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The Horological Journal

SEPTEMBER 2018
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ANNIVERSARY EDITION

BHI 160 YEARS

1858–2018

The World's Oldest Monthly Technical Journal
published continuously since September 1858

BRITISH HOROLOGICAL INSTITUTE

BHI 160 YEARS

AWARDS DAY 2018

Join us in recognising the successful achievements of our students
on Saturday 27 October at Upton Hall (Please note that this is by invitation only)

Prizewinners 2018

With thanks to prize donors for their support

	Diploma in Clock and Watch Servicing – Best Result **British Watch and Clock Makers Guild**	**Tim Bankes**

Unit Prizes

D1	Best Theory Paper, Clocks / Watches **Malcolm Barratt Prize**	**Tim Bankes**
D2	Best Technician Grade Practical Test Piece **The Beresford Hutchinson South London Branch Prize**	**Tim Bankes**
D3	Best Serviced Carriage Clock **Charles Dilley Memorial Prize**	**Tim Bankes**
D4	Best Serviced Quartz Watch **QP Magazine Prize**	**Tadas Danusas**
D5	Best Practical Test Piece **The Time Aeon Foundation Prize**	**Kes Crockett**
D6	Best Drawing, Clock / Watch Escapements **Malcolm Barratt Prize**	**Adam Jackson**
D8	Best Recoil Escapement **Iain Campbell Memorial Prize**	**Adam Jackson**
D9	Best Serviced Striking Clock **BHI Prize**	**Tyler Davies**
D11/18	Best Theory Paper (Clock or Watch) **BHI Prize**	**Rob Kramer**
D15	Best Serviced Manual Winding Watch **Arthur Tremayne Memorial Prize**	**Christopher Roushias**
D16	Best Serviced Automatic Watch **BHI Prize**	**Tom Felton-Smith and Kris Stanulewicz**
D20	Best Serviced Chronograph Watch **BHI Prize**	**Kris Stanulewicz**

Qualifications Awarded in 2018

Diploma in Clock and Watch Servicing, Level 3					
Mark Baird	Clock	Pass	**Roger Lampert**	Clock	Pass
Tim Bankes	Clock	PwM	**James Morris**	Clock	Pass
Roddy Bell	Watch	Pass	**Peter Mundy**	Watch	Pass
Thomas Hannagan	Clock	Pass			

Diploma in the Servicing and Repair of Clocks / Watches, Level 4			
James Northwood	Watch	Pass	

No candidate this year met the required criteria for the **George Daniels Educational Trust** prize for the Best Result of the Diploma in the Servicing and Repair of Clocks/Watches

The First Word

It seems incredible, because it also seems like only yesterday, that it is now ten years since the British Horological Institute celebrated its 150th anniversary over a long weekend in June and in temperatures as blisteringly hot as those we have been experiencing recently. I think many people were surprised that the BHI had survived for so long, given its long history of fluctuating membership and consequent financial constraints. However, the BHI has proved itself remarkably resilient in the face of difficulties it has encountered over the years. Now, at 160, it continues to maintain and develop its role in the forefront of horological education in the UK.

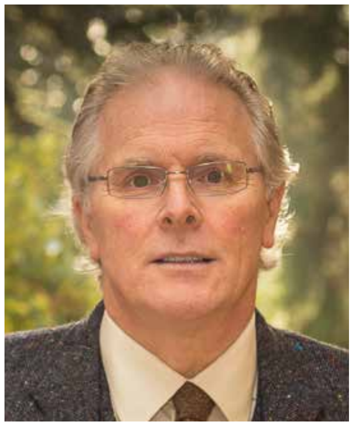
Like other decades in the Institute's history, the past ten years have not been without their difficulties and disappointments. However, it is encouraging to see how these have been faced and overcome and we continue to thrive with increasing confidence in the future.

For many members, though, it is the monthly *Horological Journal* dropping on to the doormat which is the most tangible achievement of the BHI. This month marks the 160th anniversary of the first issue in September, 1858 – and we should not just note it, we should celebrate it.

In the very first *HJ*, the Editor was keen to encourage the new readers to contribute to its pages, writing: 'There are among the practical followers of horology those who by wealth and attainments have great power of action. We appeal to them to lend a hand .... To give by their energy and talent a character to a movement that is surely worthy of the best of us, namely – THE PROMOTION AND ENCOURAGEMENT OF INTELLECTUAL SUPERIORITY.'

This last sentence may seem a little pompous today, but it did have the desired effect. Horologists, many of whom up to this point had not considered themselves men of words, did indeed make significant contributions to the *HJ* and to the increase of horological knowledge. This trend has been followed by generation after generation of BHI members and it is their enthusiasm and generosity that makes the *HJ* such a varied and fascinating read. It is the liveliest horological publication around – in my opinion that is, but then, I am biased!

The first Editor of the *Horological Journal* was James Breese and his pioneering work is expertly continued today by Rachel Reeves. Happy 160th birthday, *HJ*. Long may you prosper!



Alan Midleton FBHI
President

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The front cover of this commemorative issue of the *HJ* shows the BHI Bronze Medal, awarded to any student who has achieved the highest pass rate result at 70% or above for the Diploma in the Repair, Restoration and Conservation of Clocks/Watches. The back cover shows the list of the original proposers of the BHI, along with the donations they made for the establishment of the Institute. The names are:

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(Unclear, possibly Trewinnard)
H. Richards
M. Whiting
George Dunkley
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Daniel Medcalf
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Letters

Spring Forward

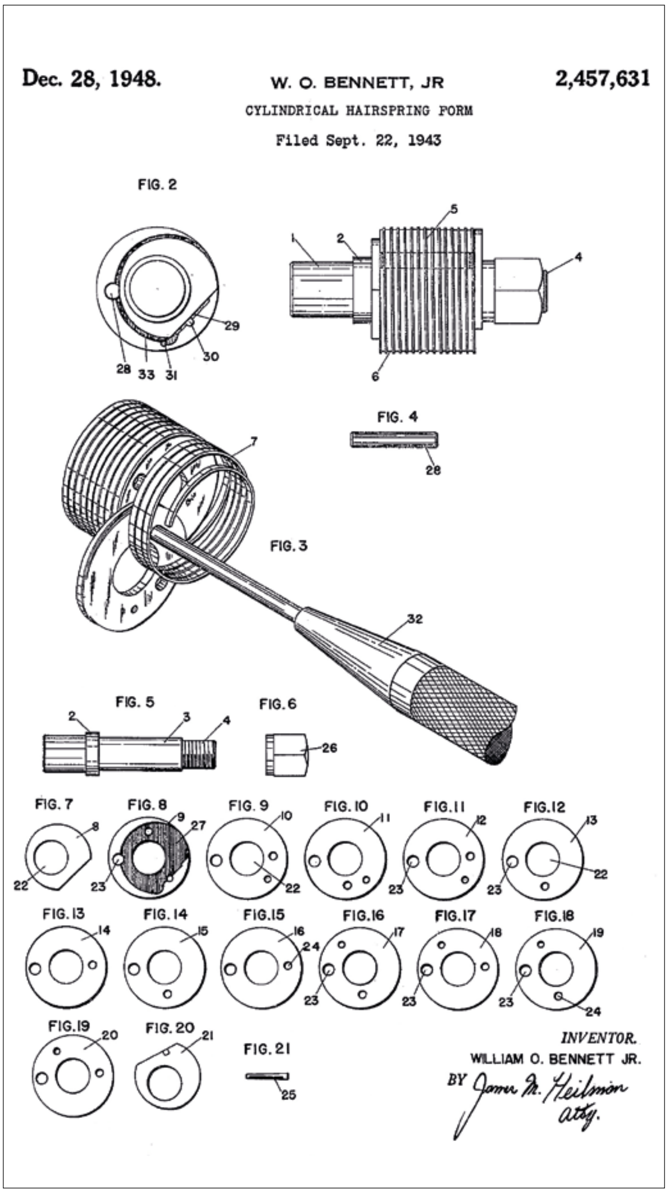
I would like to thank Graham Morse for his correspondence with me and his letter about duo-in-uno and tria-in-uno balance springs (*HJ*, August 2018). Something that Graham didn't mention in his letter, possibly to spare my blushes, is that David Penney also said that tria-in-uno springs have a definite second spiral. Graham and I are grateful to David Penney for this information, which means that I was wrong to suggest that Hammersley might have termed the spring illustrated in Figure 2 of my article ('Duo-in-Uno and Tria-In-Uno Balance Springs', *HJ*, July 2018) a tria-in-uno.

I speculated that tria-in-uno balance springs were rare because of the difficulty of removing from the former a hardened spring with a coil at both ends. This idea was based on the simple former for duo-in-uno balance springs illustrated by Daniels that I referred to in the article. I should have given greater respect to the ingenuity of watchmakers.

For their Model 21 chronometer, the Hamilton Watch Company wished to manufacture a balance spring with terminal curves in a way that would require no further manipulation. This meant that the spring had to be made on a former and, after heat treatment, removed from the former without distorting the terminal curves. To achieve this, a former composed of numerous discs on a central arbor was created. After the spring was formed and heat treated, the central arbor was withdrawn and the individual discs slipped out between the coils of the spring. This was patented as US patent No. 2,457,631, application filed 22 September 1943. The figure from the patent reproduced here shows the former and requires little explanation. The hole in the discs labelled 23 takes a pin, 28, which ensures that the discs are aligned so that the helical groove cut on their outer edges to guide the wire is continuous. The tool labelled 32 screws into threaded holes on the discs so that they can be separated after heat treatment, which presumably caused them to stick together.

No doubt the ingenious Hammersley would also have conceived a method of making a former that could be removed from tria-in-uno balance springs without distorting them.

Eur Ing David Boettcher CEng MIET



The Worth of Tulips

I very much enjoyed Spiridion Azzopardi's article 'The Paramythia Clock Tower' (*HJ*, June and July 2018). It is a fine and comprehensive historical overview, and the tulip decoration on the clock is also mentioned.

With regard to the fact that in the sixteenth century the tulip was worth its weight in gold, here are a few additions.

400 years ago, tulips in Holland were rare and very expensive. They had been brought by merchants from Turkey to the Netherlands, as well as the snowdrop bulb.

They were so expensive that one could buy a precious merchant house in Amsterdam for two tulip bulbs. The famous painter Rembrandt invested a fortune in tulip bulbs.

The Dutch succeeded in culturing tulips, after which the price collapsed to virtually zero. An early synthetic diamond story?

Adrian Van Der Meijden

Omega: The First Dive Watch

In 'From the Auction Room' (*HJ*, July 2018), Richard Fox refers to the Aqua-Lung patented in 1943 by Cousteau and Gagnan, which is often thought to be the first self contained underwater breathing apparatus (SCUBA). It was in fact an improvement of a much earlier invention by Commander Yves Le Prieur of the French Navy.

In 1925 Le Prieur saw a demonstration of Fernez lightweight diving equipment fed with air by a tube from the surface. Knowing that Michelin had recently started to deliver air for inflating tyres in steel cylinders at high pressure, Le Prieur immediately realised that an air cylinder with a hand operated regulator could be used instead of the tube from the surface;

the SCUBA was invented! Le Prieur and Maurice Fernez demonstrated the apparatus publicly in 1926 and it was officially adopted by the French Navy.

In his book *The Silent World*, Cousteau published a photo of Le Prieur diving using another of his inventions, a full face mask that he had patented in 1933. Cousteau called the Le Prieur SCUBA 'the ancestor of our aqualung'. Cousteau and Gagnan improved it by replacing the hand-operated regulator with a 'demand valve' that delivered air only when the diver inhaled.

Where is the horological interest in this? In the photo of Le Prieur, he wears an Omega Marine on his left wrist. Introduced in 1932, this was the first watch to be independently tested for water resistance. In May 1937 the Swiss Laboratory for Horology in Neuchâtel certified the Omega Marine as being able to withstand a pressure of 13.5 atmospheres, equivalent to a depth of water of 135 metres (445 feet). This was the first official certification of water pressure resistance of any watch, making the Omega Marine the first 'dive watch'.

Eur Ing David Boettcher
CEng MIET

Items for Disposal

Recently, we noticed slates were becoming detached from the roofs of the ancillary buildings opposite the Clockhouse Café at Upton Hall. Closer inspection has revealed rotten timbers, faulty gutters, rotting window frames etc.

Listed building consent is necessary before the repairs can be commenced. We have to prepare a notice complete with documents to demonstrate the work will be in keeping with the original construction. The notice has to be submitted to the Conservation Officer, who has already visited the site and agreed repairs are necessary.

However, before the work can safely commence the contents of one of the buildings, the Garden Store, must be cleared.

Many of you will know that the BHI has, over the years, acquired large and small items that 'may be useful one day'. In the Garden Store are three categories

Letters

of items: a) pure junk such as broken furniture, old temporary directions signs etc. b) horological machinery acquired from Manchester and c) other horological items which need to be rehoused before being conserved.

The Garden Machinery store was full to the extent that it was impossible to see what was actually in the building. With the assistance of Jan Wright, Alan Jones and Alan Atkinson (in between his other duties), two skips have been filled during July from this small building alone.

This allowed us to view the machinery, assess the condition, record and photograph it ready for disposal.

The BHI Directors have resolved to give all BHI members the opportunity to submit sealed bids for the items from the Garden Store. There is also a quantity of smaller items, which are surplus to requirements.

Full details will be posted on the members' area of the website towards the middle of September.

Nick Brown
Director - Upton Hall Estate

Note: To log in you will need your membership number and password. The latter is bhi[lower case first name initial][lower case surname initial]. So if your name is John Smith, your password will be bhijs.

Speaking Out – An Addendum

Further to my letter in the August edition of the *HJ*, I would like to add two more points. First is the importance of encouraging more horologists to be prepared to give talks. Varying views and experiences need to be broadcast to create discussion and to debate further all aspects of the world of timekeepers and timekeeping. The other point to make is that when I ventured to give talks all those years ago, invariably there would be a letter of thanks and appreciation. This very rarely happens these days. This is something that really should be addressed within any code of practice for those who arrange talks and lectures. Whilst a letter is probably most unlikely nowadays, surely at the very least a message could be sent by the ubiquitous email.

Andrew King

Correction

The letter headed 'Speaking Out' (*HJ*, August 2018) should have been attributed to Andrew King. We apologise for the error.

Obituaries

Rita Betty Bailey FBHI

The first female Fellow of the BHI, Rita Betty Bailey FBHI, has died aged 86. Rita achieved her Fellowship in 1954, aged just 22, by a unanimous Council election. She also gained first class passes in her horology course at Hanson Technical Institute in Bradford and ran her own business in Halifax. A full obituary of her life and work is forthcoming.

Dennis Moore

Horological historian Dennis Moore has died aged 92. Author of the book *British Clockmakers and Watchmakers Apprentice Records 1710–1810*, he was a volunteer and researcher for over 20 years at the Prescot Museum before moving to National Museums Liverpool. A full obituary of his life and work is forthcoming.

Apprenticeships

The draft standard of the clockmaking apprenticeship will be published on the BHI website's Members' Area.
Please email any response to
clockapprenticship@hotmail.com (sic)
by Thursday 20 September.

BHI Photography Competition Postponed

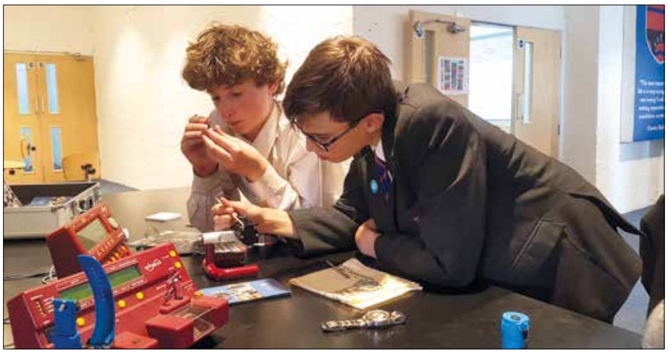
The BHI has had to make the decision this year to cancel the annual photography competition. This has proven very popular in the past two years, thanks to the efforts of Ross Alcock. However, this year Ross has understandably had to focus on the commitments of his business and his role in chairing the working group for creating a new clockmaking apprenticeship. Staff at Upton Hall have also had little time between other duties to market the competition further. As a result, we have had very few responses and have decided to postpone the competition until next year when we will review the situation to find the best way forward.

We would like to thank everyone who submitted entries, as well as Robert Loomes for his kind offer to donate the prize money.

Nurturing Young Talent at Fulham

Earlier in the year, the BHI was asked to provide training media for The Worshipful Company of Clockmakers, for its presence at the London Livery Showcase at Guildhall.

Shortly after the event, the BHI was invited by Ben Maddison, the Assistant Head Teacher of Fulham Boys School to the Science, Technology, Engineering and Maths 'Big Bang Fair' – a careers event to be held at the end of summer term for the 1500 students at the school.



Armed with the usual training media, watch timing testing machines, BHI stress balls for self-defence and sweets for bribery, Zanna and I bravely ventured into the school grounds, not knowing what to expect. Of course, the sweets went down well and most of the stress balls were confiscated from some over exuberant pupils by teachers, but it soon became clear that some of these students were fascinated with the workings of our training watch movements. On occasion, they were a little too fascinated and one or two jewels were dropped on the floor to be lost forever!

However, two 13-year-old students in particular – Phillipe Andrewitch and Armand De Lambilly – seemed to spend the whole day with us at our stand. After we had explained how to adjust the timekeeping on the movements and test them on the watch timing machines, they ended up telling other students what we were doing and showing them how to do it. The upshot is that both pupils have been invited for a day at Upton Hall. Hopefully our tutors will teach them a thing or two, and not the other way round. Talent for the future? To be continued…

Brian Noble, Operations Manager

Europe's Greatest Antiques Fair

If there's one place you're sure to find lovers of clocks and watches, it's an antiques fair. So when the largest one in Europe was held almost on Upton Hall's doorstep, the BHI was sure to be there.

Thousands of people, both trade professionals and members of the public, flocked to the world-renowned Newark International Antiques & Collectors' Fair (IACF), at the Newark and Nottinghamshire Showground last month, one of a number of fairs that the IACF hold annually across the country. There, among the 2,500 stands, Brian and Zanna flew the flag for the BHI, sharing all the details of our education programme.

The takeup for the taster days was almost immediate. We could see there were a great many clocks and watches at the fair and we seemed to create a lot of interest in the BHI.

We are very grateful to the fair management and hope to forge good links between us and the antique collectors of the future.

I'd especially like to thank the fair management and Rachel Everett for their generosity in allowing us to attend the show. This is Europe's biggest antiques collectors' fair, and with so many people looking to learn more about clocks and watches. We were delighted and privileged to be there. Next stop, the IACF fair at Alexandra Palace on Sunday 2 September!

Brian Noble, Operations Manager

Swiss Conference Marks BHI's 160th

A Swiss conference on 3 November will mark the BHI's 160th year and celebrate Swiss-UK horological relations.

A collaborative effort between the BHI and the International Museum of Horology, the event at Théâtre L'Heure Bleue in La Chaux-de-Fonds will feature speakers including David Penney, Anthony Randall, Stephen Forsey, Robert Loomes and Dr Rebecca Struthers.

It coincides with the nearby Museum's English Time exhibition.

Baselworld: An Analysis

In July, Swatch Group CEO Nick Hayek announced that all 18 Swatch brands were leaving the MCH Group's annual Baselworld Show, blaming its lack of progress and engagement with exhibitors and too little return on investment. Shortly afterwards, MCH Group CEO René Kamm resigned. Hundreds of other exhibitors have also left the fair in recent years. Here, two industry experts give their analyses of the situation.

