

STEDMAN!

Why do we even bother with Stedman? It's pretty weird stuff: it is difficult to ring, it doesn't lead on to any other methods, and you could even argue (although you'd probably be wrong) that it isn't that musical.

So my first job is to explain why we should bother – why Stedman is so important.

In order to do that, we need a bit of context. So first of all, let us step back four hundred years, to the origins of change-ringing in the early 17th Century. Exactly how it came to be that our art was born is shrouded in a great deal of mystery, but it seems that about this time, when few towers would have more than five bells, and most only three, people began to be interested in how many permutations of their bells they could ring.

We all know that on three bells there are only six possible permutations – six different orders in which the bells can sound. Probably quite early in the 17th Century, if not before, ringers discovered that all six could be rung without repetition, and in fact there exists two distinct ways of doing this. They called these, logically enough, "The Sixes". Since these will be very important for our story, I will write them out here:

123	123
213	132
231	312
321	321
312	231
<u>132</u>	<u>213</u>
123	123

Today we would know the first as Plain Hunt on Three, and the other as Reverse Hunt. The main difference is that, in Reverse Hunt, the bells lead back-then-hand, compared to the perhaps more natural-feeling "right place" leading of Plain Hunt, at hand-and-back.

You might notice that each column appears to have seven rows listed, with rounds appearing twice, once at the start and once at the end. Do not be confused! There are only six rows. Ringing is a circle. The rounds at the end are the **same** as the rounds at the start. Really we should write it like this:

123	
132	213
312	231
321	

Now it's more obvious that there are only six elements. You can also see that Plain and Reverse Hunt are just different directions about the circle: one clockwise, one counter-clockwise, or "widdershins" as our forebears might have said.

Anyway, we must move on a few years, because at some point in 1640 a chap called Fabian Stedman was born. We know the names of relatively few of the early pioneers of change-ringing, but his is one I suspect everyone is familiar with. He was born in Yarkhill in Herefordshire – you can go and visit, they have a very nice light eight now. He must have grown up in turbulent times, because the English Civil War and the subsequent Cromwellian upheavals took place throughout his early life. However, by his twenties he appears to be settled in London, having trained as a printer –

a fact that will be critical to the story. He was also ringing in the City, at first with a society called the Cheapside Scholars, but then soon after poached by our old friends the College Youths.

By this time, ringing had advanced. People had figured out how to ring all 120 changes on five bells, a length they called a "sixscore" (score being the old word for twenty). Advances in hanging technology, including three-quarter wheels then full-circle wheels, made this possible, as well as the beginnings of a deep mathematical understanding of permutations. This is a field known today as "Group Theory", and is really the mathematics of symmetry. It underpins much of our modern world, including the public key security that keeps the Internet secure. Most mathematicians consider it to have been invented in the 19th Century, by famous names such as Cauchy and Galois, but in fact ringers like Fabian Stedman were the first people to develop it, two centuries earlier. We should be very proud of this!

Who knows the name of the first book on change-ringing? That's right – Tintinnalogia. This was published in 1667 by Stedman and another fellow called Richard Duckworth; Stedman's background as a printer was no doubt instrumental. The text listed several sixscores, but many of these were in a style called "Plain Changes", which had dominated ringing for the previous half century. Here, only one pair of bells swaps in any given row. We do still ring methods like this today – Double Canterbury Place Minimus and Monmouthshire Place Doubles are examples – but they are arguably a bit dull, with bells stopping in long places for a loooong time. You might as well ring call changes...

But by the time of Tintinnalogia there was a brand new style of ringing on the scene, called "Cross Changes". This permitted more than one pair of bells to swap at a time – a system much more familiar to us. Because on five bells a maximum of two pairs of bells can swap, cross-change ringing on five became known as "Doubles". Getting an extent (a true sixscore) with cross changes was more difficult than with plain changes and, for very good group-theoretical reasons that the early composers understood, you can in fact only get half the extent (60 changes), needing at least two "single" changes to bring in the other half.

