Rutland		Lead from false course of Superlative						
		H	M	F	I	B	V	W
23456	H			42635 34625 62345 45623	-P-C-	65432		
23456	M				45362	-P-C- 45362	24365	
23456	F		46532	52436	32465		-P-C- 35426 35642	
23456	I	45362		34625	42356	24365	24365	-P-C- 34256
23456	B	-P-C- 63254	36524			43652 45623		43265
23456	V		-P-C-			24365	34625	34625
23456	W	35264 45362 35642 54263		-P-C-			53624	

Falseness between Superlative and Lincolnshire Surprise Major

Lead from the plain course of Superlative	Lead from false course of Lincolnshire: H	M	F	I	B	V	W
23456 H	43652		26354				42635 64235
23456 M	52643		65243				
23456 F	24536		35426	35264 52364			
23456 I		62453		34256		32465	
23456 B	65432				63254	24365	24365
23456 V			53624	24365	24365	52436	
23456 W		53246			43265		42356

Lead from the plain course of Lincs.	Lead from false course of Superlative: H	M	F	I	B	V	W
23456 H	63254	36524	25346		65432		
23456 M				36452			43526
23456 F	24653	46532	52436			53624	
23456 I			42635 34625	42356		24365	
23456 B					43652	24365	43265
23456 V				32465	24365	35426	
23456 W	35264 45362				24365		34256

Falseness between Superlative and London Surprise Major

Lead from the plain course of Superlative	Lead from false course of London: H	M	F	I	B	V	W
23456 H	43526	64235 42635 43265 53246	43652 24536 52436 35426		-P-C- 32654		
23456 M		24653	36245 26543 26354	62453 53246 42356 34256	42563 26543 24536	-P-C- 25346	
23456 F			45236		35426 26354 43652 63254	52364 35264 32465 62453	-P-C- 36452
23456 I	-P-C- 26543 42563 24365 34562		24365 32465 42563 53462	32654		34256	
23456 B	25634 35264	-P-C- 36245					63254
23456 V	52436		-P-C-			42563	25634 42635
23456 W		42356		-P-C- 45236	43265 24365 63425 36245		26543 36245 24365 46325

Lead from the plain course of London	Lead from false course of Superlative: H	M	F	I	B	V	W
23456 H	53246			-P-C- 26543 36245 24365 62345	25634 42635	35426	
23456 M	45362 35264 43265 43526	26354			-P-C- 42563		34256
23456 F	63254 25346 35426 52436	42563 26543 24653	45236	24365 32465 36245 63425		-P-C-	
23456 I		36452 43526 34256 42356		32654			-P-C- 45236
23456 B	-P-C- 32654	36245 26543 25346	52436 24653 63254 43652				43265 24365 53462 42563
23456 V		-P-C- 24536	34625 42635 32465 36452	42356		36245	
23456 W			-P-C- 62453		43652	25634 35264	26543 42563 24365 54263

Falseness between Rutland and Lincolnshire Surprise Major

Lead from the plain course of Rutland		Lead from false course of Lincolnshire: H	M	F	I	B	V	W
23456	H	46253			-P-C- 46253 24536			
23456	M		24365			-P-C- 62453		
23456	F			63425	24365		-P-C-	
23456	I					24365	24365	-P-C-
23456	B	-P-C- 53462						24365
23456	V		-P-C- 24365				53246	
23456	W			-P-C- 32546				26354 32546

Lead from the plain course of Lincs.		Lead from false course of Rutland: H	M	F	I	B	V	W
23456	H	46253				-P-C- 63425		
23456	M		24365				-P-C- 24365	
23456	F			53462				-P-C- 32546
23456	I	-P-C- 46253 25346		24365				
23456	B		-P-C- 36452		24365			
23456	V			-P-C-	24365		43526	
23456	W				-P-C-	24365		24653 32546

Falseness between Rutland and London Surprise Major

Lead from the plain course of Rutland		Lead from false course of London: H	M	F	I	B	V	W
23456	H			43652		45236 32546	34256 34625	
23456	M	56423			52436 54263	25463	32654 65432 42635 46325 46253	63254
23456	F					42356	35264	26435 62345
23456	I	46532	35426	24365	45362 34625	24365	43652	36524
23456	B	23564 54263	42635	34256				
23456	V	52436	45236 53624 35264 34562 32546	23645	63254 62345			63542
23456	W		42356 45362	32654 46253		35426		

Lead from the plain course of London		Lead from false course of Rutland: H	M	F	I	B	V	W
23456	H		56423		65243	23645 46325	35426	
23456	M				52436	35264	45236 53624 42635 62345 32546	34256 64235
23456	F	63254			24365	42356	23564	32654 46253
23456	I		35426 46325		64235 52364		43652 34562	
23456	B	45236 32546	26435	34256	24365			52436
23456	V	42356 52364	32654 65432 35264 54263 46253	42635	63254			
23456	W		43652	25463 34562	52643		63542	

Falseness between Lincolnshire and London Surprise Major

Lead from the plain course of Lincs.	Lead from false course of London H	M	F	I	B	V	W
23456 H	23564	42635	43652 34256		-P-C- 65243	62345	
23456 M	64523			52436 63254		-P-C-	56342
23456 F		54263	52643		35426 42356	35264	-P-C- 26435
23456 I	-P-C- 46532		24365 62345		45236 64523 54326	34256 43652 53624	
23456 B		-P-C-			25463	32654 65432 42635 64352	63254
23456 V	52436	45236 53624 35264 54326	-P-C- 23645				
23456 W		42356 35426 65432	32654 64352 56342	-P-C-	24365 54263		36524

Lead from the plain course of London	Lead from false course of Lincolns ire H	M	F	I	B	V	W
23456 H	23645	56342		-P-C- 65243		35426	
23456 M	35264		46325		-P-C-	45236 53624 42635 54326	34256 52436 65432
23456 F	63254 42356		36524	24365 34562		-P-C- 23564	32654 64352 64523
23456 I		35426 43652					-P-C-
23456 B	-P-C- 46532		52436 34256	45236 56342 54326	26435		24365 46325
23456 V	34562	-P-C-	42635	42356 63254 53624	32654 65432 35264 64352		
23456 W		64523	-P-C- 25463		43652		52643