Baselworld at the Crossroads

Martin Foster FBHI

On Friday 3 August, René Kamm resigned as CEO of the MCH Swiss Exhibition (Basel) Ltd. Kamm was appointed CEO in 2003 with overall responsibility for the now beleaguered Baselworld Show. His resignation is perhaps the last piece in the playout of the management collapse of MCH following disruptive unrest within the Baselworld exhibitors. Prior to this, Baselworld Managing Director Sylvie Ritter resigned in June. This followed a turbulent Baselworld 2018 show which suffered a 50 percent drop in exhibitor numbers over 2017. At the same time, Sales Director Martin Fergusson and Marketing & Communications Director Loraine Stantzos also tendered their resignations.

Finally, two months later, Mr Kamm's departure was triggered by the stormy withdrawal of the Swatch Group from Baselworld 2019. In an interview with the NZZ am Sonntag, Swatch Group CEO Nick Hayek announced the withdrawal of his exhibitors (18 brands, including the heavyweights Omega and Longines) from Baselworld as of 2019. Swatch was the biggest Baselworld exhibitor; its reported budget for all Baselworld-related costs for its brands was 50 million Swiss francs (CHF). This included booths, travel, accommodation, staffing, food, hospitality and so on for the six-day show. Certainly within the MCH Group, the withdrawal of such a huge budgetary sum did get guaranteed attention.

But Swatch Group's withdrawal came as a surprise. On Wednesday 28 March, the day after the 2018 show closed, Baselworld issued a press release declaring that 'all leading brands will exhibit at Baselworld 2019'; the Big Five would be back. Sceptics around the industry were, however, waiting for the first of the big Hall 1.0 exhibitors to 'blink'. Many believed it would be Breitling, which is openly fidgety about its continuing association with Baselworld. Swatch Group, however, felt free to be a bit cavalier with the unresponsive MCH management as it was emboldened by its triumphant, record (unaudited) half-year results:

Net sales up by 14.7% to CHF 4,266 million at current exchange rates.

- Operating result up 69.5% to CHF 629 million.
- Operating margin up from 10.0% on the previous year to 14.7%.
- Net income increased by 66.5% to CHF 468 million.
- Massive gains in market share in all price segments and regions.

These numbers are consistent with the export statistics published by the Federation of the Swiss Watch Industry FH which commented: 'Exports of timepieces priced at more than 500 francs experienced sustained growth. The strongest growth was achieved by watches priced at more than 3000 francs whose value rose by a strong 16.7%.'

The difficulty for the Swiss industry is that 10–15 years of deteriorating goodwill cannot be rectified overnight as it has morphed into a Basel 'culture'. It is not just the exhibitors who are objecting to the notorious rapacity. As reported already in these pages, 110,000 buyers and journalists must come to the city of Basel during the show and feel trapped in the finely honed culture across Basel of relentless personal and corporate wallet gouging.

Today, we can see that there is not much sympathy for Baselworld or the MCH management, which implemented outrageous pricing within the show and set an appalling example for what took place elsewhere within the city. We won't know if there is a future for Baselworld until the MCH management issues are sorted and the scope of changes must be sufficient to entice exhibitors to renew each year.

One question that remains is whether Swatch Group's decision is really final or if it constitutes a bargaining tool, but any possible return will need to be on the basis of broad culture and financial change. Attempts to coax the world's leading watch group back to the Baselworld premises are likely to be well underway, but after all, this is not the first time that the Swatch Group has left the Baselworld Show, or the Basel Fair as it was known.

In a very frank interview with American network CNBC, Mr Hayek challenged the raison d'être of the giant trade shows: 'The old traditional watch fair doesn't make sense anymore. If you look around the world we are close to the consumer, close to the retailer,' he said.

Mr Hayek went on to accuse Baselworld's executive team of lacking the clout to make real progress: 'I invited the executives and told them they have a big opportunity to change. The Swiss watch industry is booming, so now is the time to make changes. All of the Swiss watch industry is ready to help, not just Swatch Group. But you must open up. You must do something now.'

He concluded: 'We are ready to help, but for 2019 we are definitely out.'



A Perspective from Switzerland

Serge Maillard
Managing Editor, *Europa Star*

René Kamm's resignation sounds like the end of an era: that of a fast-growing Baselworld that could spend hundreds of millions on its infrastructure and claim for itself an ultra-dominant position in what was then a very 'vertical' and top-down industry and world. The strategy had been successful for a while, but the new digital, 'horizontal' world changes everything. I would even compare the problems of Baselworld with the downfall of Swissair, our former national pride, with its over-expansion strategy of the 1990s. Swiss companies seem to work best with some degree of self-moderation and constructive openness to criticism…aligned with our political culture!

Swatch Group's withdrawal happens after years of a phenomenon that we have called 'Basel-bashing'. It has become very common, almost a habit, among brand representatives, retailers and journalists to criticise the fair. Keeping a good reputation, or good dynamics, could have made up, somehow, for the diminishing relevance of all trade fairs, as retailers are less and less 'courted' by the brands and as the discussion goes on all year long through the internet.

Why have Swatch Group, and hundreds of others, withdrawn from Baselworld in recent years? The historical monopolistic position of Baselworld as a trade fair created a mindset that made it seem out of touch with the reality and depth of criticism. It lacked innovation in adapting to the digital age. There were year-after-year battles around costs such as booths and accommodation and an unfavourable comparison with the growing challenger, SIHH in Geneva. More fundamentally, I would say that Baselworld has evolved to be as much a marketing event as a sales event. However, as brand boutiques and new subsidiaries of watch brands increase, company budgets are split more than ever between virtual and physical investments, and the growing importance of local events. At some point, the will to invest in a 'one size fits all' global fair like Baselworld is simply not there any more. The middle-range brand Eberhard & Co left the fair last year, investing the saved money in its own events. Swatch Group does the same today on a larger scale.

How will other brands react? Rolex or Patek Philippe, for instance, are known for their consistent strategy over the years and do not appreciate sudden changes. Baselworld management assures us that other brands have confirmed their presence for 2019, but they already announced in March that all big brands would be present, including Swatch Group, so this must be taken with caution. The big question as far as Swatch Group is concerned is whether it will organise a 'Swatch Fair', which may or may not coincide with Baselworld. The Movado Group, let us recall, left Baselworld last year and organised an event this year in Davos.

Swatch Group announced record numbers for the first half of 2018, days before it withdrew from Baselworld. It shows that there is a real existential threat for the trade fair. Swatch Group can probably live without Baselworld but can Baselworld live without the Swatch Group? Swatch Group is providing the Basel fair with an 'electroshock'. In my opinion, Baselworld would be well advised to focus much more on what makes the essence of the watch culture today. It could for instance introduce vintage watches and try to target both professionals and end consumers. In a nutshell, address the whole watch world as it exists today.

It is critical for Baselworld to show that it is ready to take bold steps to evolve. It must repair its image to build trust again. I personally believe that even in the digital age, a yearly 'ritual' like the Basel fair can still make sense. Baselworld cannot really be replaced by the SIHH, which is focused on high-end watchmaking. The fair has this unique feature to gather brands from very wide horizons, from Japan to Belgium (and not only the Swiss brands), from affordable to ultra-exclusive. But to survive it should have smaller financial ambitions and greater cultural ambitions.

Will Swatch Group return this time? It will depend on the scope of the changes and the restoration of the long-lost Baselworld prestige. Swatch Group is probably the watch group that was most like the fair's own profile: both global and very diverse. Like others, Swatch Group complained that it was not being included enough in the revival of the fair. We can, however, still dream of a fair that is connected both technologically and culturally to the new reality of the industry. The watch culture is flourishing on the international markets.

Now, Mr Kamm's resignation also paves the way for Michel Loris-Melikoff, the new manager of the show, to have a fresh start. He has not been compromised with the strategies of the past and it will hopefully make his task easier.

Synchronome Revisited

A Gift of Time

Philip Kuchel

Motivation

It is a cliché, I know, but as the saying goes: 'Our time is the most valuable gift we can give.' So with two years ahead of my brother Tim's 65th birthday, and inspired by suggestions from several members of the Sydney Clockmakers Society (SCS), I set out to make such a gift to him. Interpreting the quote literally, it took my personal time, and yielded something that represents time, and our connection, in the longer term.

I decided to make a version of a Synchronome master clock, having read Hope-Jones's book Electrical Timekeeping when researching the O'Leary and Earl of Meath's free-pendulum clocks.[1–4] Hope-Jones rather quaintly refers to his device as a 'time transmitter', and he provides an excellent description of its mechanism of operation and detailed plans for its construction.[5] In the process I would explore various methods of making components, use modern materials and technology, and study the basic mechanism with a view to, perhaps, improving it. I thought that readers of the *HJ* might be interested in learning about these ideas for their own clockmaking projects.

Components

Case

Figure 1 shows the final result. The mechanism is housed in a modern case with a 25mm thick marine-ply backboard (for stability) with ebony veneer, solid ebony surrounds, concealed milled aluminium supports top and bottom, and glass panels with one opening on the left-hand side for access to the hands and pendulum.

Pendulum

The Invar rod has a total length of 1.15m with an attached bob of 76 × 810mm copper tube that is filled with fine lead shot, making this a '1m pendulum'.

Beat Plate

The arrangement with the beat plate fixed to a stand projecting up from the bottom of the case, in a horizontal arc of brass sheet, is a departure that I have seen on only a few clocks. An advantage of this plan is that the printed-and-laminated scale (calculated using *Mathematica* to read actual degrees[6]) can be readily slid into the dead-centre position under the pointer on the end of the pendulum rod. A beat plate simply attached to the back of the case does not allow this. In its present installation, the clock has a pendulum amplitude of two degrees on either side of centre.

Dial

As the focal point for most casual observers, the dial, **Figure 2A**, needed to convey the clock's *raison d'être* – the celebration of Tim's 65th birthday. The dial was drafted in Adobe Illustrator, laser printed onto standard A4 paper, and then laminated with Celloglas. I wanted to record the assistance I had received from SCS members and others in the project, so I added the requisite information around the dial, just outside the chapter ring. This wording occupied only half of the circle so for visual balance I needed to fill the rest of it. Why not add π to as many decimal places as required to complete the circle? This turned out to be 254 (generated in *Mathematica* as before) and it is, of course, a quirky talking point.

Hands

These are brass art-nouveau-esque renditions of Tim's initials (TRK), with the hour hand carrying a counter-poise shaped like a spiral shell with a tail, making it appear like the letter 'Q' (hence 'Q-shell' a phonetic rendition of our surname), **Figures 1, 2A and 2B**. This is the insignia I use for fun on my horological projects.[7] It also appears on the dial under the maker's name and city. The minute hand is counterpoised by an 'R' shape with a small additional weight to ensure proper action of the slave movement.

Figure 1. Modern Synchronome-based electromechanical clock.

Bezel

This posed the first main challenge in constructing the clock, and bezel-making by various approaches had been the topic of previous discussions in the SCS. I settled on fabricating it from 9.5mm square-section engraving brass. To bend it readily into a circle it was heat-annealed. With one end held in a vice and the other in the jaws of a large adjustable spanner, I manually formed a circle. This was much easier than I had anticipated, and after repeated by-eye tweaking of the shape, I cut across the overlapped ends of the circle. Running a thin file between the cut ends that were under tension from the split circle, I was able to ensure a close and parallel fit between that the mating faces. A piece of flattened silver solder was placed between the two faces, along with a generous amount of flux, and this was then heated on a graphite plate under a

Figure 2A. A close-up of the dial, hands and bezel.

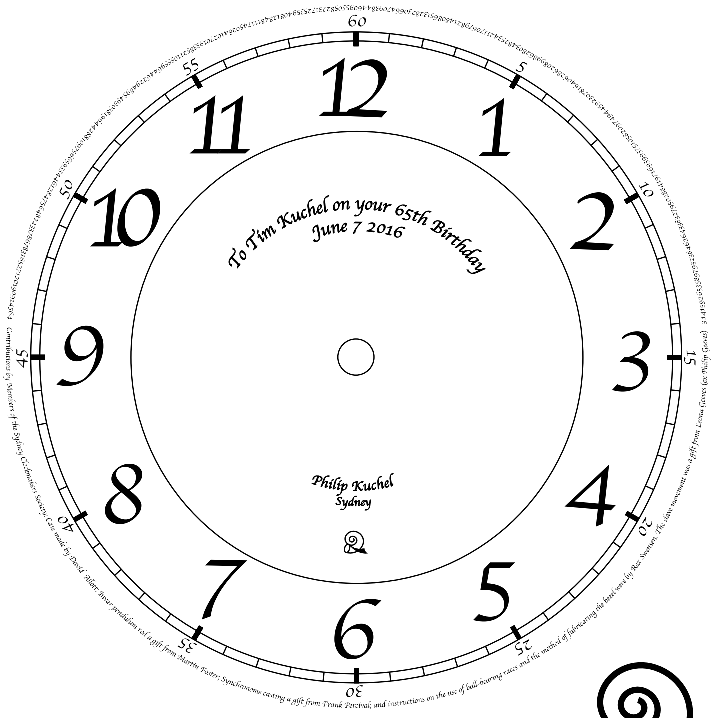


Figure 2B. Detail of the printed dial.

Figures 3A–C. Three stages in the production of the brass bezel. A: Silver soldering the butt joint of the brass ring. B: Fixing the brass ring by six screws to a 3mm thick brass disc that in turn was bolted to the faceplate of a Myford Super7 lathe. C: The final result before it was polished and gold plated.

liquid-propane flame on a fire-brick stove, **Figure 3A**. The circle was then fixed by 6 × 3.5mm metric screws to a brass disc 3mm thick that had been turned, using the faceplate on my Myford Super7 lathe, **Figure 3B**. After truing the outer and inner diameters, a chamfer was turned in the brass circle to complete the bezel, **Figure 3C**.

The brass disc then served as the dial plate for the clock, notwithstanding the four fixing holes that had been used to attach it to the faceplate.

Pendulum Brackets and Trunnion

Hope-Jones describes a trunnion and bracket system that has the important feature of allowing adjustment of the position of the pendulum rod and impulse pallet, to avoid clashing of components and giving correct alignment of the rollers on the pallet slope.[8] The details of the arrangement are seen in **Figure 4**.

Figure 4. Bracket and trunnion supporting the pendulum on a steel suspension spring.

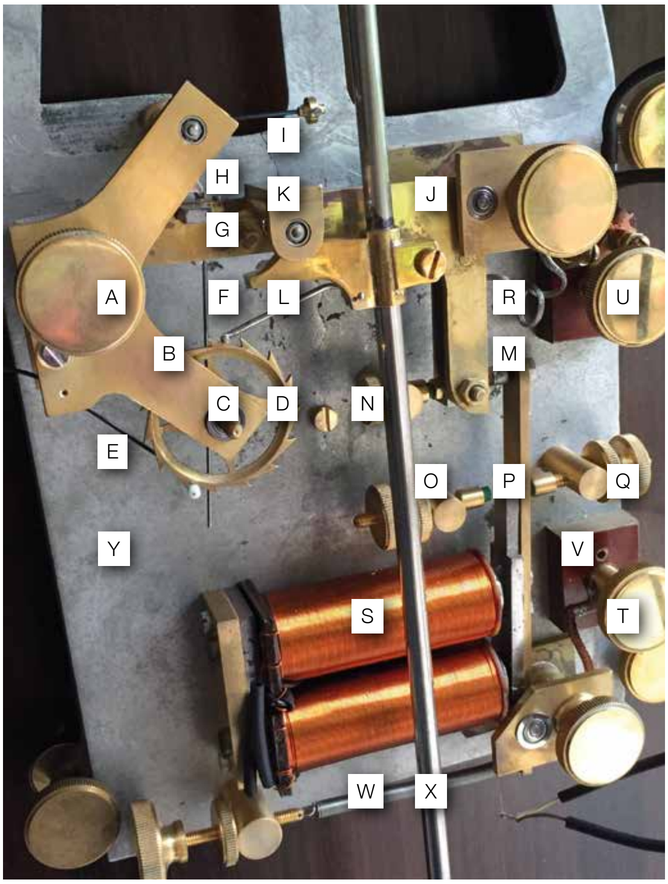


Figure 5.

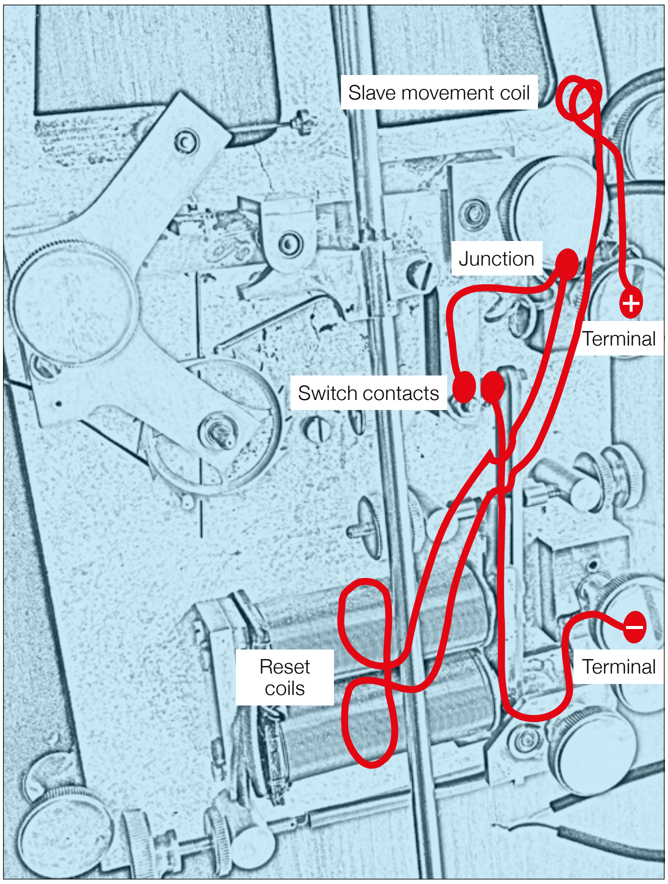


Figure 6. Electric circuit outline on a sketch-form version of **Figure 5**. *The electrical terminals, coils, switch contacts and wire junction are indicated. The main diagonal wires actually pass behind the base-plate.*

Layout and Identification of the Components of the Synchronome-based Clock

A. One of 14 large (25mm diameter) knurled knobs.
B. Front bearing plate.
C. Arbor of 4mm brass in 9mm o.d. steel ball-race.
D. Ratchet wheel with 15 teeth.
E. Detent of blue pivot steel with Teflon acting surface.
F. Unlocking vane with diametrically opposite counter balance.
G. Locking bar of hardened 3mm steel gauge plate.
H. Catch of hardened 3mm steel gauge plate.
I. Counter-balance arm and weight.
J. Gravity lever, L-shaped with horizontal and vertical arms.
K. Bracket on gravity lever with impulse roller pivoted in steel ball races.
L. Pallet attached to pendulum with gathering pawl of mild steel wire.
M. Silver contacts.
N. Adjusting knurled nut and screw with end housing a buffer of Habasit (commercial round, synthetic belt polymer like hard rubber); limits upward travel of gravity arm as it resets.
O. Lockable (with knurled nut) adjustment system preventing contact of armature with poles of electromagnets.
P. Soft iron armature and brass extension holding silver contact.
Q. Lockable (with knurled nut) adjustment system controlling drop of gravity arm prior to resetting in locked position.
R. Braided electrical cable.
S. Electro-magnets.
T. Electrical terminal.
U. Electrical terminal.
V. Insulating Bakelite block.
W. Spring with lockable tension adjustment to rapidly re-set the armature after an impulse.
X. Invar pendulum rod.
Y. Cast aluminium base-plate of Synchronome design.

Base-plate and Layout

In commercial Synchronomes the base-plate is made from cast iron, but the one I was given is of aluminium. It was intended as a mould for cast iron copies but time passed and these were never made. The casting has imperfections and yet they were well concealed by coating the base plate with black automotive wrinkle paint.