The first cross-change extents used what was called a "system of hunts". Grandsire Doubles was one of these, probably composed by a chap called Robert Roan, and listed (although anonymously) in Tintinnalogia. In these compositions, one bell, normally the treble, plain hunts, and this was known as the "whole hunt". Another bell, perhaps the 5, was the "half hunt". We would today call this the observation bell – think of the 5th in the standard 120 of Grandsire, P-P-PS, repeating the same two leads. The other three bells "went the sixes", i.e. rotated round at every part end in order to generate the extent.

It's amazing to think about the historical times in which these technical and mathematical breakthroughs were made. The restoration of Charles II had occurred only a few years before, and shortly after that plague ravaged the country, killing a quarter of the population of London, only for the city to suffer the Great Fire the following year. Ringers were hard at work in a time of turmoil.

And now we reach the point where Stedman makes his mark. In 1677 he published another book – Campanalogia – and this time it contained some of his own methods. I have a reproduction of it here, which I'll pass round. Turn to page 129, and you will see "Stedman's Principle" in print for the very first time. In creating this, Fabian was attempting to do something quite new: to compose a true extent of cross changes which did not rely on hunts. His principle would be democratic – every bell would do the same work.

In this he was wildly successful. His key insight was to go back to the old Sixes, and use them to exhaust all the permutational possibilities whilst the two remaining bells dodged on the back. It

turned out that if you glued the two Sixes together, one the standard Plain hunt, and the other reverse hunt, you could form a lead of twelve changes, at the end of which all five bells had rotated around. Repeat that four times (five leads in total), and you have rung all sixty rows possible with double changes only. Add a single change – what Stedman called an "extream" – and the rest of the extent was joined up. In group theoretical terms, what Stedman did was link the cosets of the group known as "Twisted S_3 in A_5 " using a Petersen graph. Ahead of his time? Oh yes, he was.

Anyway, here's what that first lead of his Principle, formed from the two Sixes, looks like:

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12345
21354 h
23145
32154 h
31245
13254 h
31524
35142 h
53124
51342 h
15324
13542 h
31452

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I've marked the handstrokes with an "h", so that you can see, in the first Six (what today we call a Quick Six), bells lead at hand and back, and in the second (the Slow Six), at back and hand. Between the sixes is what Stedman called a "parting change", which mixes up the bells dodging at the back, or, in his words, "Parts the hind bells". That final row, 31452, has all five bells rotated to different positions, and so generates a plain course of five leads.

Now, this is how the principle is constructed, but it's not quite how we ring it today, and not actually how Stedman showed it in Campanalogia. Instead, almost invariably, we start the method midway through a Quick Six, like so:

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12345
21354 h
23145
32415 h
23451
24315 h
42351
43215 h
34251
43521 h
45312
54321 h
53412

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This is the same method – we've just rotated it – but why do we do that? Why don't we start at the beginning of a Quick (or Slow) six? Anyone?

The reason is pretty simple. If we draw out the blue line from this "conventional" start, we see that it is symmetrical top to bottom. I don't know whether Fabian also knew this, but I assume that he did, because why else would he have done the same? If you start the method at the beginning of the

six, the blueline is skew-whiff, because the six starts and ends are not points of symmetry.

Our symmetry-preserving start has an important effect when we come to look at compositions. I know many of you are keen to call some touches, and we will talk about that soon, so this is a very important thing to know. Compositions are almost always laid out by the six ends. The first full six end is 23145, not 12345. That explains why touches, peals and quarter peals of Stedman don't appear to start in rounds. They just don't bother to show the first two changes. It also explains why bobs and singles can come up so quickly at the start of a touch of Stedman on Triples or higher – "Go Stedman... bob!". It is only two changes from the conventional start to the first six end, which is where a call can take effect.

The printing of *Tintinnalogia* and *Campanalogia* had a dramatic effect. For the first time, ringers across the country could pick up a book and see what other, perhaps more advanced towers, were ringing. Methods like Grandsire and Stedman spread widely throughout England as a result. And ringers enjoyed Stedman's Principle so much that they extended it to seven bells, and then higher numbers.

But this is where our story takes a darker turn...

