The Garde Temps is a very rare clock and it seems that only a few have survived, 5-6 clocks are known at the moment.

The movement of the Garde-Temps is completely different from any other Bulle. Instead of the usual Bulle mixed fabrication, the movement has two round plates (rather typical of French clocks) and is unsigned and without serial number.

The driving pawl indexes a ratchet wheel on the seconds arbour which has a gear wheel that drives the minute arbour and the motion work for the hour hand via a contrite wheel and worm, an arrangement made necessary for beating seconds.

This Bulle is the only model not priced in the reprint of the 1931 Bulle catalogue, so I guess it was priced on application which probably suggests that they were only made to order. I think it very likely that the movement was not made in Bulle's own factory but made for them; leaving Bulle to marry it to their normal electro-magnetic coil pendulum and contact system.
However, a standard Bulle pendulum plus a movement made to take a seconds hand would not have made a better time keeper than any normal Bulle with 1/2 second pendulum.
So Bulle incorporated a temperature compensation device forming part of the length of pendulum and mounted immediately above the coil. This is a 'box' design which lifts or lowers the effective length of the pendulum depending on temperature variation. It is mentioned next to the illustration on page 53 of Belmont and described as a "*new additional device for compensation at all temperatures and covered by a Favre-Bulle patent".*

This temperature compensation for the pendulum is mentioned again on page 95 of Belmont in a note which says, *"The marvellous improvement combined with an invention of M. Favre-Bulle relating to a high precision regulator has enabled Generale Horo-electrique to manufacture the Garde-Temps which keeps exact time at temperatures from -10 to + 50 degrees. The Garde -Temps will soon be the subject of a special publication".*
I wonder if this publication did in fact see the light of day and I think probably it did not. I say this because, whilst Bulle might have applied for a patent, the idea might have failed to be accepted by the patent office for the reason that it was not original. In other words, and in spite of what is claimed in the catalogue, Bulle did not invent the idea.
I say this because I know of two similar examples of temperature compensation devices that form part of the pendulum length that were in production many years before the Garde Temps was made. The one made by the Viennese clockmaker Joseh Vorauer in 1860 is precisely the same.

I have a very long interest in precision pendulums and so had a great interest in how well the Garde Temps would behave. Sadly, in spite of meticulous servicing and adjusting, it simply refused to perform with any better accuracy than a normal A Type Bulle. I do in fact like Bulle clocks, but think that the design contains too many variables that prevent it ever being a precision clock, and these mask any benefit that the 'new additional' box device can bring. The very small number of these clocks suggests that it was soon realised that it could not succeed as a precision regulator.

Correspondence Garde-Temps clock

We spoke at the Birmingham Clock Fair and I promised to send you some pictures of the Bulle Garde-Temps.

It is shown in Chapter III of the Belmont book in French, "*La Bulle-Clock, Horlogerie Electrique"* , that contains a reprint of a 1931 catalogue. There is an illustration on page 53 of Belmont describing it as a high precision regulator. The list of models and prices in the catalogue start on page 66 of Belmont and the Garde-Temps is shown at the end of the list as model Z. It is the only one not priced, so it was price on application I suppose, which probably suggests that they were only made to order.

It was the only Bulle made with a seconds hand and the mechanism (like the Ato and the Brillié) begins with the pendulum driving a second's arbour which arrangement (unlike the normal Bulle movements) is necessary for a regulator beating seconds.

The only person I have spoken to who has ever seen one saw the clock over 20 years ago but didn't manage to buy it. Anyway, I now have one so that would seem to make three.

I have taken it out of the case and the attached images are of the movement and case before cleaning and restoration. it would seem to be completely original and not messed up by anyone. The suspension has long been broken and the hairspring for current path mangled owing to the top of the pendulum rod being free to move about; however, that seems to be the only damage. It is dirty but without any rust and the dial is mint so I have been very lucky; even the screw slots are undamaged.

there is no serial number but you might be able to make a guess at the date from the type of pendulum etc. out of your experience. The details at the top of the pendulum (method of hanging, hairspring for current path, etc.) look like the Model XA which was made in the late 1920s.

You will see that the movement is completely different from any other Bulle. Instead of the usual Bulle mixed fabrication, It has two round plates (rather typical of French clocks) and is unsigned and without serial number.

The driving pawl indexes a ratchet wheel on the second's arbour. This pawl and associated detent and friction spring are not similar to other Bulles. Also on the second's arbour is a gear wheel that drives the minute arbour and motion work for the hour hand via a contrite wheel and worm.

The pendulum and contact system is normal Bulle except that <u>there is an interesting compensating device mounted above the coil.</u> I have no idea yet what it does but might get some clues when I strip everything down for cleaning.

The case is mahogany with inlays. The front door has a massive piece of bevelled glass so the whole clock is very handsome.

I have asked a friend to make me a suspension and I would like to buy from you the spring that provides a current path from the rocking contact arbour to the chassis.