Figure 5 shows the various components of the electro-mechanical device before they had been polished and gold plated, and the base-plate painted. Several of them warrant further comment:

1. I chose knurled knobs as a design theme, so I made 14 of them (25mm o.d.), to be deployed around the

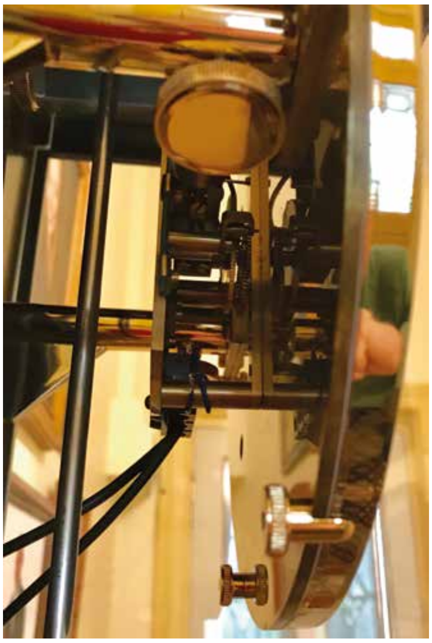


Figure 7. Slave movement behind the dial, also showing the means of attaching the bezel to the dial plate with knurled nuts, and in turn the attachment of the dial assembly to two brass pillars onto the back-board.

Figure 8. Left oblique view of the movement.

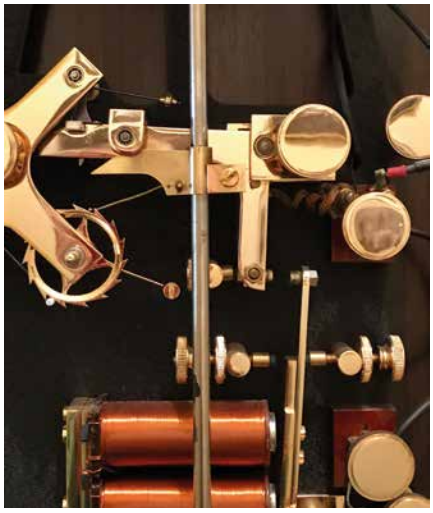


Figure 9. Front view of the movement.

mechanism in places where otherwise one might expect simple cheese-head screws.

2. Smaller knurled knobs are used on the stops, with knurled nuts used for locking adjustable-depth screws.
3. There are 12 small steel ball races used in pivot holes: on the armature on the electromagnet, the gravity arm, the arbor of the impulse roller and two also serving as the roller itself, and on the ratchet and catch pivots.
4. The electrical contacts on the end of the armature, and the vertical limb of the gravity arm, are silver cylinders from an old high-current switch.
5. The gravity arm catch and locking bar on the gravity arm are made from 3mm gauge plate and both were quench hardened, and polished after fabrication.[9]
6. The two electromagnets were made from 0.4mm lacquered copper wire wound onto soft iron cores salvaged from high-voltage relays. The winding was done with a core mounted in a 6mm Lorch-Schmidt watchmaker's lathe and manually feeding the wire onto the work. Obtaining very uniform winding was much easier than I had expected. Yet, for a smooth final layer, I cut a rectangle of X-ray film and taped it onto the coil to form an even substrate for the top layer of windings.
7. The detent that acts on the ratchet wheel is of blue pivot steel tipped with a Teflon cylinder.

Electrical Circuit

Figure 6 shows a sketch-form of **Figure 5**, with the electrical circuit of the clock in a bold overlay. The two terminals are connected to a 9-volt DC supply capable of delivering 1.5 amps. The switch contacts are closed by the release of the vertical part of the gravity arm swinging from left to right, after the catch is nudged off the locking bar by the tripping vane (wire-arm) on the ratchet arbor.[10] Current flows in series via the slave movement (advancing the minute hand 30 seconds) to the re-set coils which impulse the armature, which in turn lifts the gravity arm and re-sets it to the locked position.

Impulsing the pendulum: The pendulum is impulsed by two ball-races that form the roller. This is pivoted in the bracket of the gravity arm, rolling along (under gravity alone) the slope on the pallet arm. This occurs every 30 seconds when one of the tripping vanes (the other is bent out of line so as not to connect with the catch but to be a counter-balance) nudges the tail of the catch and displaces it from the locking bar on the gravity arm. The gravity arm then drops down, bringing the impulse rollers onto the pallet slope.

Re-setting the gravity arm to its locked position occurs as described above (under Electrical Circuit) ready for re-release 30 seconds later.

Slave movement: This has the appearance of an early twentieth century slave movement and is not a typical Hope-Jones design, **Figure 7**. It has no identification mark and yet I suspect it is American. It has a 120-tooth ratchet wheel that is advanced every 30 seconds by a driving pawl. The minute arbor drives the hour hand via a typical 1:12 motion work train.

Various Inspection Angles

Figure 8 shows an oblique view of the movement from the front-left. It shows the pallet which has a straight impulse slope, which is a significant departure from the previous curved form used by Hope-Jones and which is shown in **Figure 5**.[11] The change was made after it became obvious that the duration of contact of the impulse roller on the slope was too short to sustain an adequate amplitude of oscillation between the 30-second impulses. In addition, the gathering pawl was changed to be of finer (lighter) iron wire. Its arm was bent so the transverse section makes positive contact with only one of the ratchet-wheel teeth. **Figure 9** gives a front view of the various components, all of which, except the impulse pallet, were gold plated.

The Catch System

Figure 10, upper left, shows the catch displaced anti-clockwise from the locking bar of the gravity arm. In its first incarnation the catch was designed according to Hope-Jones, but on re-setting, it would bounce back off the locking bar causing re-activation of the electromagnets and inappropriately advancing the hands. It transpired that this is a common problem. It was solved by the late Frank Percival of the SCS on his version of the Synchronome by making the catch out of Teflon, and by using an alarm clock balance spring between the arbor and the front plate to give more positive action to the return of the catch.

Figure 10. Catch and locking block on the gravity arm, also showing the ratchet wheel and unlocking vane.

Figure 11. Close up of the catch, and a stylised drawing of it in the inset.

To the same end I added a counter-weight that can be seen in the figure, but this did not completely solve the problem. A reliable solution was only achieved after I ground the hardened steel catch so that its tail has a radius that is equal to (or slightly less than) the distance between the pivot of the gravity arm and the back of the locking bar. This is readily seen in **Figure 11** and its inset.

This means that as the gravity arm rises briskly, the locking bar causes no backward displacement of the catch. Indeed, if it overshoots then it impacts on the upper face of the rectangular slot, drawing it even more positively into the locked position.

The modified catch was the single most important new development in the design of the clock. As simple as it may seem, it does overcome a common problem with the basic design of the Synchronome.

Conclusions

This personalised version of a Synchronome clock introduced several new fabrication and design challenges. These included a means of making a bezel from a solid brass bar and a revised version of the Hope-Jones catch. From an aesthetic perspective, the modern black ebony case fits well with the black base-plate that 'hides' in the background behind large knurled brass knobs and the brass front plates, ratchet wheel and levers. The copper pendulum bob and large copper coils blend well (in terms of relative total area) with the contrasting brass bezel and personalised brass hands in the dial. The exposed mechanism has the appeal of many skeleton clocks, which draws in the viewer to spend a few minutes understanding the modus operandi of the device.

I think Tim liked his gift; but as with all Synchronome clocks it remains to be determined if the 'clunk' every 30 seconds of the resetting/impulse system will be listened to appreciatively in the longer term!

Acknowledgements

Thanks to members of the Sydney Clockmakers Society for the following: David Allott who had made six clock cases for the regulator project that he terminated, so he passed this particular one on to me; Martin Foster for the Invar pendulum rod from an IBM master clock; Rex Swensen for advice on fabricating the bezel and the annealed brass rod for it, for advice on ball races, and having the dial laminated with Celloglas as he had done on some of his previous clocks; the late Frank Percival for the Synchronome base-plate casting and ratchet wheel; and the late Leona Geeves for the electromechanical slave movement.

ENDNOTES

1. F. H. Hope-Jones, *Electrical Timekeeping* (London: NAG Press Ltd, 1940 reprinted 1942).
2. P. W. Kuchel, K. Prentice, and F. Percival, 'O'Leary's Precision Timekeeper 1.', *The Horological Journal*, vol. 146 (2004) pp438–443.
3. Ibid, pp20–24.
4. P. W. Kuchel, 'The Earl of Meath's Clock', *The Horological Journal*, vol. 148 (2006) pp10–14.
5. F. H. Hope-Jones, *Electric Clocks and How to Make Them* (London: Percival Martin and Co., 1931) pp30–54.
6. S. Wolfram, *Mathematica* V11.3.0 (Champaign, ILL: Wolfram Research Inc.).
7. P. W. Kuchel, 'Flat-Wheel Cylinder Escapement: Reproduction of a Watch or Small Clock', *NAWCC Watch and Clock Bulletin*, vol. Jul/Aug (2014) pp411–414.
8. F. H. Hope-Jones, *Electric Clocks and How to Make Them*, Figure 8, p44.
9. F. H. Hope-Jones, *Electric Clocks and How to Make Them*, p43 (Figure 7, for the definition of 'catch').
10. F. H. Hope-Jones, *Electric Clocks and How to Make Them*, p33 (item F2 in Figure 2, for the definition of 'tripping vane').
11. F. H. Hope-Jones, *Electric Clocks and How to Make Them*, pp30–54.

Balance Springs, Part 1

The Technical Development of a Principal Watch Component

Eur Ing David Boettcher CEng MIET

The balance spring may seem simple, but its development has been lengthy and complex. In this four-part series, David Boettcher explores and outlines the extensive history of the material of this integral watch element.

The balance spring is the most important component of a mechanical watch, and often the least understood. Besides the polished plates, sparkling jewels and intricate mechanism, it appears to be just a simple strip of spiral coiled wire. At one level it is just that, but it is also so much more. It is the vital component that endows a watch with its beat, the rhythm that enables it to keep time.

The first portable timepieces, which evolved into watches, were created in Southern Germany or Northern Italy in the late fifteenth or early sixteenth century. In their infancy, before the balance spring was invented, watches were poor timekeepers; they were expensive novelties. At a stroke, the balance spring transformed watches into useful devices. Without a balance spring, even the finest watch with the most ingenious escapement would be little or no better at keeping time than its early sixteenth century predecessors.

The balance spring and the balance form a simple harmonic oscillator with a natural frequency that can be used to measure time accurately. The balance usually does little or nothing active in this partnership; like a rider on a swing, it is there for the ride and simply contributes its mass to the system. The spring does all the hard work, first turning the balance so that it accelerates in one direction, then slowing it down to a halt, and then turning it in the other direction. It does this hundreds of thousands of times a day; many millions of times over its lifetime. The timekeeping of the watch depends on the rotational inertia of the balance, and how vigorously the spring swings it to and fro.

Improvements in the timekeeping of watches since the introduction of the balance spring fall broadly into two categories: improvements to the balance and spring so that the frequency of oscillation is more regular, and improvements in the escapement that lets the balance and spring get on with their job with less distraction whilst still registering each swing and providing a small impulse to replace lost energy.

Improvements to the escapement were prodigious in the eighteenth and nineteenth centuries, but improvements in the materials that balance springs were made from had to wait until the end of the nineteenth century and new developments in metallurgy. Because these are invisible they often go unnoticed, but their effect on timekeeping is equally profound.

The balance and balance spring are made from metals that react to variations in temperature which cause changes in their dimensions and elasticity. These change the inertia of the balance and the turning force the spring produces, which would affect the frequency of oscillation if not compensated for. Most famously, this was done for steel balance springs by employing the delicate and expensive cut bimetallic compensation balance, which played an active role in temperature compensation by altering its moment of inertia as the temperature changed. **Figure 1** shows a steel balance spring and compensation balance with gold timing screws from a Longines wristwatch sold in 1911 to Baume & Co., Longines' UK agents.

Figure 1. Balance spring and balance from 1911 Longines wristwatch.

At the end of the nineteenth century it was discovered that balance springs made from iron-nickel alloys could achieve temperature compensation with an uncut 'monometallic' balance.

In this article I will go over some historical ground, introducing some less well-known material, and then explore the principal technical developments and personal contributions of some of the main players in the development of the modern compensation balance spring.

It is often thought that the effects of temperature are nullified in modern watches by employing monometallic balances that have a low coefficient of thermal expansion and balance springs that do not vary in their elasticity with changes in temperature. This is not correct; I explain why.

I use equations to illustrate some points. I have tried to make the explanations in the text stand alone for those who don't like reading equations. If you do like reading equations and want to see the proofs, or have any other questions, please feel free to get in touch with me via the Editor.

The shape of the balance spring, its terminal curves, and the relative positions of attachment at the collet and stud, all have significant effects on isochronism, but these are outside the scope of this article.

The Invention of the Balance Spring

In 1658 the great English scientist and polymath Dr. Robert Hooke had the idea of using a balance spring to improve the timekeeping of watches.[1] Hooke had discovered a linear relationship between the force applied to a spring and its extension and formulated his famous law, *ut tensio, sic vis*: as the extension, so the force. That is to say, the force exerted by a spring is proportional to its extension. Hooke thought that applying a spring to the balance of a watch would make it an even better timekeeper than a pendulum clock.

The balance of a watch swings backwards and forwards in rotation around a fixed axis and therefore does not suffer from the problem of 'circular error', which is caused by the unidirectional pull of gravity and prevents pendulums from being isochronous. Hooke realised that by adding to the balance a spring that obeyed his law, the conditions for an isochronous harmonic oscillator would be fulfilled.

Hooke showed a pocket watch with a balance spring to Lord Brouncker, Robert Boyle and Robert Moray, seeking their sponsorship in an application for a patent. A draft patent was drawn up in January 1665 stating that the spring was to be attached to the axis of the balance.[2] Although it seems obvious with 20/20 hindsight that this means the spring must be a spiral around the balance staff, no details of the form of the spring were given and it appears that the invention of the spiral shape was not as easy as we might think.

The King (Charles II) instructed that the patent be granted, conditional on a detailed description of the invention being published by May. But Hooke was very busy with many scientific investigations, and from 1666 with supervising the rebuilding of London after the Great Fire. Development of balance spring watches was put on the back burner, the description was never completed and the patent application lapsed.

Hooke's idea of using a spring with a balance to create an isochronal regulator was communicated to Christiaan Huygens in 1665 by Moray, by Oldenburg, the secretary to the Royal Society, and also by Wren.[3+4]

In January 1675, Huygens drew in his notebook an Archimedian spiral spring connected to the axis of a watch balance and wrote beneath it in Greek 'εὑρηκα' (eureka), a word he repeatedly used in his notes to signal a moment of discovery. This was announced as an invention of Huygens, to Hooke's intense annoyance.

Hooke had previously said that there were a hundred different ways of attaching a spring to a balance, but when he heard of Huygen's invention he remarked: 'Zulichem's spring not worth a farthing'.[5] The implication of this remark is that, even though he had thought of a spring attached to the balance staff, the spiral shape conceived by Huygens was something that the brilliant, but distracted and overstretched, Hooke had not thought of. No wonder he was hopping mad – with himself as much as anything. But the proud and irascible Hooke would never have admitted that.

Timekeeping of Early Balance Spring Watches

Early watches without balance springs were not good timekeepers. The balance had no inherent natural frequency. At each tick of the escapement the momentum of the balance caused the train initially to reverse slightly, until friction and the force of the mainspring caused it to stop and reverse. The high gear ratio and the friction in the train between the mainspring and the balance meant that they could not form an oscillator with a natural frequency, an essential element of which is low damping. Lack of precision in cutting wheel and pinion teeth, and the poor quality of lubrication available at the time, added to the problem, so that the balance was simply flicked backwards and forwards at an uncertain rate. The use of a fusee or stackfreed to keep the force of the mainspring delivered to the train relatively constant was essential if the watch was to tick at even approximately the same rate between fully wound and unwound, but timekeeping was poor compared with the accuracy with which even a small portable sundial could be read.

With the invention of the balance spring, watches were transformed into useful timekeepers. Not to longitude standard; that would take another 85 years and the labours of John Harrison. But it became worthwhile to fit a minute hand and, even at the end of the seventeenth century, a verge watch with a balance spring could keep time to within a few minutes a day. Cecil Clutton, one of the founder members of the AHS, was the first and, as far as I am aware, only person to write in detail about the performance of early balance spring watches.[6] George Daniels remarked that, with the introduction of the balance spring and improved wheel cutting, the rate of a verge watch improved to within five minutes per day.[7] Daniels was a great friend of Clutton and this remark was quite likely based on Clutton's observations.

Clutton kept two watches in his waistcoat pocket winter and summer, one with a 'sun and moon' dial by Edward Speakman dated circa 1698, and another with an ordinary dial by Andrew Dunlop dated circa 1710. The worst performance of the Speakman watch was a variation of 3½ minutes in one day in January 1954. Apart from this one day, variations were only a few minutes per day, with an average gaining rate of 2½ minutes in winter which reduced to ½ minute per day in the summer.

Clutton learned to fly in the RAF during WWII and acted as a transport pilot for Wellington bombers. The Andrew Dunlop watch accompanied him on many flights and, at around 230 years old, was almost certainly the oldest watch that saw active service during the war. Clutton observed its rate closely over a fortnight in 1940, when he found that it was never more than half a minute away from Big Ben.

Unfortunately, Clutton does not distinguish between differences from mean time caused by random variations or steady rates of gaining or losing. However, his observations are interesting regarding the actual performance of early balance spring watches.

Clutton remarked that he could not understand why verge watches with balance springs had such a bad reputation as timekeepers, since his experience did not bear that out. They were made for over six centuries. If they had been as bad as people made out, something better would have been devised much sooner.

Temperature Effects

Clutton's watches were fitted with steel balance springs, as was just about every watch until the twentieth century. The best quality balance springs were made of high carbon steel, quench hardened, tempered, polished, and usually blued by heating. For cheaper watches, balance springs were used in the work hardened condition that resulted from drawing and rolling, and were heat blued. The blue colour was caused by an oxide film, which gave some protection against rust.

Temperature effects would cause the rate of a watch with a steel balance spring to alter by around 11 seconds per day for every degree Celsius change in temperature. This effect probably went unnoticed by most, and was too small to be of consequence for life in the seventeenth century. Every town had its own local time, set by a sundial, which would change throughout the year by half an hour due to variations in solar time.

Until the coming of railway time in the 1840s, verge watches were more than sufficiently accurate for everyday use. The only people who needed timepieces more accurate than a verge watch were scientists, astronomers, and sailors. When John Harrison started to construct marine timekeepers in an attempt to win the Longitude Prize, he was well aware of the effect of temperature on the timekeeping of clocks and watches. All of Harrison's marine chronometers have devices that compensate for the effects of temperature; they could not have achieved the accuracy that they had without them.

Harrison's watch known as H4, which achieved the accuracy of timekeeping required to win the Longitude Prize, had a bimetallic strip that moved curb pins to change the effective length of the balance spring. The bimetallic strip was formed of steel and brass strips held together by rivets. Before the voyage to Barbados in 1763 to 1764, William Harrison stated that H4 had a gaining rate of 1 second per day, and a temperature coefficient of -0.2 seconds per day per degree Fahrenheit.[8] The gaining rate was applied to the time shown by H4, but the temperature coefficient was not used.

Steel balance springs continued to be used for the next 200 years. Over this time the quality of steel improved vastly, but steel balance springs continued to suffer from the principal defect that their stiffness is affected by changes in temperature. Increasing temperature reduces the elastic modulus of the metal, reducing the stiffness of the spring and thus the turning force it produces. If nothing were done about it, this resulted in the time taken for the balance to swing to and fro increasing, and the watch losing time. Steel springs are also susceptible to rust and, as electricity was more widely used, the problem of magnetism increased.

Ferdinand Berthoud

Ferdinand Berthoud was the first to analyse in detail the effects of temperature on timekeeping.[9] He recorded in 1773 that a temperature change from 0° to 27° Réaumur (0° to 33.75° Celsius) caused his marine chronometer No. 9, with its temperature compensation disabled, to lose 393 seconds in 24 hours. He apportioned the effects as follows:

Expansion of the balance	62 seconds
Loss of the spring's elastic force	312 seconds
Elongation of the Balance-Spring	19 seconds
Total loss per day (seconds)	393 seconds

Figure 2. Berthoud's observation and (incorrect) apportionment.