As we've seen, Stedman's Principle uses elegant mathematical constructions in order to obtain the extent on five bells, without resorting to the old system of hunts. But when we look at seven bells – Stedman Triples – it all goes horribly wrong. The plain course of the method no longer divides up the extent into neat blocks that can be joined to make a peal. Although peals of Stedman Triples were attempted early in the 18th Century, they were not true. Disaster! Throughout this next century "indefatigable assiduity" was employed to try to solve the problem, to little avail. Clavis in 1788 told its readers, "It is one of those occult mysteries that have never yet transpired".

Nevertheless, by the dying months of the 18th Century, progress had been made, for instance by Birmingham composers like John Noonan. However his peals, and those of successive emulators, required a profusion of calls – many, many bobs, keeping bells dodging behind for interminable periods – and often several different kinds of call – singles and "Holt's bob-singles" as well as ordinary bobs. No-one liked these compositions.

It would take many more decades of intellectual effort, and competition between composers, including men such as Hudson, Day, Lates and Thurstans, before the problem was cracked. Published in 1846, and followed soon by other variations, Thurstans' famous four part was at last a peal not only true, but worth ringing. It contained very few singles, and the bobs always came in pairs, separated by plenty of plain sixes. Nearly two hundred years after Fabian had come up with the idea, it had finally been made to work on seven bells. We shall return to Thurstans' twin bobs soon, when we look at calling a touch.

However, it so turned out that the story didn't end there. Roll on another one hundred and fifty years of painstaking exploration, and a fellow called Colin Wyld, perhaps the foremost Stedman genius of all, found a way, using "magic blocks", of producing all 5040 changes using bobs alone. Andrew Johnson then turned this idea into practical peals mere mortals can ring. These two made history, completing a chain of intense research and development that spanned three and a half centuries. This is most definitely part of the mystique of Stedman – what makes it great.

Who here has rung a peal of bobs-only Stedman Triples?

So that is where we are today. It started with a man who, from a rural background in Herefordshire, went to London in a time of turmoil, became its leading ringer, mastered the mathematics of group

theory a century before mathematicians even thought of it, used that to create the most innovative method of its time, and had the ability to publicise it via the mass media of the day. Down the centuries, Stedman's Principle has never lost its popularity. Go to any village six with a decent band, and they will be ringing, or aspiring to ring, Stedman Doubles. Sit outside St Paul's Cathedral whilst a peal is rung for some national occasion, and you will hear Stedman Cinques. Stedman is the one method that has been rung through all our history and across all strata of our ringing society. It is the most democratic of methods, both in its appeal and its execution.

And that is why it is important – perhaps the most important thing we ring.

It is difficult though, isn't it! What do you think is the hardest thing about ringing Stedman? Yes – most people would say it's remembering whether to go in slow or quick. There are various techniques that you can use to keep track of this, but I would say one of the most important is simply using your ropesight. You see, ropesight is not just about seeing which bell you're due to follow in the next change. People with excellent ropesight can see what every bell is doing, on any number of bells. A goal for everyone should be to develop your ropesight skills as much as you can. You can do this by ringing on higher numbers than you normally do, or by trying to look at bells not working directly with you.

For example in Stedman, try looking at the bells on the front when you are dodging 5-4 down, to see whether they are leading right or wrong. This will tell you what kind of six is being rung. When the bells are leading hand and back, it's a quick six; that means the next six will be a slow one, and therefore you must go in slow. Conversely if bells are leading back and head, the next six is quick. This method is most useful if you keep track of the sixes throughout your dodging at the back, not just when you are in 5-4 down, because then you are more insulated from mistakes on the front. As a conductor, it's pretty useful to have an idea of the succession of the sixes throughout the touch, but this is easier than it seems if you're following the calling positions anyway, each of which are anchored to either quick or slow sixes.

This leads me nicely on to talk about touches of Stedman Triples, and how to call them. I know many of you are interested in this. Calling Stedman is of course very different to anything else, because there is no treble to anchor yourself. And then there are two calling positions in every lead, at the six ends instead of the lead end! This makes it seem very alien to start with, but bear with me, and we will make sense of it.