Best wishes, >

Hello again,

Just to give you an update on this clock.

I delayed quite a while before doing anything because I dit not get the new suspension yet.

I have disassembled the clock, cleaned everything, and it is now back together and on a solid rig where I have adjusted things as necessary.
The silver contact and impulse pin is now correctly positioned with respect to the impulse fork and under the grime, both these parts turned out to be in excellent condition. The main adjusting involved the indexing pawl which was hopelessly set at the wrong angle and gathering two or more teeth. I have reset the angle so that only one tooth is gathered whatever the pendulum amplitude and the seconds hand is now moving in positive steps and without backlash. It will now run for regulation whilst I clean and polish the case.
I am extremely pleased with how it's going so far and will be interested to see just how good the clock proves to be.

I attach an image of the pendulum compensation disassembled before cleaning which will provide you with a record of how this interesting device is fitted, and also an image of the finished clock on the test rig before the dial goes back on.
Best wishes,

Thanks for your mail and your interest in the Garde - Temps.
Yes, it has all been completed, the clock has been running vigorously since December 2008, and I am very pleased with it. Its performance, however, is something I haven't yet cracked because a seconds hand on a Bulle reveals all sorts of anomalies in the short term rate that we wouldn't normally notice.
For at least two months of the period since December, I kept detailed notes of its rate but, unfortunately, found it too variable too arrive at any conclusions as to the efficiency of the unique system of pendulum compensation. I therefore decided to investigate the possible issues causing the variations in rate before considering the compensation device.
I have now considered two main possible causes of variations in rate.
1) Variations in the current through the coil due to variability in the contact performance.
2) Variations in drag in the seconds indexing arrangements caused by the friction spring acting on the index wheel to prevent backlash of the seconds hand.

With respect to 1), it seems clear that (in spite of the action of the isochronal spring) very small differences in coil current can cause a relatively big change in the pendulum amplitude. To address a potential problem in this area, I took great care over the surface quality of the contacts of the fork and impulse pin.
I also made sure that the current path through the silver spring would, as far as this method allows, be constant.
My own feeling is that variation in coil current might be the main cause of rate variations but to prove this I would need to devise a constant current supply that varies the voltage supplied to the clock in a way that keeps the coil current constant. I haven't done this although the electronics are not difficult.

With respect to 2), it is clear from the design that without the friction spring acting on

the index wheel, the seconds hand would exhibit very marked backlash. This itself is an aesthetic rather than material factor, but one can understand why Bulle would not want the Garde-Temps seconds to show marked backlash. However, whilst the friction spring helps to control this, the introduction of drag into the mechanism also introduces the problem of varying friction at the point of indexing.
I have tried to adjust the friction to the point where backlash is just eliminated and hope that the drag does not vary materially from the point.

Having done these things, I again kept a month's rate record. It was better but still rather variable; enough, in my opinion, to mask the compensation device.
The trouble is, I do not know what sort of rate an ordinary Bulle with 1/2 seconds pendulum and in good condition is capable of. The long term rate might be quite good but without a seconds hand the short term rate of a standard Bulle becomes invisible.
Added to which, once one starts looking for precision timekeeping, one needs to isolate each variable on its own and deal with it. With the Bulle design this is difficult because, just to take one example, the silver spring has three functions to perform:
A) providing reliable current path.
B) eliminating play in the fork arbor.
C) stabilizing the fork, making it insensitive to vibration.
Each of these functions might cause erratic timekeeping but we cannot separate them.

I also wonder if how deeply the silver pin enters the fork notch can affect variability in coil current.
In paragraph 54 of Belmont it says, *"the silver pin G only enters the notch of the fork by a distance of a little less than its diameter".*
In paragraph 105 he says, *"The depth of the penetration of the silver pin on the pendulum into the notch of the fork is of very great importance. The penetration has to exceed three quarters of the diameter of the pin".*
He goes on to explain that insufficient penetration can result in butting of the pin against the fork or cause a wrongly time contact on the return swing of the pendulum. The butting problem is something I have some across myself when the the pin enters the notch by less than its diameter.

I don't really know what I will do next - if anything.
In view of your very wide experience and expertise with Bulle clocks, any comments you might have would be very much appreciated; particularly on the question of what, in your experience, is the best timekeeping a standard 1/2 second pendulum Bulle capable of? That would at least give some sort of bench mark.

Lastly, I have discovered that the compensation device fitted by Bulle, whilst unique to the Garde-Temps, derives from a much earlier inventor.
I attach a photo of a compensation device which in principle looks identical to the

Bulle but done in 1860. Handmade rather than casting and steel bolt of course, and the material of the components is different; nevertheless it is an expanding/contracting box forming part of the pendulum length.

I have never seen this method before except on the Garde-Temps, so this clock in the Vienna Museum is interesting for me. Favre-Bulle claims a patent for his device but perhaps did not know of Josef Vorauer.

David Read.