Berthoud does not explain his reasoning in ascribing the individual losses. It is well known that the rate of a watch can be altered by changing the length of the balance spring. This is done either at the stud, or by moving curb pins to change the effective length. All of Berthoud's marine clocks and watches had compensation for temperature changes by moving curb pins, but his idea that 19 seconds of the loss was due to elongation of the spring is wrong.

Berthoud's idea that lengthening of the balance spring with increasing temperature caused a watch to run more slowly was accepted in England until 1882, when T. D. Wright pointed out that it was not correct. Mr Wright was a highly regarded technical instructor at the BHI and, amongst many other positions, Vice President of the BHI. He is one of the very small group of recipients of the BHI Gold Medal.[10]

The torque or turning force produced by a balance spring when one end is turned through an angle of one radian is given by the equation:[11]

$$S = \frac{t^3 h E}{12 l} \quad (1)$$

Where E is the modulus of elasticity of the spring, and t, h and l its thickness, height (width) and length respectively. The 12 is a constant that arises from the geometry of the section.

The modulus of elasticity, often called Young's modulus, is the ratio of stress to strain. This ratio is a constant (or nearly so) for metals strained below their elastic limit. It is a generalised form of Hooke's law. Although it is often called Young's modulus, I prefer the term elastic modulus because that clearly expresses what it is. The elastic modulus is used in the equation to work out the turning force that results from the strain in the spring caused by the angle of turning.

One important thing to notice is that the equation shows that the turning force is proportional to the height of the spring and inversely proportional to its length. These two dimensions are affected in equal proportion by thermal expansion. The *ratio* of height to length therefore remains exactly the same and there is no effect on the torque produced by the spring.

The idea that the spring expanding in heat caused a watch to run slower died hard. In 1903 Dr Guillaume remarked: 'Of ten professors, six still teach their pupils today that thermal expansion of the balance spring has the effect of slowing the rate of the watch.'[12] Even in 1981, some in the trade were still saying that the lengthening of the balance spring with increasing temperature would cause a watch to run slower.[13]

The confusion arises because it is true that lengthening the spring by letting it out at the stud, or by moving the curb pins with the regulator, does cause a watch to run slower. But when this is done the temperature remains the same. If the spring increases in length due to an increase in temperature, it increases in height at the same time, which nullifies the effect of the increase in length. The increase in spring length due to an increase in temperature does have the same effect as moving the curb pins very slightly but, because it is only the short length of spring between the stud and the curb pins that causes this effect, the result is negligible.

The effect of temperature on the thickness of the spring is a different matter. The restoring torque is proportional to the cube of the spring's thickness. Thermal expansion of the spring therefore causes an *increase* in turning force which, in isolation, would cause an increase in the rate of a watch.

The overall loss recorded by Berthoud of 393 seconds in 24 hours, due to a change in temperature of 27° Réaumur (33.75°C), equates to 11.6 seconds per day per degree Celsius. Sir George Biddell Airy, the Astronomer Royal from 1835 to 1881, showed by experiment in 1859 that a chronometer with a plain brass balance lost 6.11 seconds in 24 hours for each degree Fahrenheit increase in temperature, equivalent to 11.0 seconds per day per degree Celsius. The chronometer makers Arnold and Dent reported in 1836 that a chronometer fitted with an uncompensated glass disc balance and steel balance spring lost 385 seconds in 24 hours when the temperature was raised from 32°F to 100°F (37.78°C), or 10.2 seconds per day per degree Celsius.[14] A smaller loss with a glass balance is to be expected because glass expands less than brass with increasing temperature.

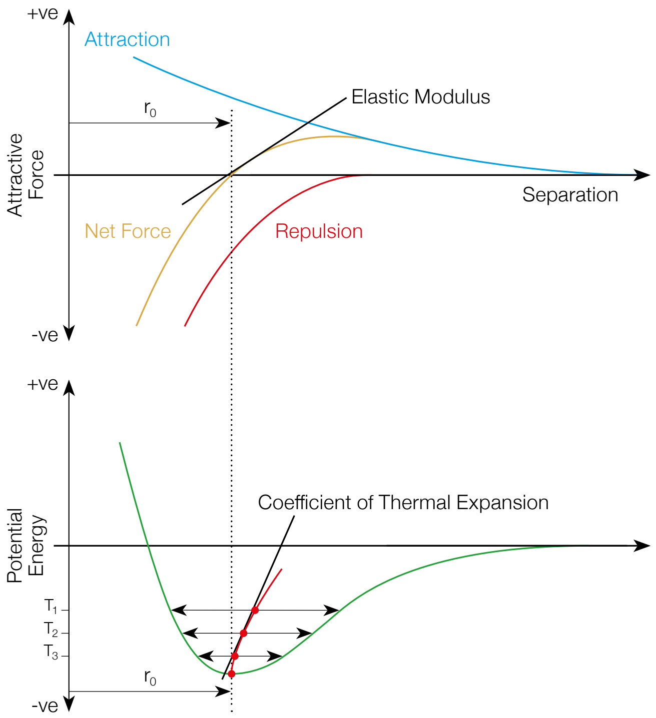


Figure 3.

Temperature Effects

An increase in the temperature of a metal causes it to expand in all three dimensions, and reduces its elastic modulus. Before trying to work out what effect these have on the rate of a watch, it is instructive to explore why they occur. Although metals are not usually thought of as being elastic, this property is easier to understand than thermal expansion, which is commonly known about.

Metals are elastic because the bonds between their atoms are not infinitely stiff. If you stand on a piece of metal, your weight compresses the bonds between the atoms, forcing them closer together. Although it is not at all visible, the metal compresses slightly, and when you step off it springs back. This is elasticity in a metal. It is what makes springs springy.

Thermal expansion is paradoxically more difficult to explain. Although most people understand intuitively that metals expand when heated, this is actually a direct or indirect result of an observation of the effect, not an explanation of why it happens.

Applying heat to a metal increases the kinetic energy of its atoms, causing them to vibrate with increased amplitude around a mean position. If the atoms were connected by symmetrical bonds, their mean position would not change and there would be no thermal expansion. However, the bonds are not symmetrical. Metal crystals are made up of positive ions surrounded by a sea of negative electrons from their outer electron shells, which is incidentally why metals are good conductors of electricity. Metallic atomic bonds are a balance of long range attractive forces between the negatively charged electrons and positively charged ions, and shorter range repulsive forces between the positively charged atomic nuclei, shown by the blue and red lines in **Figure 3**. The dotted curve represents the net resultant force.[15]

The point where the net force curve crosses the zero line is where attraction and repulsion are in balance. The interatomic distance at this point is called the equilibrium separation 'r_0'.

At interatomic separations greater or smaller than the equilibrium distance, the potential energy of the atoms is increased, as shown by the green line in the lower diagram. The potential energy curve has a 'potential well', with the lowest state of energy at the bottom of the curve. This is where an atom rests in equilibrium at the temperature of absolute zero. If the material is heated from temperature T_0 through T_1 and T_2 to T_3, the potential energy and amplitude of vibration will increase. Because the well of potential energy is asymmetric, the mean positions of a vibrating atom follow the curved path shown in red. It is this shift in the mean position, called the anharmonicity of vibration, that manifests itself as thermal expansion. In the special case of the 'Invar effect', the potential energy well is symmetrical and no expansion takes place. This will be discussed in a later section.

The slope of a tangent to the curve of the path of mean position gives a linear rate of thermal expansion at the temperature where the tangent touches the curve. The linear rate alone can be used in calculations involving small temperature changes or where high accuracy is not required, but watches are high precision machines and the curvature of the path of mean position needs to be taken into account. To represent the curvature of the path requires a second, non-linear, term. The thermal expansion of metals over small ranges of temperature, e.g. a few tens of degrees, the range of interest to horologists, can therefore be modelled by an equation in the form:

$$L_\theta = L_0(1 + \alpha\theta + \beta\theta^2) \qquad (2)$$

The length of the specimen at temperature θ (theta) degrees, L_θ, is the length at the initial temperature L_0 multiplied by a thermal expansion factor ($1 + \alpha\theta + \beta\theta^2$). In this factor, α (alpha) is the linear coefficient of thermal expansion, representing expansion which is directly proportional to the change in temperature. The β (beta) coefficient is added to represent simple non-linear expansion, where the rate of expansion changes with temperature. Mathematicians call β the 'quadratic coefficient' because it is associated with the square term, quadratus being Latin for square. I find it clearer to think of the $\beta\theta^2$ term as an indication of non-linearity. The addition of the $\beta\theta^2$ term allows thermal expansion that is non-linear, which in reality is all thermal expansion, to be modelled. If a more complex curve is required to model the actual thermal expansion, then further terms such as $x\theta^3$, $y\theta^4$, etc., can be added. For the range of temperatures of concern here the $\beta\theta^2$ term is adequate. Over wider temperature ranges additional terms become necessary.

Changes in temperature also affects the modulus of elasticity, represented by the slope of a tangent to the net force curve as shown in **Figure 3**. Increasing temperature causes the slope to decrease, which is experienced as a reduction in the elastic modulus. Because the net force curve is asymmetric, the change in the modulus of elasticity is also non-linear with temperature. The result of this is that at higher temperatures, the reduction in the modulus of elasticity per degree is greater than it is at lower temperatures. This causes the stiffness of a steel balance spring to decrease at an increasing rate as the temperature increases, rather than linearly.

As with thermal expansion, a linear equation can be used to represent changes in the modulus of elasticity over a small temperature range, or when high accuracy is not required. For more accurate calculations an equation of similar form to **equation 2** can be used, e.g.

$$E_\theta = E_0(1 + \gamma_0\theta + \gamma_1\theta^2) \qquad (3)$$

Where γ_0 and γ_1 (gamma zero and gamma 1) are the linear and non-linear temperature coefficients of the elastic modulus, also called the *thermoelastic coefficients*. The values of these are usually negative in sign, since the elastic modulus usually decreases, and with an increasing rate, as temperature increases.

The thermal coefficients of brass and steel from various sources are shown in **Figure 4**.

		Coefficient of Thermal Expansion		Thermoelastic Coefficient	
Metal	Source	α: per °C	β: per °C²	γ_0: per °C	γ_1: per °C²
Brass	Rawlings[16]	19×10⁻⁶	-	-	-
	Guillaume[17]	18.6×10⁻⁶	5.5×10⁻⁹	-	-
	Defossez[18]	18.6×10⁻⁶	5.5×10⁻⁹	-	-
	Traité[19]	18.5×10⁻⁶	5.3×10⁻⁹ (Note 2)	-	-
Steel	Rawlings	11×10⁻⁶	-	-240×10⁻⁶	-
	Guillaume	10.4×10⁻⁶	5.2×10⁻⁹	-	-
	Defossez	10.4×10⁻⁶	5.2×10⁻⁹	-263×10⁻⁶	-300×10⁻⁹
	Traité	10.4×10⁻⁶	5.2×10⁻⁹	-263×10⁻⁶	-200×10⁻⁹

Note 1. '–' means no value is given in the source
Note 2. The figure given is actually 3×10^{-10} but this is clearly an error; the leading 5 has been omitted

Figure 4. Thermal coefficients of brass and steel.

Because the non-linear coefficients of thermal expansion and thermoelasticity are much smaller than the linear coefficients, they are called 'second order' effects, and are often ignored. But in watches, where a few seconds in a day of 86,400 seconds are significant, they produce a small but noticeable effect on timekeeping, especially the non-linear thermoelastic coefficient of steel.

Modelling a Balance and Spring

To investigate the effects of temperature on a watch it is necessary to model how the balance and spring control the rate of a watch. The periodic time of oscillation T is determined by substituting into the basic equation for simple harmonic motion the rotational inertia or 'moment of inertia' I of the rotating assembly, comprising the balance and balance spring, and the turning couple or torque S produced by the balance spring per radian of rotation. The period T is then given by the general equation:

$$T = 2\pi\sqrt{\frac{I}{S}} \qquad (4)$$

This equation gives the period of one complete oscillation, e.g. from one extreme of rotation of the balance to the other and then back to the first. Horologists often think in terms of half this value, because that is the time between ticks of the escapement, often called 'beats' or 'vibrations'. A watch with an 18,000 vibrations per hour (vph) train ticks five times per second and its balance oscillates at 2.5 Hertz (Hz).

The equation above can be expanded by substituting the mass m and radius of gyration k of the rotating assembly as mk^2 for the moment of inertia, and the equation for the spring couple as given previously, to arrive at:

$$T = 2\pi\sqrt{\frac{mk^2 12l}{t^3hE}} \qquad (5)$$

The radius of gyration is often thought of as simply the radius of the balance rim, because most of the mass is concentrated there. However, in addition to the balance rim, the balance spoke, balance spring, collet, and even the balance staff, are part of the rotating mass and its radius of gyration. This is the reason that static poising of the balance cannot completely eliminate positional errors and dynamic poising is used.[20]

If the input data was known exactly with sufficient accuracy, the rate of a watch could be calculated using **equation 5**. However, in practice it is impossible to measure the dimensions and modulus of elasticity with sufficient accuracy. Also, determining the moment of inertia of the rotating assembly would not be a trivial exercise. But an accurate watch *must* count 86,400 seconds in a day and, taking this as a basis, the equation can be used to see how the effects of temperature on each component will vary this.

An increase in temperature causes the balance to expand in diameter, increasing its radius of gyration and rotational inertia. If this occurred in isolation (which of course it cannot) it would cause an increase in period and the watch would run slower by a certain amount. Changes in elasticity of the balance have no effect on timekeeping.

An increase in temperature causes the balance spring to expand in all directions; thickness, height and length. As already discussed, the increases in height and length cancel each other out. The torque produced by the spring is proportional to the cube of the its thickness. The increase in thickness of the spring, if it occurred in isolation, would cause a decrease in the period and the watch would run faster.

An increase in temperature reduces the modulus of elasticity of the balance spring, lowering its stiffness so that it produces a smaller restoring torque for a given angle of rotation. If this occurred in isolation it would cause an increase in the period and the watch would run slower.

Recognising that the numerical constants (2, π and 12), the rotational mass, and the ratio of the length of the spring to its height, are not affected by changes in temperature, we can lump them together as one constant and write:

$$T = constant \frac{k}{\sqrt{t^3 E}} \qquad (6)$$

This tells us that for changes in temperature, the period is affected principally by changes in the radius of gyration, the thickness of the spring and the elastic modulus. By working out the effects of temperature on these, the resulting change in the period can be estimated.

The equations for thermal expansion and thermoelasticity can be used to model the changes that occur for a temperature change of θ degrees. The radius of gyration of the balance would change by $1 + \alpha_b\theta + \beta_b\theta^2$, the thickness of the spring by $1 + \alpha_s\theta + \beta_s\theta^2$, where the subscripts $_b$ and $_s$ represent the balance and balance spring respectively. The elastic modulus of the spring would change by $1 + \gamma_0\theta + \gamma_1\theta^2$.

By substituting these thermal effects into **equation 6** and rearranging with a little algebra, it can be shown that the ratio of the period T_θ at temperature θ to the base period T_0 at the initial temperature (e.g. the temperature at the workbench) is:

$$\frac{T_\theta}{T_0} = \frac{(1 + \alpha_b\theta + \beta_b\theta^2)}{\sqrt{(1 + \alpha_s\theta + \beta_s\theta^2)^3(1 + \gamma_0\theta + \gamma_1\theta^2)}} \qquad (7)$$

The expressions within brackets in this equation can be used to calculate separately the individual effects of temperature.

For example, expansion of a brass balance, which is represented by the expression above the line in the equation, using the coefficients in **Figure 4** from the 'Traité', will change the period by

$$1 + 18.5\times10^{-6} + 5.3\times10^{-9}$$

parts for a temperature increase of 1°C. There are 86,400 seconds in a day and a watch will make a certain number of vibrations in that time. The longer period will cause the watch to take

$$86{,}400 \times (1 + 18.5\times10^{-6} + 5.3\times10^{-9}) = 86{,}401.60 \text{ seconds}$$

to make the same total number of vibrations, i.e. it would take 1.60 seconds longer to make the same number of vibrations. The watch would therefore be running slow by −1.6 seconds per degree Celsius per day: −1.6 seconds per °C per day.

An increase in temperature causes the length, height and thickness of the balance spring all to increase in the same ratio. The effects of the change in length and height cancel each other out. Using the coefficients of thermal expansion from **Figure 4**, the increase in thickness works out to be very small, e.g. for a one degree Celsius rise in temperature, a steel balance spring of thickness 0.03mm would increase in thickness by 10.4 parts in a million to a thickness of 0.0300003mm.

The effect on the period of this increase in thickness is given by:

$$\frac{86{,}400}{\sqrt{(1 + 10.4\times10^{-6} + 5.2\times10^{-9})^3}} = 86{,}398.65$$

That is fast by 1.35 seconds per °C per day. Quite a lot for such a small increase in thickness, and a good illustration of why it is impossible to calculate the rate of a watch accurately from measurements of the parts.

The effect of a one degree Celsius rise in temperature on the elastic modulus of the spring is given by:

$$\frac{86{,}400}{\sqrt{1 - 263\times10^{-6} - 200\times10^{-9}}} = 86{,}411.37$$

That is slow by 11.37 seconds per °C per day.

The overall effect of these changes in rate is tabulated in **Figure 5** for a steel balance spring with a brass balance and with a steel balance. I have also included for comparison a column of rates computed for a brass balance and steel balance spring using the coefficients from Rawlings.

	Brass Balance	Steel Balance	Rawlings
Balance thermal expansion	-1.60	-0.90	-1.64
Spring thermal expansion	+1.35	+1.35	+1.43
Spring decrease in Elastic modulus	-11.37	-11.37	-10.37
Totals (- indicates loss)	-11.62	-10.92	-10.58

Figure 5. Rate (seconds per day) for 1°C rise in temperature.

This table shows how the thermal expansion of the balance spring, rather than causing a slowing in rate, actually causes an increase in rate that partially compensates for the expansion of the brass balance, and overcompensates for the expansion of a steel balance. The change in the elastic modulus of the balance spring contributes by far the greatest amount to the overall loss.

The difference between the rates calculated using the coefficients given in the Traité and Rawlings gives an indication of the sensitivity of the calculations to their values. The non-linear coefficient of steel is very sensitive to mechanical and heat treatment.[21] The calculated figures are in reasonable agreement with those reported by Berthoud, Airy and Dent. Theoretical models of mechanisms, no matter how accurate, are only as good as their input data.

Dent's glass balance would have had a coefficient of thermal expansion of around 8×10^{-6}/°C. The calculated loss due to expansion of such a balance is −0.69 seconds per °C per day, 0.91 second less than with a brass balance. Dent reported an overall loss of −10.2 seconds per °C per day with the glass balance, with a brass balance the loss would have been around −11.11 seconds per °C per day.

Over a temperature change of 1°C the non-linear coefficients make very little difference to the computed result. Over greater temperature ranges their effect becomes more significant, particularly the thermoelastic coefficient of steel, where the non-linear coefficient is much larger those of brass and steel. For a temperature increase of 20°C, the non-linear effects make a difference of about −3½ seconds per day in a total error of around −235 seconds.

Thermal Effects in Practice

A watch that is carried in the pocket or worn on the wrist is kept at a fairly constant temperature by warmth from the body, but it is usually taken off overnight and becomes cooler. If an uncompensated watch that can be expected to lose or gain around 11 seconds per day for every one degree change in temperature was adjusted to run correctly on the watchmaker's bench at, say, 20°C, which is perhaps also the temperature at which it might spend eight hours overnight on the bedside table, and it is strapped to a wrist at the higher temperature of 34°C for the remaining 16 hours of the day, it would lose over a minute and a half each day.