First of all I am going to write out the six ends of a plain course of Stedman Triples. As we saw above, we start with the end of the first quick six, rather than rounds:

2314567	Q	1
3426175	S	2
3467251	Q	3
4735612	S	4
4751326	Q	5
7142563	S	6
7126435	Q	7
1673254	S	8
1635742	Q	9
6514327	S	10
6542173	Q	11
5267431	S	12
5273614	Q	13
<u>2351746</u>	S	14
2314567	Q	

At first sight this seems to be a random string of numbers, with little utility. However if you look closely you can start to work out what each bell is doing where. For example, look at the second line, the slow six ending 3426175. Clearly bells 2,3 and 4 must be in the slow. Bells 1 and 6 must be dodging in 4-5, and bells 5 and 7 in 6-7. In fact the 6 and the 7 are dodging down, and the 1 and the 5 dodging up.

The same pattern holds in the next, quick six. It ends 3467251. Bells 7 and 5 are dodging down, bells 2 and 1 dodging up, in 4-5 and 6-7 respectively. That leaves bells 3, 4 and 6 on the front. Although it is a quick six, only one of them is the quick bell! Can you work out which? Clue: it's the one that vanishes up to 4-5 soon after.

Now let's return to William Hudson and Thomas Thurstans, whom I referred to earlier; these were two of the mid 19th-Century composers who finally cracked the problem of how to produce a respectable peal of Stedman Triples. The "twin bob" style of composition invented by Hudson and perfected by Thurstans is still very popular, and it's easy to learn. There is typically one bell unaffected by the calls, which leaves four "calling positions" for the twin bobs through the course. We label these S, H, L and Q. I'll give you the course again, with these marked out for the 7th:

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2314567
3426175
3467251 S
4735612 S
4751326 H
7142563 H
7126435 L
1673254 L
1635742
6514327
6542173
5267431 Q
5273614 Q
2351746
2314567

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Here:

- "S" stands for "In Slow". You call the first bob when you are in 5-4 down, and the second just before you make your first whole turn.
- "H" stands for "Half turns". You call the two bobs just before you make each half turn.
- "L" stands for "Last whole". The first bob is just before you make your last whole turn, and the second just before you go out slow.
- "Q" stands for "Quick". One bob is in 5-4 down, the other as you run out quick.

In our practical session we will get some of you to try calling a very simple touch – SLQ. This means you will call the two bobs at S as above, skip the H position, call the two at L, and then the last pair at Q. It doesn't matter which bell you ring, although (for example) if you call it from a bell like the treble, you'll notice you are already halfway through the Q position: that means you have to **start** the touch with the second bob in the Q pair, and finish it with the first one.

But where exactly do you shout "bob"? Well, it is always two blows before the six end, but you are going to have to learn where that is on the blueline, because, as ever, there is no treble to guide you! Fortunately it is not too hard. Here are some rules:

1. It is always at a handstroke.
2. If you are dodging, it's at the handstroke point of your last dodge.
3. If you are in quick (i.e. the second bob of the Q), it's as you come away from lead in 2nd's place.
4. If you are in the slow, it is at the handstroke immediately before the point of the next half or whole turn. For the whole turns, that will be one of the blows at lead before the point in 2nd's place. For the half turns, it's either the 3rd's or 2nd's place just before the point at lead.
5. If you are going out slow (the last bob of the L), call the bob at handstroke as you start to make thirds.

Phew! However, if you've got all that, that's the hard part done. You can now try to call that touch – remember, it's SLQ.

What about a quarter peal? People worry about calling Stedman because they feel they won't be able to "conduct" it. But most people misunderstand what conducting is all about. A conductor has only three jobs:

1. To keep themselves right.
2. To put the calls in, in the right place.
3. To stop the ringing if it no longer meets the expected standards of quality.

There is no requirement, absolutely none, to "keep everyone right". That is the individual ringers' jobs. It is true that many conductors are following the order of the bells, and have very good ropesight, so they can see more of what's going on around them, and that helps them spot and correct other bells. But that will come naturally as your conducting career develops – do not worry about not being able to do it.