Precision time references such as marine chronometers are not normally worn and are therefore potentially subject to greater temperature fluctuations, which were more significant in times before houses and workshops were evenly heated in the winter, and especially so in the cabins of ships sailing to the tropics or arctic regions.

Palladium Balance Springs

During the nineteenth century, alternatives to steel such as bronze, gold, glass and palladium were tried as balance spring materials. These were rustless and non-magnetic but, like steel, they all lose stiffness (apart from some glasses, which increase) with increasing temperature, and all require a compensation balance. They also have lower moduli of elasticity than hardened steel, so are less satisfactory as spring materials.

The only material that achieved wide use was a palladium alloy which, when drawn and rolled, had a modulus of elasticity similar to steel. Because it was rustless and non-magnetic it was attractive to makers of marine chronometers. Its introduction to UK makers in the *HJ* was rather confused. Edward Rigg reported that substituting a palladium spring for a steel one in a compensated chronometer caused a gain of 40 seconds over 24 hours for a temperature rise of 33°C.[22] To chronometer makers this was not a desirable result, especially as Dent had earlier experimented with palladium balance springs and found them unsatisfactory. But Rigg had confused the results of tests with a spring made of pure palladium with a recommendation for the use of palladium alloy. This was pointed out by Paillard, the inventor of a palladium alloy, who stated that balance springs made of it had similar thermoelastic characteristics to steel springs, with lower middle temperature error, and could be used with an ordinary compensation balance.[23] In order to avoid such confusion, the term ‘palladium’ would ideally be used only for the pure metal and ‘palladium alloy’ for Paillard and similar balance spring materials.

Middle temperature error is the name given to an effect where a chronometer that is adjusted to time at two temperatures exhibits a losing rate at higher or lower temperatures, and a gaining rate at temperatures between, reaching a peak at or around the middle temperature. During the nineteenth century, in order to attain a high place in chronometer trials it became increasingly important to reduce middle temperature error. Some manufacturers invented new balances, others added auxiliary compensation devices to the ordinary compensation balance.

Paillard reported statistics gleaned from 40 chronometers that had obtained first class observatory certificates, 24 with steel and 16 with palladium alloy balance springs. The middle temperature error of those with palladium alloy springs was less than one third of the ones with steel springs. In the 1883 Greenwich trials, fifth place was taken by a chronometer with a palladium alloy balance spring and ordinary compensation balance with no auxiliary.[24] This came as a surprise; no chronometer maker would have expected such a result with a plain compensation balance and steel balance spring.

Palladium alloy balance springs were subsequently adopted by many English chronometer makers. From 1895 to 1914, chronometers with palladium balance springs and compensation balances with auxiliary compensation took first place in the Greenwich trials every year.[25]

***Part 2 of this article will appear in the October edition of the* HJ.**

ENDNOTES

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A Case of Bad Bushing

Rectifying a Fusee Great-Wheel Problem


John Reynolds FBHI


with Robert Ovens MBHI

When an owner brought his clock to me for repair, he told me that the chiming train was running intermittently, sometimes stopping mid-sequence, and this in turn was frequently causing the clock to stop. The clock in question was a three-train fusee bracket clock of circa 1895, **Figure 1**, signed 'Jones, Chiswick' on a plaque attached to the dial centre.

Figure 1.

After taking the movement out and removing the bell hammers and levers, I allowed the train to run free and it was easy to see, and hear, the fluctuating train speed. Further inspection revealed that both the great-wheel and the first wheel pivots had at some time been bushed, but the correct depthing had not been preserved. **Figure 2** shows correct depthing and **Figure 3** shows the result of incorrect depthing. Here, only the addenda of the teeth are driving the pinion and as a result hollows will be formed. The shallow depthing would have given rise to increased pressure on the two arbors involved, causing the pivot holes to wear even quicker. The actual resulting wear on one side of the addendum of each tooth of the great wheel in this clock is shown in **Figure 4**. In this state, the wheel was completely unfit for further service.

The usual solution is to make a new wheel or perhaps to fit a new ring of teeth. However, as the teeth were damaged on only one side outside the pitch circle, I investigated the possibility of turning the wheel over. The full tooth width was still available on the pitch circle where the teeth should work and they were still perfectly formed on their other side.

Initially, this seemed an impossible task because of the large recess in the centre of the wheel for the fusee ratchet and click assembly. However, I decided to go ahead and started the task by removing the entire centre of the wheel. I then made a recess on the new outside of the wheel, **Figure 5**, for a disc of brass with a new central boss, **Figure 6**, both of which were soft soldered in place. This formed an identical recess for the ratchet and click, but on the other side of the wheel. The recess was then lightly skimmed over in the lathe to clean out any excess solder and the click-stud and click spring were fitted, **Figure 7**, ready for receiving the fusee, key-hole washer and screw. In order to ensure a good result with this work, it is essential that all measurements are carefully taken and checked.

After rebuilding the wheel, it was set up in a depthing tool against the first wheel pinion and the correct engagement determined. This was compared with the pivot holes in the plates and it was found that if the bushes were punched out, and the holes drawn in the correct direction and re-bushed, the correct depthing could be achieved. Thankfully, the old bushes were not over large, otherwise plugging and re-drilling would have been necessary.

Figure 8 shows the state of the previous bushing. If the bushes had been prepared to the correct length to start with, none of the filing would have been necessary and there would be just a trace of a ring where the bush is.

On completion of this work, the chiming train was set up between the plates and tested. It ran smoothly without hesitation with only one or two clicks of winding. The clock is now working as it should, after some years of unreliability.

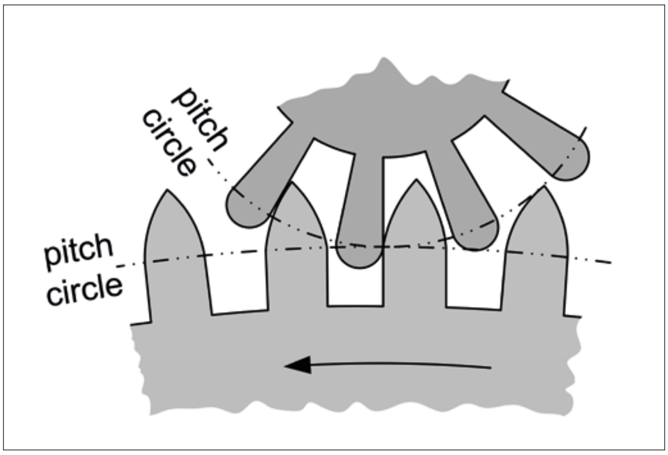

Figure 2.

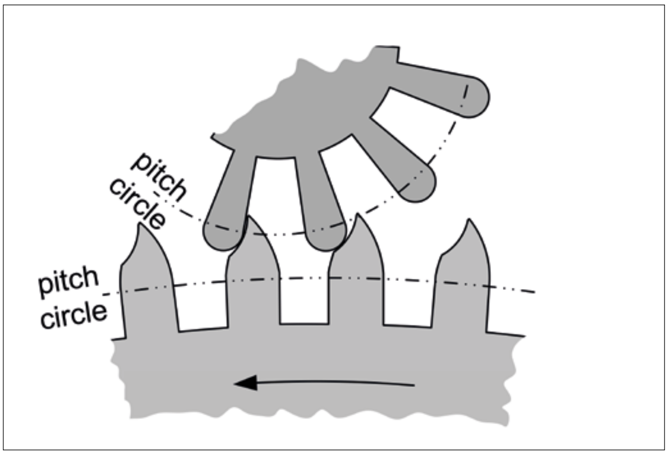

Figure 3.

Figure 4.

Figure 5.

Figure 6.

Figure 7.

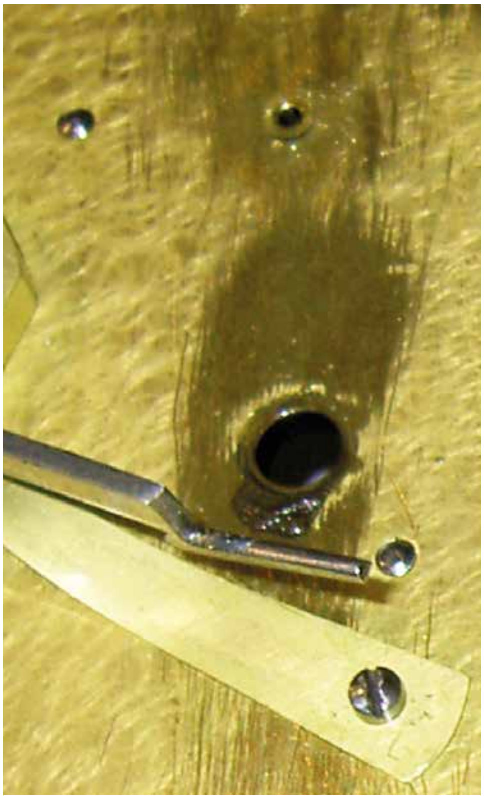

Figure 8.

THE STORY OF THE HJ: 160 YEARS IN THE MAKING

Rachel Reeves

When James Breese sat down at his writing desk in 1858 to produce the first *Horological Journal*, he could not have known what he was starting. Certainly, as the *HJ*'s first Editor (and Secretary of the new BHI), he made the fledgling publication's intentions very clear in its first issue. But did he imagine that it would be published every single month, without fail, for the next 160 years? That it would become the longest continuously published technical journal in the UK and, most probably, the world?

The very first issue reports how it all began. A number of watch trade professionals gathered on 16 February 1858 to form a Preliminary Committee for the creation of a British Horological Institute. Shortly afterwards, at a public meeting in Pentonville on 15 June, the BHI was officially established. In September, the first *Horological Journal* appeared.

It was humble in appearance, but lofty in its ambitions. It hoped to be a 'healthy stimulant' to horologists, an 'arena…for disputed points' and a way of bringing professionals 'into more frequent contact, and the inventors into more intimate relation with those most capable of usefully employing their discoveries'. In the interests of accessibility, too, it was declared to be sold 'at a price without profit'.

A message to readers acknowledged the *HJ*'s founders' 'temerity' in their haste to begin the publication. 'Most happy should we have been to see the work in abler and better hands,' they wrote. 'In the absence, however, of any medium of communication between the various branches of the Watch, Clock and Chronometer Trade…we have presumed to fill a gap which no one else seemed disposed to enter.'

Breese was a salaried editor, but many of those who came after him were 'honorary'. Duplex and horizontal escapement maker Theodore Gordon was followed by meteorologist R. Strachan, whose 12 years in post were only briefly interrupted at one point circa 1861 by W. Hislop, the first BHI Chairman. George Mayes succeeded Strachan for one year, and then F. J. Britten took the role in 1874 – the longest serving Editor so far with 33 years in post. Next in line was James Savidge for over 20 years, then F. W. Tournay for one year. He was succeeded by J. F. Cole from 1929 to 1934, and then E. W. Birch.

One of the most eminent Editors was Arthur Tremayne, who held the post individually from 1945 until his death in March 1954, having initially co-edited

Arthur Tremayne working at his desk.

for several years with E. W. Birch. Prior to taking on the role, he already had experience as an advertising consultant in the jewellers' industry. He founded several trade publications: in 1926 he created NAG Press Ltd to publish *Goldsmiths' Journal* for the goldsmith industry and later, in 1931, he created *The Gemmologist*, thus coining this particular term.

He later came to focus more on the horological side of the sector. In 1928 he founded the *Practical Watch and Clock Maker* and then a quarterly called the *British Clock Manufacturer*, which soon became known for being the main source of information for a Parliamentary debate about the horology industry. *Industrial Diamond Review* followed in 1940.

His relationship with the BHI began at the end of 1938, while the *HJ* was being edited by E. W. Birch. The *HJ*'s contract with the printers had ended and the printers did not wish to renew it. The BHI approached Tremayne to see if he might incorporate the successful *Watch and Clock Maker* into the *HJ*, and edit and publish the new amalgamated journal. The process was smooth and the new *HJ* was first published in May 1939. As his obituary in the *HJ* stated: 'His death will be mourned by many but his influence will linger for many years.'

Nothing can run for 160 years without incident, of course. In 1865, rumour had it that the printers had created a shortfall of 18,000 copies, leaving the BHI in debt. In 1872, frustrated by the number of people who were buying the *HJ* but not joining or supporting the BHI, the Editor threatened to resign immediately 'unless in the meantime the Institute receives such an amount of support from the horological trades and the public as will justify his continuing his time and attention to the Journal.' This may or may not have been a bluff, but either way, it did the trick.

More recently, there was the Saving Time Project, which ended in 2016 when the idea of converting the Upton Hall stables into a horological centre proved to be infeasible. But with its natural resilience, the BHI continued on together with the *HJ*. Indeed, the Financial Report for 2017 showed it to be one of the BHI's most successful years of recent times, with a £95,000 surplus and increases in income from courses and membership. Advertising in the *HJ* rose from £10,900 to £11,600. Operations Manager Brian Noble called it 'a sound start that gives us the opportunity to build for the future.' Similar praises were made in 1860, when the BHI Annual General Meeting said that the *HJ* 'continues to make substantial financial progress'. By 1861 it had become 'thoroughly financially remunerative'.

It has certainly changed its style over the years. The very first issue was closer to a small booklet, merely 16 pages long. Time passed, publishing and printing technology developed, fashions changed, and the *Journal* went through several transformations.

Under Editor Jayne Hall, it became a 48 page, full colour publication. 'My predecessor Tim Treffry did a superb job and was a huge support to me,' she recalled. 'Hot from being a newspaper journalist, I threw in lots of colour, tinted boxes, fancy typefaces etc – it did not go down well! I soon learned what the readership liked. I did everything: the design, page planning, editing, photography and selling adverts. It was a very busy, but very worthwhile, job.' To assist Jayne, the *HJ* also appointed its first Technical Editor, Justin Koullapis Hon MBHI. He was a BHI employee for five years and since then the role has been pro bono. In 2018, Colin Fergusson MBHI became the first Assistant Technical Editor. Under her editorship, the current format was first seen on the front cover for July 2013, as designed by Peter Ling. During 2014, the interior pages were developed towards the clear and distinctive style that remains today.

Jayne, who now edits *TimePiece* for the British Watch & Clockmakers' Guild, added: 'I really enjoyed my time at the *HJ* – the people, the place, the work. It was all so absorbing and engaging. I have made many new, lifelong friends.' She described her predecessor Timothy Treffry Hon FBHI as being of 'huge support', both then and now.

'It was a great privilege to be part of the BHI's rich story, which included the 150th celebrations,' she said. 'Congratulations to all on the 160th and long may the BHI continue to flourish.'

Jayne was followed by Eve Makepeace, who believes that the 'enthusiasm and effort of its readers and contributors' have been key to the *HJ*'s longevity. 'They are precise in their thoughts and interactions, they expect the highest quality of publication and are very vocal about current affairs within the industry and at the BHI,' she said.

The very first *HJ* stated that, as a proper record of the 'honour of invention', it would 'prevent the formation of many a soured temper and misanthropic disposition'. There have inevitably been robust discussions, both within the *HJ*'s pages and surrounding the issues of its production. Such exchanges, however, are vital for a publication that exists to share and advance knowledge. They are also necessary to keep it evolving so that it can run without fail for 160 years, and still show no signs of stopping.

Happy birthday, *HJ*. Here's to the next 160.

HJ EDITORS 1858–2018

James Breese	*1858–Unknown*
Theodore Gordon	*Unknown–c. 1861*
R. Strachan	*c.1861–1873*
(including brief stint by W. Hislop around 1861)	
George Mayes	*1873–1874*
F. J. Britten	*1874–1907*
James Savidge	*1907–1928*
F. W. Tournay	*1928–1929*
J. F. Cole	*1929–1934*
E. W. Birch	*1934–1939*
E. W. Birch/Arthur Tremayne	*1939–1945*
Arthur Tremayne	*1945–1954*
Eric M. Bruton	*1954–1964*
Paul Foulkes	*1964–1966*
David Mason	*1966–1970*
Norman Stuckey	*1970–1980*
Leslie Allen	*1981–1987*
John Richard	*1987–1988*
Allan Davies	*1988–1989*
Timothy Treffry	*1989–2006*
Jayne Hall	*2006–2015*
Eve Makepeace	*2015–2018*
Rachel Reeves	*2018–present*

BHI 160 YEARS

Roger Smith

'160 years marks another notable anniversary for the Horological Journal *which, having been published every month without fail since September 1858, has been the horologist's exemplar... a remarkably reliable keeper of time!'*

Antiquarian Horological Society

Dr James Nye, Chairman

'The AHS offers sincere congratulations to their colleagues in the BHI on the occasion of the 160th anniversary of the Horological Journal. *We are delighted that the AHS and BHI have been able to co-operate towards digital access to historic editions of the* Horological Journal *for members of both organisations, and we wish the BHI Council and the journal editor all the very best as they embark on the next 160 years of the journal's life.'*

Worshipful Company of Clockmakers

'The Worshipful Company of Clockmakers offers its congratulations to the BHI on the occasion of the 160th anniversary of the Horological Journal.

'The Horological Journal *has kept clock and watchmakers informed and in touch since 1858, providing an important record of the industry's activities since that time and a commentary on, and discussion forum for, modern day horologists. We congratulate the* Journal*'s editors, past and present, as well as all those who continue to be involved in its publication, not least its current contributors.*

'We look forward to many further editions of the Journal *and the part it plays in educating and informing the practitioners of, and enthusiasts in, our trade.'*

In-Time

Brian Jones, Managing Director

'Congratulations to the Horological Journal *for 160 years of support, training and direction to the watch and clock making industry. We wish you many more years of publication. All the very best from In-Time Watch Services Ltd.'*

Bremont

'Huge congratulations from all of us at Bremont on this incredible milestone anniversary. The Horological Journal *continues to be a great source of information and education for all those with an interest in the industry and we hope it will continue for many years to come.'*

Patek Philippe UK

Mark Hearn, Managing Director

'As one of the key publications in our field, it is fantastic that the Horological Journal *is celebrating its 160th anniversary. This is such an amazing milestone. Like Patek Philippe, the* HJ *is celebrating uninterrupted activities since it was created in 1858 and it is a great achievement for a team who have worked hard to ensure that technical information is shared in a very competent way. I do hope that you will celebrate many more years to come and keep bringing interesting, relevant and educational content to all of us who have a real passion for horology and watchmaking.'*

George Daniels Educational Trust

'The Trustees of the George Daniels Trust congratulate the BHI on the occasion of the 160th anniversary of the Horological Journal. *It is a great achievement for the journal to have a continuous and unbroken record of publication and one that represents such a wide spectrum of horology and horologists. The Trustees are particularly pleased that the* Journal *is seen by students and apprentices of horology as a means to further their interest and career in clock and watchmaking. The Trustees thank those at the BHI and editors of the* Journal, *past and present, for their hard work in maintaining the record of the last 160 years. Long may this continue.'*

West Dean College of Arts and Conservation

'Many congratulations to our friends at the BHI as they celebrate 160 years of the Horological Journal, *as relevant today in the vibrant world of horology as it has ever been. We support and share the BHI's commitment to the future of horology as we train the clockmakers of tomorrow, and the conservators who look after the clocks of past decades and centuries.'*

Jeremy Hobbins FBHI

Deputy Head, Birmingham City School of Jewellery

'The Birmingham City University School of Jewellery has been teaching Horology for over 100 years, having evolved from City and Guilds qualifications, through the BHI's own syllabus, to our own Higher National Diploma and more recently the first BA in the subject. We have long valued the contribution that the HJ *makes in providing a vehicle to both discuss and inform on the established and the new in the world of horology, there is a great benefit in sharing information and the* HJ *is a great source for students and professionals alike. Long may it continue and congratulations to all the editorial staff past and present for maintaining this wonderful publication.'*

BHI 160 YEARS

Dr John C Taylor OBE

Inventor, horologist and recipient of the Harrison Medal by the Worshipful Company of Clockmakers

'The British Horological Institute continues to champion new clock and watch making, as well as the constant good maintenance of our rich horological history, during a period that has seen great change. With the advent of the almost universal usage of the mobile phone, many young people don't wear watches any longer. Clocks aren't needed in the kitchen as the time is displayed on so many appliances. The institute must be commended and supported for continuing to keep a firm foothold for horology in challenging times.'

Robert Loomes FBHI

'The HJ *has taught and guided me in my chosen profession for 25 years. Some of the regular contributors feel like old friends, even if we have never in fact met.*

'In business, I have had the pleasure of helping numerous people through their MBHI examinations, and seeing them go on to set up their own successful businesses, both in Britain and overseas. None could do it easily without the Journal *to help them along.*

'The HJ *offers an unrivalled body of expertise and allows the inexperienced (and the experienced) an opportunity to read up on and see pictures of practical solutions to fiddly problems. It is interesting to look back through old copies and see the same questions crop up, decade after decade.*

'The HJ *offers a depth of content greater than any other British offering and is read and respected across the globe. I know many Swiss and Americans who read it avidly.*

'I look forward to my next 25 years with enthusiasm, knowing that every journal I receive will teach me something new. Thank you, HJ*.'*

Hong Kong Trade Development Council

'Congratulations to the Horological Journal *on its 160th anniversary from the Hong Kong Trade Development Council, organisers of the HKTDC Hong Kong Watch & Clock Fair, the world's pre-eminent timepiece event. We look forward to continuing to work together in the future, keeping ahead of the times.'*

Charles Frodsham & Co

Philip Whyte Hon FBHI, Vice President

'As one of the founders of the BHI and as an early contributor to the Journal*, Charles Frodsham & Co. would like to congratulate the* HJ *on its 160th anniversary and all that it has achieved during those years.'*

Stephen Forsey FBHI

Co-founder of Greubel Forsey

'Robert Greubel and I would like to sincerely congratulate the Horological Journal *on the occasion of its 160th anniversary.*

The Horological Journal *is proud to be the oldest professional publication for horology in the UK and probably in the world.*

'The leading work of the British Horological Institute has been vital in seeking to maintain high standards in horology through generations. Working tirelessly with its branches, the Horological Journal *is a mainstay to be at the forefront in supporting horologists, not only in the UK but also far beyond its borders.*

'The Institute and the Horological Journal *have also traversed many challenging times and just like time itself still maintain the path to preserve and pass on the traditions and crafts associated with horological excellence. The* Horological Journal *informs and introduces horology to the general public, while the Institute maintains and builds the museum and library and much more.*

'We are proud to share with the British Horological Institute

Paul Roberson FBHI

Palace of Westminster Clockmaker

'I would like to congratulate the BHI on the 160th anniversary of the Horological Journal*. It is one of the publications that keeps us horologists connected and well informed.*

'All horological publications are difficult to produce. I only once saw two horologists agree with each other and then I realised one was talking to a mirror!

'I remember when I first joined the BHI and how I looked forward to receiving the Horological Journal*. I still look forward to it today. Long may it continue.'*

Smith of Derby

'We would like to pass on our congratulations to everyone at the British Horological Institute, past and present, for their 160th anniversary of the Horological Journal*.*

'Here at Smith of Derby, we understand this is a significant moment in time; the publication of a monthly technical journal is no mean feat. We particularly enjoy the variety of clockmaking stories, historical and contemporary, from student achievements, clock repair and restoration news and the very useful 'hints and tips' section.

'Your passion for craftmanship shines through and we, like you, also share this passion. We understand the importance of moving with the times and always remembering our small beginnings when John Smith I founded our clockmaking business.'

BHI 160 YEARS

MY TIME WITH THE HJ:
MEMOIRS OF A LONG-SERVING EDITOR

Timothy Treffry Hon FBHI

For most of its 160 years, the Institute had very little to do with the *Horological Journal*. It was produced by a publishing company which profited from the advertising. By the late 1980s, the decline of the UK horological industry meant that this process was no longer viable. The *HJ* was cobbled together by a jobbing editor responsible for a number of disparate special interest magazines. In 1989 the BHI Council decided to change the process and looked for someone to do it. At that time, Council was a large, rambling and inefficient body including Branch Representatives. I, the Sheffield representative, was selected, though my experience was limited to having published scientific papers in my day job. I became an Institute employee and Dennis Harris was appointed to hold my hand.

In those days most printing was done, quite literally, by 'cut and paste'. Articles would be mailed to the printer and returned as 'galleys'; column-width strips of text. Using the photocopier from my day job, I prepared layouts on page templates. The Institute agreed to boost my BBC computer to a 64KB memory. I had a dot matrix printer and, knowing the number of characters per line and the number of lines in a column, I could add material to the layout. It came to look like a noticeboard with overlapping bits and pieces.

I travelled to the Sunderland-based printer every month by train, via Newcastle. Material that did not already exist as galleys would be typed into an IBM typesetter, images would be scanned and the precision 'cut and paste' for off-set printing done by an expert. I was often asked to shorten a piece by a couple of lines or be told that I could add a bit. For my first issue, April 1989, this was all very time consuming — I slept overnight on a settee in the manager's office. Sadly, 'Horological' was prominently misspelt on the contents page. This was my first example of 'error enhancement' — errors becoming visible only when they exist in a few thousand copies!

That issue included articles by some of the great names in horology: Philip Woodward and David Bodley-Scott, who became regular contributors as well as Anthony Randall, Jonathan Betts and Beresford Hutchinson. Later I met the superb craftsman Derek Pratt and had a long friendship with him. My first interview was with an 18-year-old Roger Smith.

Being 'Editor of the *Horological Journal*' generated invitations to fairs in Basel, Munich, Vicenza and Geneva, teaching me a lot about the industry. Through Grahame Brooks Hon FBHI, who represented Audemars Piguet in the UK, I started to visit watch factories. Over the years I visited most European brands apart from Rolex, which remains a closed shop. Through my friendship with Derek Pratt, I was able to follow closely Omega's adoption of the Daniels Coaxial Escapement (he had a large role in it) and was the first journalist admitted to Swatch Group's escapement production at Nivarox FAR. I also visited Glashütte Original and Lange und Söhne soon after the reunification of Germany. I usually took Jim Arnfield along as my photographer. This was a good move as he often had a better understanding of what was going in a watch factory than I had.

The last decade of the twentieth century saw the mechanical watch transformed, by clever marketing and nostalgia for an understandable technology, from an obsolete device to a luxury product. When I first visited Audemars Piguet it was diversifying into the production of medical pumps. Patek had added quartz to its portfolio along with light powered mantel clocks and high precision quartz clocks for marine navigation. Jaeger-LeCoultre, rather neglected by its then owners VDO, still had large numbers of cam-operated Tornos lathes that were so difficult to set up that there were separate machines for each task and vast shelves stacked with press-tools for producing flat components. A few years later, watch factories had just a handful of multi-tasking computer-controlled machines, capable of operating 24/7 with only occasional visits from technicians.

I retired from the University of Sheffield as a Lecturer in Biochemistry in January 2002 and my last issue of the *HJ* was June 2006. By then, it had become fully computerised. In these later years I was greatly assisted by my wife Amyra who is quite an expert in everything to do with desktop publishing. This expertise was also applied to the books we produced on behalf of the Institute. I remain extremely grateful for the life-changing, indeed life-enhancing, opportunities and experiences I had as Editor. My most lasting memory is of the people met, and friendships made.

Rachel has asked me why I think the *HJ* has run for so long. Notwithstanding the Institute's other activities, the *HJ* remains the major part of its offer to members. It is the Institute's great achievement to have 'muddled through' and survived.

BHI 160 YEARS

The Hypnotic Large Balance Wheel Electric Clock

Some Adaptations to John Wilding's Design

Nick Andrews

My last construction project was the battery-driven electric clock designed by John Wilding MBE FBHI ('An Attractive Electric Mantel Clock', *HJ*, July 2016). It was eye-catching in operation with its visible pendulum swinging from front to back. I am drawn to clocks with unusual actions, so John Wilding's 'Large Balance Electric Clock' seemed to be a good candidate for my next project. My finished clock is shown in **Figure 1**. It is based on the Murday-Reason battery clock manufactured in Brighton at the beginning of the twentieth century. It seems that only about 300 were made as it was not a commercial success. The clock's large balance is impulsed by a solenoid which is switched by the well-known Hipp toggle. The oscillation of the balance is transferred to the movement by a rocking lever, gathering pawl, crown wheel and worm. These are shown in **Figures 2 and 3**. The motion work is conventional.

John Wilding's instruction book is based on a series of eight articles which appeared in *The Clockmaker* magazine, which was published bi-monthly from April 1990 until April 1994. I suspect that this format restricted the amount of detail that John Wilding usually includes in his books. For me, this gave the added pleasure of solving some of the construction methods from scratch. John Wilding's publishers, RiteTime, also supply the steel ring for the balance, the balance spring and the three ball races that are needed, so I purchased these as well.

After the preliminary read-through of the book, I decided to make some minor changes to the design. Because of the size of my lathe, I would not be able to turn the brass base plate or the wooden base, so I chose to make these both square. This also meant that I could make a simple rectangular acrylic cover, rather than use a glass dome which I knew would be difficult (and expensive) to acquire. In the original clock the base plate was raised above the wooden base on three short pillars. John Wilding was not sure of the reason for this so I dispensed with them.

Another change that I made was to the motion work. John Wilding used a 0.45 module wheel cutter which I did not have. Instead, I checked whether my 0.525 module cutter could do the job. Referring to the comprehensive book *Wheel and Pinion Cutting in Horology* by J. Malcolm Wild FBHI, I recalculated the sizes of the motion work wheels to see whether they could be accommodated on the front plate. They could, but it was necessary to reposition the bottom plate pillar some 15mm to the right to clear the reverse minute wheel stub arbor.

In the construction book, several components are held by slots and pinching screws. I have had rather mixed results with this system in the past so I used grub screws and lock nuts throughout. This also made for easier adjustment during the build.

Figure 1.

The frame, balance and electrical components were constructed first. It should be noted that the top ball race housing is not the same as the bottom one, as is suggested in the book. John Wilding says that these parts should be put on test whilst the movement is constructed. The frame, ball races, balance wheel (with its spring and regulator) and all the electrical components were assembled on the base plate. The balance wheel was set running and its oscillations were timed. I was glad that I followed his advice because some significant adjustments had to be made to get the required 36 oscillations per minute. These adjustments involved removing the washers behind the finger screws holding the balance arms and shortening the balance spring by 295mm. Clearly, my balance assembly must have ended up rather heavier than John Wilding's original one.

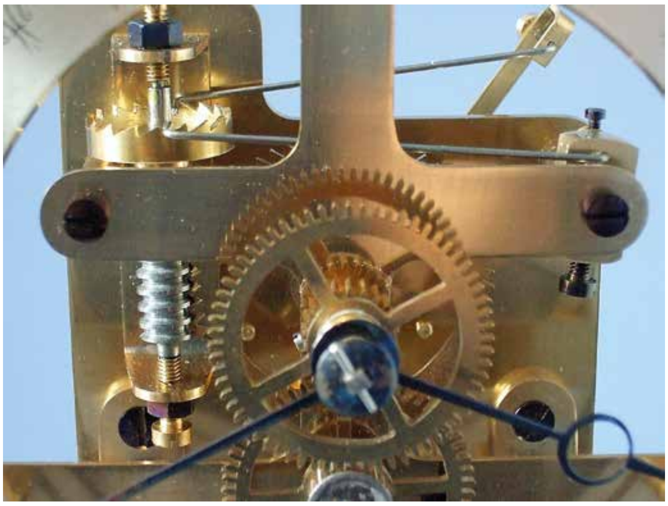

Figure 3.

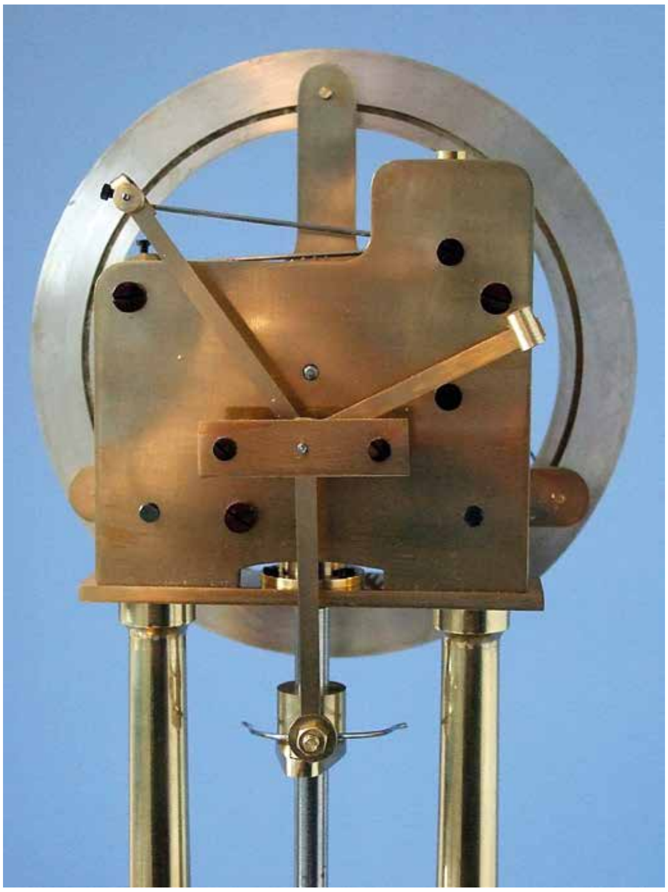

Figure 2.

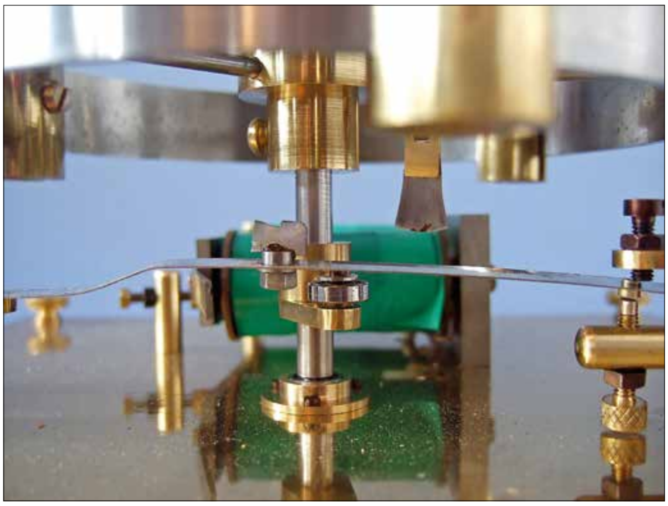

Figure 4.

Another adjustment that aided reliable running was made to the contact spring and the notched blade of the Hipp toggle. The construction book shows that the spring should have a slight double bend in it so that the nut holding the blade does not foul the impulse crank turning below it. This had the effect of moving the blade a small amount to the left of the centre line. To get the smoothest operation with the Hipp toggle, I found it beneficial to turn the blade slightly clockwise so that its side faced the balance staff. Also, the impulse crank and the Hipp toggle trailing trigger were moved clockwise on the balance staff to restore them to their correct positions relative to the blade, **Figure 4**.

The balance wheel worked quite well with a 3V supply but was much better with 4.5V so this was used. On test the duration between impulses from the solenoid increased from about 16 oscillations to some 24 oscillations as the components bedded in.

The construction of the movement was straightforward. When shaping the wires (gathering pawl, back stop and horseshoe), the drawing in the construction book was enlarged using the facility in my printer so that it was full scale. This made it easy to shape the wires by placing them over the drawing.

The dial and hands were bought in and the clock was polished, lacquered and finally assembled. This was followed by a period of adjustment and regulation to achieve a reliable and accurate performance. Meanwhile, the case of mahogany veneered MDF and the acrylic cover were made. This threw up a last minute problem (there is always one, isn't there?). Because of the change from a circular base plate to a square one, the solenoid armature post at the back of the clock got in the way of the back of the case. A small cut-out in the case gave the necessary clearance but if I had foreseen this problem, the clock's frame could have been moved forward by 10mm and there would have been no conflict. Well, you cannot win every time!

From the large oscillating balance to the delicate levers and their wires, the action of the clock is hypnotic. Altogether, a very satisfying construction project, but what to make next?

ENDNOTES

1. N. Andrews, 'An Attractive Electric Mantel Clock', *The Horological Journal*, vol. 158 (2016) 314–315.
2. J. Wilding, *The Construction of a Large Balance Wheel Electric Clock* (Hampshire: RiteTime Publishing, 2001).
3. J. Malcolm Wild, *Wheel and Pinion Cutting in Horology* (Wiltshire: The Crowood Press, 2001), p139 and Appendix VI.

BHI Examinations Report

The Results for 2018

Jeffrey O'Dowd MBHI

It is always a pleasure to see successful candidates in the BHI examinations and this year's students have delivered once again. Very well done to all those whose hard work clearly paid off, and I wish them everything they hope for in their future careers. Generally, the standards produced show a continuing overall improvement in comparison with previous years, and some exceptionally high scoring passes were achieved at a record 97 percent.

As is the usual practice, an Examinations Results Booklet has been provided for all this year's candidates along with their results. It includes generic feedback on each examination unit. Within this article, I will expand on some of the more common errors that examiners see with uncanny regularity when they are marking the servicing examination pieces. I hope this builds on last year's article, which focused on attention to detail – in particular avoiding dust and dirt under the dial. Examiners see evidence of this year after year and this year is no exception.

For Your Eyes Only

Using a good quality, clean eyeglass, **Figure 1**, is often neglected in favour of peering through an oily fingerprint on an eyeglass that is simply not up to the job. A clear exception to the bad workman blaming tools adage. In **Figure 2** a hair, or fragment of fabric can be seen to the left of the hour hand. As a customer receiving his or her watch back following a service would you find this acceptable? Probably not, especially having paid handsomely for the work.

Figure 1.

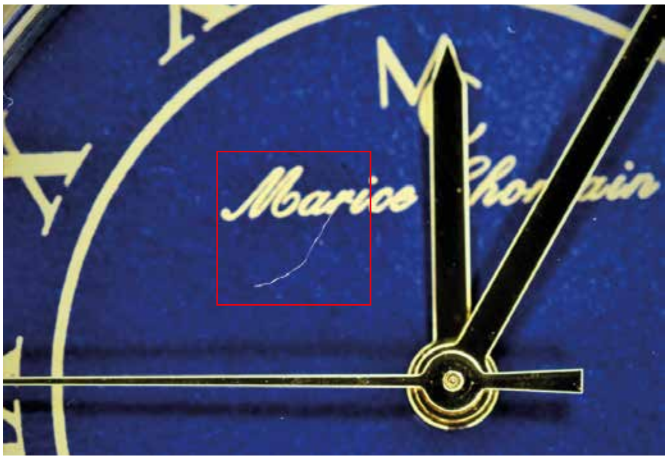

Figure 2.

Gold Finger

In the watch servicing units candidates often use finger cots to avoid touching the movement during assembly of the watch. This is a recommended practice, but they can and do become contaminated with oil from the oiler, or from contact with an oiled pivot which in turn transfers oil to other parts of the movement. It is something to be mindful of and candidates should change the cots from time to time, especially if they become contaminated.

Figure 3.

The Shining

Most candidates are capable of the basic skills required to make the parts specified in the practical units. What examiners are not seeing though are parts finished to a suitable standard and tolerance. Perhaps candidates are underestimating the time needed to achieve a high standard finish or it could be insufficient practice. Either way, the answer is preparation. Don't rush and allow plenty of time for finishing. Corners and edges should be sharp, not rounded. Use several grades of polishing materials, with each one removing the polishing marks of the previous one, until a highly polished finish with sharp corners and edges is achieved. The BHI provides a training course to assist with this, when candidates can become familiar with accepted standards and how to achieve them.