It is also true that point (3) above does imply that you should to be able to spot "surreptitious swaps". These don't actually happen very often, but it could be that two bells have got confused and have swapped over with each other, and no-one has noticed. That means you have immediately fallen foul of point 3, because you are not ringing the composition any more. Also you could ring on for another half an hour, only to find it hasn't come round. No-one wants that!

Because of this, when ringing a longer length like a quarter peal, it is helpful to have at least a few points where you can check that the bells are in the right order. How do you do this, in the random morass of ropes that is Stedman?

There are several quarter peals based on Thurstans' twin-bob courses, and if you've mastered the SHLQ calling positions, you could easily call any of these. One good example is:

<https://complib.org/composition/105248>

For longer touches, the six ends are not normally laid out, and instead only the course ends given. Here, the first course is called SQ, the next HQ, and the third H (yes, that's right, Christmas has come early – there's "no L"). That calling then repeats four times. Note also the convention of using an "x" to denote a twin bob.

There are ways of tracking the order of the bells in these twin-bob compositions, but for your first forays into conducting I would recommend something even simpler:

<https://complib.org/composition/22408>

1260 Stedman Triples

Composed by [Mark B Davies](#)

2314567	7	12
2415367	–	3
2513467	–	S--S--
(2314567)	–	S--S--

This is more like Plain Bob than Stedman – the calling is really just W3H, W6H, W6H. From the 7th it looks like this. The bob at 7 (which I will claim is a Wrong) occurs just before the last whole turn; in other words, it's like the first bob in the L. The bobs and singles at 12 (which I'm saying are Homes) are called when you are in 5-4 down before the quick work, i.e. just like the first bob of the Q. But in this composition, there is only one call at a time. In Stedman parlance, we call it an "odd bob" composition, instead of "twin bob".

Now, how can a conductor follow what's going on? Although I said the calls were like Wrongs and Homes, actually the coursing order is a little different compared to, say, Plain Bob, or Surprise. The working bells are 1, 3, 4 and 5 (both 2 and 6 are fixed throughout the touch, meaning they also make very good bells to call it off). From the 7th, you can check the bells that have made the bob or single at 12 (the "Home") very easily, because you pass them in order as you come out quick, just after that calling position. For the first three courses, the order of the bells at this point is:

541
154
415

Can you see how the bob at 12 works the opposite way to Plain Bob, taking the last bell to the front (ABC→CAB), instead of the first bell to the back (ABC→BCA)? If you know that a single permutes the same way as Plain Bob (ABC→CBA), the next six courses will also make sense: 315, 531, 153, 351, 135, 513. The final six courses follow the same pattern, starting with 413.

Because the 2nd and 6th are completely unaffected throughout the course, you can learn where you pass or work with them, to make sure they are still in the right place. If they're not, remember, you don't have to put them right – you can just say "stand". More than with any other method, in Stedman democratic principles should hold, with everyone responsible for their own actions!

This style of composition extends naturally to ten and twelve. For example:

<https://complib.org/composition/22957>

<https://complib.org/composition/22962>

The calls at the 15th six in Caters, and the 18th in Cinques, are much like our "Homes" at 12 in Triples. On higher numbers we do have to do a bit more learning, though: I am afraid there is no getting away from this, those opening and turning courses have to be got down by rote. It is the normal and inalterable course of nature that the back bells are "thrown into the Tittums, where they most likely ever will remain"; at least until the turning course that brings up the Handstroke Home. I would like to set down, however, that learning is good for you. Particularly as you get older, make sure you keep learning compositions! Here is my best tip. If you don't think you are very good at learning things, and you don't enjoy doing it, simply pretend that you are, and that you do. You will find it becomes easier. Own it.

These "turning course and odd bobs" schemes can be extended to peals for Caters and Cinques, but sadly this does not work for Triples. If it did, our predecessors would not have spent all those centuries struggling with the method. So here, I recommend turning to Thurstans, or Johnson. I have reached the end of my talk now, but if you want to know more, I would direct you to the many good articles that have appeared in the Ringing World over the years, and also to the seminal work "Stedman" by J Armiger Trollope, published in 1937, but forever young.

I hope that was useful. Good luck in your Stedman ringing, and conducting, career!