Die Hard

We have seen examples when candidates have made steel pallets but have failed to harden them. The negative effect on exam results here is twofold. Firstly, marks are lost because the pallets are not hardened and, secondly, because a good finish will never be achieved on an unhardened surface. The DLC has a very good section on hardening and polishing, which candidates should study and put into practice. Repeated practise is recommended until you can achieve a hardened item that is not oxidised or distorted, and which makes the finishing process much easier. **Figure 3** hows two poorly finished pallets.

Twister

When is a screw tight enough? Not often enough in the BHI examinations. It is possible that candidates are exercising caution when tightening screws for fear of breaking a screw head or slipping with the screwdriver causing damage to the screw head or, even worse, the plates. If the blade is not ground properly or slightly damaged, there is a risk of it slipping and scratching the watch or clock. I recommend having new spare blades available for watch screwdrivers: they are inexpensive and can be changed in seconds, and spare screwdrivers for clocks.

Equally possible, though, is a lack of appreciation of how tight is tight. It is hard to learn and comes mainly from experience, but a torque screwdriver can help. Candidates should practise on old watch movements using a good screwdriver with a new or properly ground blade at all times. The screwdriver should be used vertically with downward pressure, pushing the blade into the slot when applying the last extra bit of turn to the screw. It is something you could ask a more experienced colleague to check for you, until you begin to feel how tightly screws can be fitted without breaking heads or damaging slots.

This is so important with the click screw of a clock: the mainspring is under stress and the screw can work loose if it isn't tight enough. The result here is that you or someone else can sustain painful injuries when the winding key removes several layers of skin from fingers. Moreover, it could be your customer who suffers the injuries bringing the consequential compensatory issues. No surprises, then, that loose screws will result in loss of marks in the examinations.

Figure 4.

Jaws

Examiners have noted damage to the backs of waterproof watch cases due to poor alignment of the jaws on the case opening and closing tool, **Figure 4**.

These scratch marks are almost always deep and difficult, or even impossible, to remove. Case backs are generally not something that are available as a replacement when damaged, so a great deal of care is required. Practising on discarded watches will help candidates deal with this problem.

The Final Frontier

Practise makes perfect (or so it is said), and a candidate can attend training courses, and can practise dismantling and assembling a movement over and over. I recommend both, but neither is enough on its own, because the difference between something average and something great is attention to detail. Too many candidates lose too many marks due to specks of dust under the glass and on the dial. Put this together with some or even all the issues highlighted above, and it is entirely possible a candidate will lose enough marks to fail a watch servicing examination. These faults are critical and carry a high number of marks, so it is important not to waste them.

To those candidates who were not as successful as they hoped I will say: do not be disheartened and never give up. My advice is to use all the resources available to assist you, including the Institute's Distance Learning Course (DLC), and the courses available at Upton Hall. For the Exercises in the DLC, the Institute can arrange tutors for feedback and guidance. Mentors can even be found by attending local BHI branch meetings. Good luck to all new and returning candidates next year.

I would like to recognise the hard work of everybody who has contributed to the preparation, execution and marking of this year's examinations – thank you all, as without your participation none of this could happen.

For this year's results, see the inside front cover.

From the Auction Room

Longcase Clocks: A Market Update

Richard Fox

Longcase clocks are one of the 'perennials' of clock collecting, as well as an established clock group for those involved in the servicing and restoration of clocks. So, what are the most valuable and collectable longcase clocks currently in today's UK market, and what makes them desirable?

Having reviewed a number of recent sales of fine 'collector' level longcase clocks and after speaking to experts within the auction houses, a few general points emerge. The key attributes for all collectable items – rarity combined with age, established provenance, originality, recognised maker's name, condition – apply equally to longcase clocks. Market sentiment is also important. Items that are no longer generally seen as 'in fashion' can be impacted at auction, particularly for examples which are considered average. While top-end collector level longcase clocks perhaps don't enjoy the current publicity levels that, say, vintage wristwatches have now garnered, there seems to be a core group of knowledgeable collectors (and dealers), who will seek out high quality examples, in original condition, with established provenance. This group has helped define the longcase market at the top end in terms of both value and taste. Often, as will be seen, these rarer, sought-after examples appear to be from the late seventeenth century, the 'Golden Age' of English clockmaking.

Furthermore, for higher value longcase clocks, rarity needs to be matched by originality, including dials, movements and cases that are all related. The correct attribution to a recognised maker is important and the technical aspects of the movement need to be good. Documented provenance can be very important, as well as the state of any previous repairs or restoration work. Overall proportions, materials used to construct the case, the patina and general condition are all significant.

To help illustrate a range of current higher value longcase clocks, I have arranged a comparative sample group. They are all examples of late seventeenth and eighteenth century English longcase clocks, attributed to London makers. These longcase clocks seem to attract the higher values from the auctions I reviewed, but not exclusively, as you will read.

Generally, sale prices in longcase auctions are quite wide ranging, which is to be expected given the variation in age, style, rarity and condition available. Of the examples reviewed here, the highest value longcase to be sold was a late seventeenth century, one-month duration clock attributed to Joseph Knibb. It fetched a superb £70,000, including buyers' premium, at Bonhams, especially as it was estimated at £20,000 to £30,000.

I asked James Stratton, Director, Clock Department at Bonhams, why this longcase did so well at auction.

He explained: 'The Knibb had all the best ingredients. It was fresh to the market and it had been in the family for a couple of generations at least. It was by one of the best makers, any old restoration had been done to the highest standards and it was a good size and a great colour. Clocks like this will always be in demand, whatever the rest of the market is doing. This was bid on by both trade and private collectors, but the private collector won on the day.'

Conversely, a 30-hour longcase clock circa 1780 achieved just £500 (hammer price), despite being over 200 years old. Nor do all longcases sell. Across three of the auctions I reviewed, approximately 66% of all longcase clocks were sold (this figure does not include freestanding regulators sold at the same auctions).

Despite the examples here all being attributed to London makers, this is not to discount regional longcase clocks of the same period. A seventeenth century longcase clock with lunar indication, attributed to Joseph Norris of Abingdon, sold for £5,250 including buyer's premium (lot 37; Bonhams, 11 July 2018). The estimate was £2,000 to £3,000.

Finally, mention should be made of regulator clocks. One outstanding example, sold recently, is a rare, late eighteenth century mahogany floorstanding regulator, attributed to Pennington, London. It sold for £62,500, including premium. The estimate was £50,000 to £70,000 (lot 129; Bonhams, Fine Clocks, 11 July 2018).

What the Auction House Experts Say

The specialists' comments, provided specifically for the *HJ*, give some excellent thoughts on the current market in general and which longcase clocks command the highest values.

Leighton Gillibrand, Director, Clocks, Barometers & Scientific Instruments, Dreweatts

'The supply of fine longcase clocks into the UK auction market is limited with now only four to six sales a year devoted entirely to fine clocks, with other offerings limited to small groups included within other multi-disciplinary sales. However, demand from the high-end decorator market has softened for examples which would have traditionally had a broader appeal, hence prices have remained fairly static for such items.

'Consequently the high-end market is now mainly driven by connoisseur collectors with originality and provenance becoming increasingly important as well as market freshness, hence examples which benefit from all three stand to command a substantial premium. The most desirable examples are still the smaller (ten inch dial or less) walnut or marquetry examples from the 'Golden Period' by the leading makers.'

James Stratton, Director, Clock Department, Bonhams

'The longcases that are standing up well at the minute are the ones that tick the boxes. Name, provenance, size, colour, originality etc. But if they don't fulfil all of those criteria, there is still demand for smaller longcases of good proportions.'

Adam Wasdell MBHI, WOSTEP, Clocks, Watches & Barometers Specialist, Tennants
'Factors to look for in today's market include longcase clocks by good names with unusual dial displays, complicated movements, and the originality of the clock. The proportions of the clock case make a big difference when a private person is buying a clock for the home. From the results of recent sales, the positive trend began a couple of years ago. For example, good original longcase clocks are doing well.

'I can see a gradual improvement for the better clocks starting to move up again in value, but average longcase clocks which have no striking features, and which are not original (for example they have later movements or later cases) are still struggling in the market.'

Examples of Late Seventeenth and Eighteenth Century English Longcase Clock Sales Results – UK Auctions 2018 - Listed by Sold Value

Lot 66: Bonhams, Fine Clocks sale, 11 July 2018
Estimate: £20,000–30,000
Sold for: £70,000 incl. premium

A good late seventeenth century walnut and marquetry panelled longcase clock of one-month duration. Joseph Knibb, London.

It has a weight driven movement united by five knopped, finned and latched pillars. The going train has five wheels, terminating in an anchor escapement. 196cm (6ft 5in) high.

Lot 789: Tennants, Spring Fine Art sale, 17 March 2018
Estimate: £5,000–7,000
Sold for: £15,000 hammer price

A fine mulberry eight-day longcase clock, signed Peter Walker, Wild Street End, London, circa 1695.

It has a five pinned and latched pillar movement and anchor escapement. The inside countwheel strikes on a bell. 201cm high.

Lot 109: Dreweatts, Fine Clocks, Barometers & Scientific Instruments sale, 15 March 2018
Estimate: £12,000–15,000
Sold for: £12,000 incl. premium

A fine William and Mary walnut, olive wood and floral marquetry longcase clock of month duration. James Clowes, London, circa 1690.

It has five finned pillars bell striking movement with a high position outside countwheel and anchor escapement, regulated by seconds pendulum. 199.5cm (78.5in) high overall.

Lot 788: Tennants, Spring Fine Art sale, 17 March 2018
Estimate: £10,000–15,000
Sold for: £11,000 hammer price

A fine burr walnut month going longcase clock, signed Joseph Windmills, London, circa 1695.

It has six pinned and latched movement pillars and an anchor escapement with an outside countwheel striking on a bell. 226cm high.

Lot 65: Bonhams, Fine Clocks sale, 11 July 2018
Estimate: £8,000–12,000
Sold for: £10,625 incl. premium

A late seventeenth century walnut marquetry longcase clock with ten-inch dial and bolt and shutter maintaining power. Daniel Quare, London.

The rectangular movement plates are united by five knopped, finned and latched pillars. It has an anchor escapement and the going train has maintaining power. The strike train has an outside countwheel and release cord which can be used to advance or synchronise the strike. 196cm (6ft 5in) high.

Lot 97: Bonhams, Fine Clocks sale, 11 July 2018
Estimate: £5,000–8,000
Sold for: £8,750 incl. premium

A late seventeenth century walnut and marquetry longcase clock with ten-inch dial. Robert Seignior, London.

It has a weight driven movement, (previously with maintaining power), and plates united by five ringed and knopped pillars, plus an anchor escapement and outside countwheel strike on a bell. 202cm (6ft 7.5in) high.

Lot 197: Woolley & Wallis, Furniture, Works of Art and Clocks sale, 10 January 2018
Estimate: £6,000–8,000
Sold for: £8,750 incl. premium

A walnut and marquetry longcase clock, the brass eight-day movement by Henry Jones.

The clock has a recoil anchor escapement, with five turned and knopped pillars and an outside countwheel striking on a bell. Case and movement are probably associated. 229cm (7.5ft).

Lot 156: Sotheby's, Collections sale, 3 May 2018
Estimate: £4,000–6,000
Sold for: £4,750 incl. premium

A George III mahogany quarter chiming longcase clock, Francis Perigal, London, circa 1775.

It has a substantial three train movement with six knopped pillars and an anchor escapement. The pendulum has a lenticular bob and a graduated rating nut. The clock has an altered quarter chiming on a nest of eight bells and striking on a further bell. 272cm (8ft 11in) high overall.

Further Research

If you have further suggestions for market review topics, or general comments on the longcase market, I would be very pleased to hear from you. Please contact me on richardflondon@yahoo.com

Further Information

For more information on each lot, or the individual Auction Houses, please visit their websites:

Bonhams
www.bonhams.com

Dreweatts
www.dreweatts.com

Sotheby's
www.sothebys.com

Tennants
www.tennants.co.uk

Woolley & Wallis
www.woolleyandwallis.co.uk

Please Note

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The descriptions of the above listed lots have been reproduced by kind permission of the respective auction houses. For full lot descriptions, please refer to the auction house websites as listed at the end of this report.

Branch Reports

Bristol

Despite glorious weather, our designated speaker David Penny was laid low by an incapacitating but short lived virus. We were sorry to hear of his indisposition and hope for a quick recovery. The good news was that he was perfectly happy to reschedule his talk for some time in the autumn. These little problems nearly always occur at short notice and as such it was decided that the only viable option was to convert it to a Bring and Discuss, which is what we did.

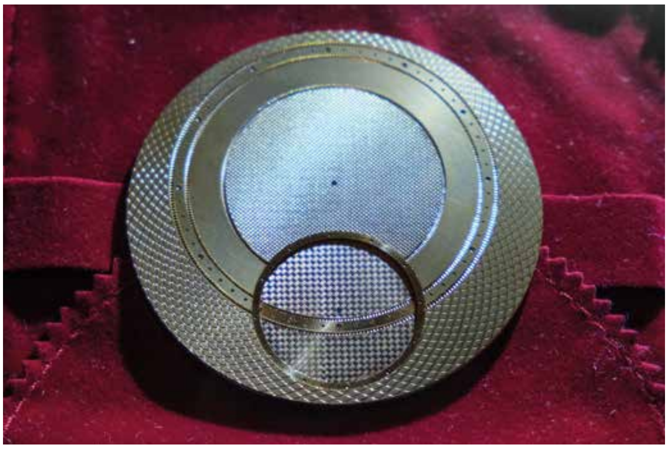
The meeting was opened by our Vice Chairman, Malcolm Pipes, as our Chairman David Spicer was unable to be with us due to a scheduling clash with a prearranged visit to the doctor. As the first speaker, Malcolm gave a splendid exposition on the best ways to take pictures of horological devices and and the equipment so to do. It was an excellent, wide-ranging discourse.

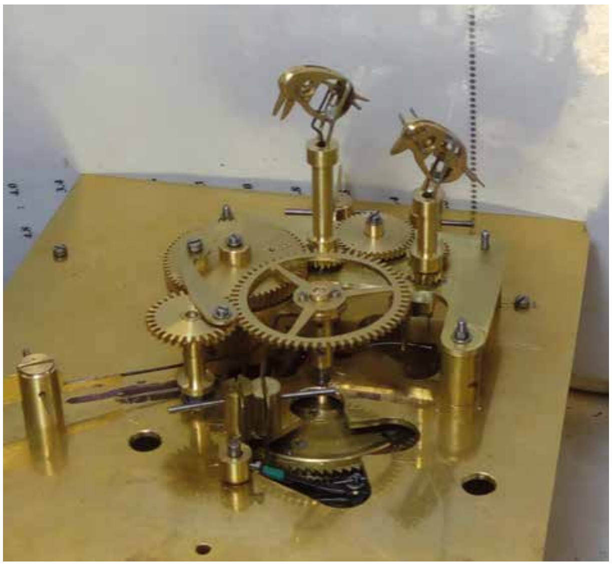
The surprise of the evening was our next speaker, a toolmaker named David Cottrell. He had brought along his first prototype tourbillon based on the George Daniels design. Having read the book (*Watchmaking*) he was first intrigued and then inspired to create his own pocket watch, which he had very kindly brought for us to examine. It was a most enjoyable canter through a good many aspects of his learning process while building his watch.

Lastly, Vernon Burchell showed us an open iron framed clock by one of the Oxfordshire Quaker clockmakers, Thomas Gilks.

Despite the difficulties, it turned out a most enjoyable and sociable evening.

Martin Dickinson





Scotland

We recently welcomed Branch member Archie McQuater who gave a talk on his latest project: an automaton clock. Archie is no stranger to building complex mechanisms, having previously enthralled us with the details of his Ptolemaic planetarium in April 2014.

His new clock is a 53cm high ebonised, break-arch, double fusee bracket clock with painted dial and brass frets to the side and back. The clock case was designed by Lizzie Sanders, the wife of our late Chairman, and was made to a very high standard by an East Lothian cabinet maker.

The clock has no bell or gong. Instead, the 'strike' side of the movement operates an automaton, once a day, through a 37-second sequence (the owner can set its start time). The automaton comprises singing robins, including a mother feeding her chicks, set in a country scene with hills, hedges, trees and a railway bridge. It will be illuminated with LED lights as sunshine, powered by a three-volt battery in the base of the clock case. As there would be insufficient power from the clock movement to operate the automaton birds fully, the battery also powers a small motor which drives the bellows that provide the bird song.

Archie admitted that making the clock was quite straightforward, but designing and making the automaton mechanism was a challenge, requiring a process of trial and error. The robins' small sizes made their structural forms difficult, and decorating them will be another challenge.

We have also taken a trip to the Chippendale International School of Furniture near Haddington in East Lothian. It is one of the world's top furniture making and design schools, teaching a wide range of skills including how to run a successful business. The quality of the students' work on display was stunning.

Zen Chowaniec

South London

We have recently had talks by Peter Gosnell and Ray Darnell.

Peter introduced us to Charles Cartwright of 22 Edgbaston Street, Birmingham, who imported and exported clocks, watches, music boxes and bronzes from 1837 to 1866.

By the late 1880s the company just imported American movements to be fitted into their own wooden cases. To separate the American from the Birmingham-made movements, Peter found very subtle differences in the frames and pointed out a mistake on the paper label inside the backboard. The N in 'movement' was printed back to front until a label from January 1889, where this had been corrected.

Peter spent ten years researching this manufacturer – with difficulty, as there has been little written on the subject and few markings on the movements. Our members much appreciated the time and effort spent researching this lecture.

Ray spoke about making a copy of John Harrison's Regulator. His plan was to be true to Harrison's design and the goal of a clock accurate to within one second in one hundred days, having low friction bearings, a gridiron pendulum and the first Harrison designed caged roller bearings. Ray has now made his fifth CNC machine and incorporated an expensive program to replace the machinist's sensitive fingers, although he assures us he has retained his old piercing saw. However, this was not on display among the many impressive parts and tools he had made to achieve the star of his display, Ray's Royal Astronomical Society Harrison Regulator. We received a thorough explanation of how this had been created, including how Ray made a fly cutter that ran up to a speed of 20,000 rpm without the bearings heating.

The hall was filled to capacity and we thank Ray for a very informative and absorbing lecture which was enjoyed by all.

Michael McDonnell

Sussex

We welcomed Bill Wolmuth to talk on 'Clockmaking in England and Wales in the Twentieth Century'.

Following a discussion with the British Museum, Bill and his colleague John Glanville agreed to research this neglected area of horological history and acquire items for future reference. Such clocks may be common at the moment, but if the work is not done now, they and the information surrounding them could be lost. Bill and John set out on what turned out to be a ten-year quest to cover all the manufacturers, record their often convoluted history and gather examples of the items produced. This finally culminated in the publication of a book, which I believe will become the standard reference work for this area of horology, and the presentation to the British Museum of 250 representative clocks to form a reference archive. Every manufacturer was researched and each clock had its movement removed, studied, measured and photographed (resulting in some 1,100 photographs in the book). Unlike many reference books where facts and figures are just cloned and reworked from other books, all the details here are from their own research and are thus 'fresh to market'.

Space does not permit the relating of everything we learned: for that you'll need to ask Bill for a talk, or buy the book. As a few aspects, however, the talk covered the British United Clock Co. who pioneered mass production, the keys to which were simple design and interchangeable parts, and H. Williamson with the well-known Coventry Astral trademark.

Bill's talk gave us a small idea of the extraordinary efforts he and John have made. We warmly thanked him for sharing his discoveries with us.

Gordon Hoare

Bench View 172

Workshop Matters

Mike Flannery FBHI

It has been a while since I have reported on my sumptuous workshop here at Bench View Towers. During the last few months I have made some fairly major changes and plan to make a few more. I am never really satisfied that I have got things right in the workshop, and I suspect that it will always be a work in progress. Firstly, something with which I am very pleased: I painted the concrete floor a few years ago and have maintained the occasional 'touching up' repaint where traffic is high. I am pretty happy with the result, as it does not seem to create dust in the way that an unsealed concrete floor tends to do. I used a grey floor paint; while this may have been an odd choice, I have found that when I drop small items on the floor (which I do rather too often), I can usually find them. Eventually!

When I built the workshop, for some unfathomable reason I chose to put in standard energy saving bulbs. This was a complete mistake and while I am sure that I was saving energy, I could not see anything and the bulbs just made me cross. So in the first major lighting change, I fitted fluorescent strip lights, 12 in all. I could now see, which was a distinct improvement. If you spend as much time in the workshop as I am supposed to do, you need to get your creature comforts sorted out. However, I then began to find that I was being troubled by the sound of the lights. The vibrations were annoying. This was making me cross. Can you see a pattern emerging yet? So the next change was to remove the fluorescent lights and replace them with similar sized, but much brighter, output LED strips. These were a revelation; they were silent *and* I could see. I was no longer cross. Poorer, yes, but not cross. Well, not *very* cross. I put a further pair of lights on a fairly basic rise and fall mechanism above the speedometer and instrument working area and when I get round to it I will do the same over the clock bench. Having good lighting is a real necessity when working on small and multilayered components, and I have found the LED lights to be excellent.

Now that the workshop was beautifully bright, I needed to put a light friendly surface on the bench tops. I eventually found a very nice dark green oilcloth which was sold as table cloth material, but has proved over the last couple of years to be incredibly robust. I have got it fixed down to the bench top with just gaffer tape, but it works.

I had been sitting at the bench over the years in a variety of second-hand office chairs. These were all right, but I found that I was gradually starting to suffer more and more from a sore shoulder and neck. Looking at the way I was working, I was more hunched up than I should have been and I suspect my chair and its relationship to my bench height may have been a cause of the problem.

Mrs Bench View has for many years suffered from a bad back and she had decided to get a stand-up, or variable height, desk for her work. It has been a great success. So, over the last year or thereabouts, I have also been working more often standing up. It takes a bit of getting used to but I can report that it is quite good and switching between sitting down and standing up tasks seems to ease my back and neck. One of the things I am considering is a multi-height work bench, but in the interim I bought a very good multi-height gas strut chair with a good back support system and a built in footrest. When you are sitting down and become engrossed in a task, I think you need to make sure that you are comfortable and not doing yourself harm with a poor ergonomic layout.

Figure 1.

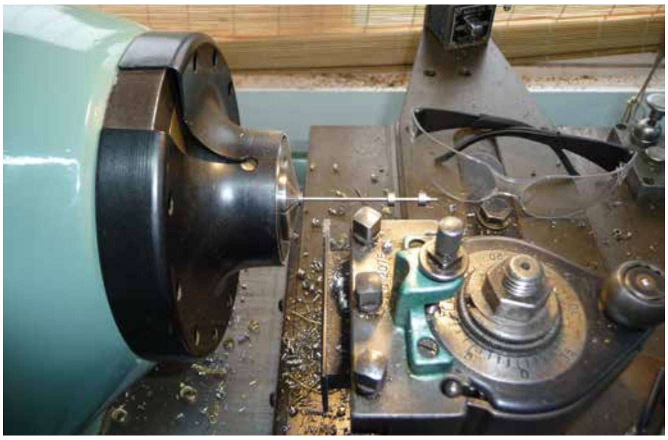


Figure 2.

I like to keep my benches clean, except for a Sunday afternoon making project, **Figure 1**. Storage for much-used tools has been greatly improved with very some simple tool racks. I use the small 'Bisley' type drawer cabinets for the tools I use less often. Lining them with upholsterers' anti-slip fabric helps to stop the tools from moving around and, of course, prevents damage to them.

A couple of years ago I bought from a friend a Feeler lathe. This is a Far Eastern copy of the Hardinge Toolroom lathe. In terms of accuracy this lathe is superb, and I have now got used

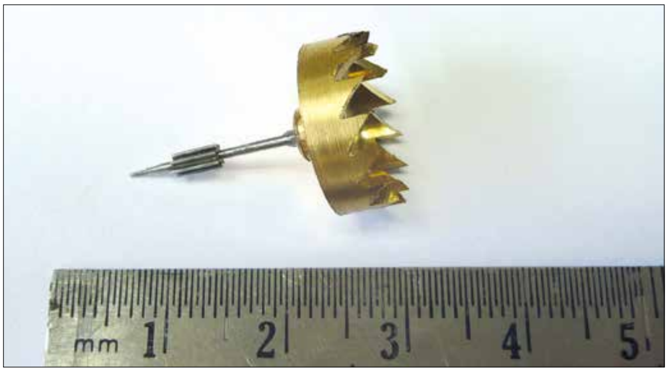


Figure 3.

Figure 4.

to using the collets on pretty much all the jobs I need to do. I rarely use the very accurate three-jaw chuck for most work on this lathe, **Figure 2**. The advantage of using a large lathe is that you can, with care, do very fine work on it. The smaller lathes, however, struggle to carry out any large work.

I still use my Colchester Chipmaster to do most of my very quick, larger jobs, but the Feeler is fast becoming my 'go to' lathe if I am making something that needs to be very accurate. The lathe has the capacity to be far more accurate than I am, and despite the inherent toolroom quality of the lathe, most of my work can look as if I am using a blunt six-inch nail as a lathe tool. It has taken me a couple of years to become comfortable with the Feeler. It has the distinct advantage of being very tall and the centre height is 1.24m, or about $48\frac{3}{4}$ inches, above the ground. The Chipmaster is 1.105m, or $43\frac{1}{2}$ inches (and that includes the $2\frac{1}{2}$ inch rising and anti vibration mounts), which is a fair bit lower. If I have a job that I know will take me a long time to machine, then using the Chipmaster becomes a real pain in the back. However, one real advantage that the Chipmaster has over the Feeler is the Digital Read Out (DRO) system that my friend Clive fitted on it for me a few years ago. This has revolutionised my work on the Chippy. I will probably either ask Clive to transfer the DRO to the Feeler or push the boat out and buy a new DRO for it. Nowadays, DROs are not particularly expensive and they are very handy.

One of the challenges that I suspect most of us face is our sporadic need to use the large centre lathe in our everyday horological work. Most of the time if I need a small turning or polishing job done, I will use my favorite Derbyshire WW pattern watchmakers' lathe.

I have not really thought about it in any great detail, but I guess that some weeks, if I am in a repairing phase of work, I do not use the large lathes at all. Other weeks, I'll use them perhaps only every so often and not for more than a few minutes at a time. What this means for me is that I really need to re-familiarise myself with the controls, and remember actually how to work the lathe. Each lathe is of course different and the controls, naturally, are also different. I really have to concentrate on what I am doing. If I am in 'making' mode then I will be using the lathe far more frequently and using the machine tools becomes more second nature, but I still have to take care. Those craftspeople who use machine tools for a longer period each day will perhaps not have this problem. I suspect that in days past, when clocks were being made in greater numbers, one person would remain doing a special operation on a specific machine for a long time, thus learning the nuances of the machine and the operation over time and gradually becoming more proficient. In effect, they would become specialists at a trade within a trade. A centre lathe turner in a workshop would be just that: all they would do is to operate the centre lathe. We modern horologists use a wide variety of different tools. Just look at your work cycle and consider what you use each day.

Consider a simple disassembly and service on a longcase clock movement with perhaps a bit of re-bushing, making a small new part and what I call 'general fettling'. We might transfer from a small lathe to a polishing machine, then use a few hand tools to complete the task. We have become far more generalist within our trade of horologists than perhaps our forerunners would have been. Look at old photographs of Victorian workshops, with lines of workers all doing machine shop tasks. One presumes that they are not all doing the same job, but that the parts being worked on are being sequentially passed down the line of workers, each a specialist in a particular task.

Perhaps you have seen the excellent videos produced by Roger Smith on the straight line engine and the rose engine. We need to remember that excellence in their use is as a result of time to practise. In my case, I am very willing to admit that it is also the time in which to make lots of mistakes.

Unless we are prepared to re-hone our skills we will soon start losing them. Re-learning skills is a very important part of our continual professional development. Speaking entirely for myself, I have found that even if I was quite accurate at using the lathe or hand tools a couple of months ago, my skill level falls rapidly unless I keep doing these tasks. Retaining hand skills is quite a battle for me. (Some might point out that they were not much good in the first place.) For me, trying to keep skills means that I need to spend time making things, not just repairing things. So for example, I might start with a blank lump of brass with the aim of making a small crown wheel for the Sunday afternoon 'making' project, **Figure 3**. This is a really good practice. It may be interesting to note that even very talented top level international musicians will spend hours each day just practising, hour after hour on practise. Talent alone is not enough: practise and commitment are still required.

Commercially, as horologists, we possibly do not build in the time to practise during our working week, yet we expect that our hand skills will maintain a level of competence to satisfy both us and our customers. Speaking personally I doubt that this is the case. I really need to think more about skills and practise. I recently fitted a small Anglepoise light over the Derbyshire lathe and this has made a big difference in my work. I can now see the mistakes I am making in far greater detail than I could before fitting the lamp, **Figure 4**. I wonder if this is progress or a form of skills regression.

HAVE YOU EVER CONSIDERED WRITING FOR THE *HJ*?

The *HJ* is always looking for technical articles that are of interest to horologists. If you have an idea you'd like to discuss, please get in touch or submit your article directly.

Contact our Editor Rachel Reeves on 01636 817602
or email: rachel@bhi.co.uk

BRITISH HOROLOGICAL INSTITUTE

BHI Courses 2018

Date	Course	Tutor	Spaces
September			
31–2	Wheel & Pinion Cutting (Including Making Fly Cutters)	Jim Arnfield	FULL
3–7	Basic Mechanical Watch	John Murphy	FULL
19	Taster Day - Introduction to Watches	Alan Burtoft	FULL
20	Taster Day - Introduction to Watches	Alan Burtoft	FULL
22–23	Basic Hand Skills	Ross Alcock	
October			
1–5	Basic Clock 1	Sunil Silva	FULL
12–14	Basic Quartz Watches	Mervyn Selley	FULL
15–19	Basic Clock 2	John Reynolds	FULL
22–26	Chronographs	John Murphy	
31	Taster Day - Introduction to Watches	Alan Burtoft	
November			
5–9	Basic Mechanical Watch	John Murphy	
12–16	Basic Clock 1	Sunil Silva	
21	Taster Day - Introduction to Watches	Alan Burtoft	
23	Taster Day - Introduction to Clocks	Paul Roberson	
23	Taster Day - Basic Clock Case Finishing	David Watkinson	
24	Taster Day - Introduction to Clocks	Paul Roberson	
24	Taster Day - Basic Clock Case Finishing	David Watkinson	
26–30	Service & Repair of Day/Date Automatic Watches	John Murphy	FULL
December			
3–7	Basic Clock 1	Sunil Silva	FULL
10–14	Basic Mechanical Watch	John Murphy	

Tuition Costs

All prices include lunch but not B&B

Course Prices
1 day - £150
2 day - £300
3 day - £450
5 day - £750

Accommodation

We can also provide non-ensuite accommodation during the course on a B&B basis at £45 per night. Courses may change subject to demand. We cannot guarantee that a particular tutor will be teaching the course. For bookings, syllabuses and details please contact Zanna Perry:
Email: zanna@bhi.co.uk
Tel: 01636 817603

If a course is full we can put your name on a waiting list and let you know when new spaces become available. See the BHI website for updates: www.bhi.co.uk

Short Courses

Due to the success of our 'taster days' we are planning more of these throughout 2018 and have added the ***Basic Clock Case Finishing*** course for this year.

New for 2018 are the courses ***Basic Carriage Clock Repair*** as well as ***Basic Cuckoo Clock Repair.***

For the experienced horologists amongst you we are gauging interest in the following courses:

Making a Balance Staff

and

Fine Adjustments of a Watch
(to include escapement/balance spring adjustment and dynamic poising)

If you are interested in any of these courses, please let me know.

Zanna Perry
Email: zanna@bhi.co.uk
Tel: 01636 817603

New Members & Upgrades

Associates

George Assaly
Christopher Bowler
Rick Cullen
Thomas Davies
Agnelo Dias
Lyndsey Esland
Louis Faine
Tina Fotherby
Jorge Garcia Moreno Villarreal
Richard Gregory
David Gries
Timothy Harris
Paul Krichten
Emmanuel Lemon
Jaanus Lillenberg
Jon Pritchard
Morgan Pugh
Andrew Robb
Peter Round
Peter-John Simmons
Robert Smith
James Southgate
Stuart Stakoff
Robert Tilley
Robert Tindall
Ashton Tracy
Philip Turner
Geoffrey Walker
Nicholas Wright

MBHI

Richard Cato

FBHI

Cyril Jennings

Members' Sales & Wants

FOR SALE: *KWM Clock bushing tool with boxes of bushes. Sale on behalf of deceased clock maker. Buyer to collect. Gloucester. £500, contact 01452 386672. Please state that you are calling with regards to the BHI sale.*

FOR SALE: *Due to impending retirement: watch repair workshop contents, including tools, materials and books. Goodwill also included subject to GDPR. Please email me for further information: harryattws@googlemail.com*

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Manchester
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South Africa
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Horological Calendar

September

5 – Turret Clock Forum, Upton Hall. Speakers: Keith Scobie-Youngs FBHI, Simon Gilchrist, Julian Parr, Jim Thompson, Stephen Dutfield, Marisa Addomine, Andy Burdon, Janet Berry, Derek Frampton and Chris McKay.
5 – South West Branch, Speaker Oliver Cooke, curator of Horology, British Museum, 'Edward East', 7:45pm, the Daw Building at Exeter School, EX2 4NP.
5 – St Albans Clock Club, Speaker Peter Gosnell, 'British Jerome – The Untold Story', 7:30pm for an 8:00pm start, The Garden Room, The Methodist Church, North Common, Redbourn, Herts, AL3 7BU. For more information, contact Bill Wolmuth on 07802 696777.
5 – Wessex Branch, Speaker Graham Morse, 'Restoration of Eighteenth Century Pocket Watches', 7.30pm, Lyndhurst Community Centre, SO43 7NY
6 – South London Branch, Speaker Andrew King: '300 Years ago – The Arrival of John Harrison and Family'. 7:30pm for an 8:00pm start, The White Hart Barn, Godstone Village Hall, Godstone, Surrey, RH9 8DU.
8 – Yorkshire Branch, Railway Timepieces in the Railway Museum Collection, Peter R. Munthe Webster. 1.00pm for a 1.30pm start, top floor of the Bradford Industrial Museum, Moorside Road, Eccleshill, Bradford, BD2 3HP.
10 – Leicester Branch, Speaker Chris Tarratt, 'Mutiny on the Bounty', 7:30pm, BRITE Centre, Braunstone Avenue, Leicester, LE3 1LE.
10 – Lincolnshire Branch, Speaker and Subject TBA, 7:30pm, Saxilby Church Hall, Church Lane, Saxilby, LN1 2PE.
11 – Merseyside, North Wales and West Cheshire Branch, Members' Skills/Collections/Demonstrations, 7:30pm, Ruskin Centre, Ruskin Drive, Denton's Green, Saint Helens, WA10 6RP.
12 – Cheltenham Branch, Speaker Philip J. Gale FBHI, 'Louis XVI Lyre Clock', 7:00pm for 7:30pm start, CACSSA, Tewkesbury Road, Uckington, Cheltenham, GL51 9SL.
12 – Sheffield Branch, Speaker and Subject TBA, 7:30pm, The Fat Cat, Alma Street, Sheffield, S3 8SA.
15 – Scotland Branch, Visit to Lucas Clocks, 5 Quayside Street, Leith, Edinburgh EH6 6EJ.
20 – Kent Branch, Speaker Barnaby Smith, 'Watch & Clockmakers of Faversham', 7:30pm, Brents Tavern, Upper Brents, Faversham, ME13 7DP.
24 – Bristol Branch, Speaker Malcolm Pipes FBHI, 'Further Horological Experiments', 7:30pm, The Globe, Newton-St-Loe, Bath, BA2 9BB.
25 – Sussex Branch, Auction, 7:30pm, Ringmer Football Club, Lewes, BN8 5QN.
25 – Ipswich Branch, Speaker Grahame Brooks, 'George Daniels the Master Watchmaker', 7.00pm for 7.30pm, St Mary the Virgin Hall, Ship Lane, Bramford, IP8 4AT
25 – Oxford Branch, Speaker Ron Rose, 'The Nineteenth Century Clockmakers', covering clockmaker Coles
30 – Essex Clock and Watch Fair, 9:00am – 2:00pm, Marks Tey Parish Hall, Old London Road, Marks Tey, Colchester, CO6 1EJ. Contact Jo Stephens on 07834 235672 for more information.

For ongoing updates to the Horological Calendar throughout the year please refer to the BHI website: www.bhi.co.uk

October

3 – St Albans Clock Club, Speaker Oliver Cooke, 'Breguet 111 and Other Breguet Clocks at the British Museum', 7:30pm for an 8:00pm start, The Garden Room, The Methodist Church, North Common, Redbourn, Herts, AL3 7BU. For more information, contact Bill Wolmuth on 07802 696777.
3 – Wessex Branch, Branch Auction. Viewing from 6.30pm, auction 7.30pm, Lyndhurst Community Centre, SO43 7NY
4 – South London Branch, 'From the SLB Workshop', 7:30pm for an 8:00pm start, The White Hart Barn, Godstone Village Hall, Godstone, Surrey, RH9 8DU.
8 – Leicester Branch, Speaker Mike Frost, 'My Norwegian Travels', 7:30pm, BRITE Centre, Braunstone Avenue, Leicester, LE3 1LE.
8 – Lincolnshire Branch, Speaker Bill Wolmuth, 'Clockmaking in England and Wales in the Twentieth Century', 7:30pm, Saxilby Church Hall, Church Lane, Saxilby, LN1 2PE.
9 – Merseyside, North Wales and West Cheshire Branch, Lathes, 7:30pm, Ruskin Centre, Ruskin Drive, Denton's Green, Saint Helens, WA10 6RP.
10 – Cheltenham Branch, Speaker Dave Shires, 'Building a Month Regulator', 7:00pm for 7:30pm start, CACSSA, Tewkesbury Road, Uckington, Cheltenham, GL51 9SL.
10 – Sheffield Branch, Bar and Discussion, 7:30pm, The Fat Cat, Alma Street, Sheffield, S3 8SA.
13 – Scotland Branch, Speaker Paul Shufflebotham, Chairman of the Coventry Watch Museum, 'The Coventry Watch Industry', 2.00pm, Canons' Gait Bar, 232 Canongate, Edinburgh, EH8 8DQ.

A BEGINNERS' ONE DAY COURSE ON BASIC CLOCK CASE FINISHING.

This one day course, delivered by a professional furniture restorer/polisher is designed for those who are new to restoring and re-finishing furniture and clock cases. The course has been designed to complement the skills of horologists and people who buy or own antique clocks or furniture that needs bringing back to life.

The aim of this course is to enable the student to recognise the state and condition of the clock case, then to be able to decide on the best course of action, salvaging the finish and making the clock usable and looking its best. It will also to enable you to perform small repairs, strip to the original wood if necessary and restore and polish to a standard suitable for the individual requirements of the case. You will be introduced to a variety of woods and veneers with a range of finishes in the BHI museum.

You do not have to bring any tools, equipment or materials with you, just a small clock case you wish to discuss and work on.

Tea, coffee and lunch will provided.

The cost is only £139, which includes the use of a small polishing kit which you can take away with you.

Places are limited so early booking is advisable.

For further details contact Zanna Perry

01636 817603
zanna@bhi.co.uk

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E O Johnson 1.1.0

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H Richards 1.0.0

W Whiting 2.6

W Davis 2.6

George Dunkley 10.0

Fred^k Potter 1.1.0

Edw^d Medcalf 10.0

Th^s Catterwood 1.1.0

Joseph Purser 5.0

William Dunkley 5.1