GREUBEL FORSEY: Creating Complications

Martin Foster and **Timothy Treffry** visit Stephen Forsey in la Chaux-de-Fonds

BASELWORLD and SIHH established 2004 as the year of the multi-axis tourbillon, one version, the result of a partnership between **Robert Greubel** and **Stephen Forsey**, took the industry by surprise. It shouldn't have; these young watchmakers have built their careers creating complicated watches based on tne needs of clients, but, as the 'Double Tourbillon 30°' was their own completely original idea, they set up their own brand, GREUBEL FORSEY, to market it.

To see this exceptional watch in a showcase at BASELWORLD is one thing but visiting the company reveals a much deeper personal commitment to exclusive design, quality and performance. To own this exceptional piece would cost £180,000; it begs the question of what is behind this extraordinary wristwatch, its designers and makers in their exclusive ateliers in La Chaux-de-Fonds in the heart of Jura watchmaking?

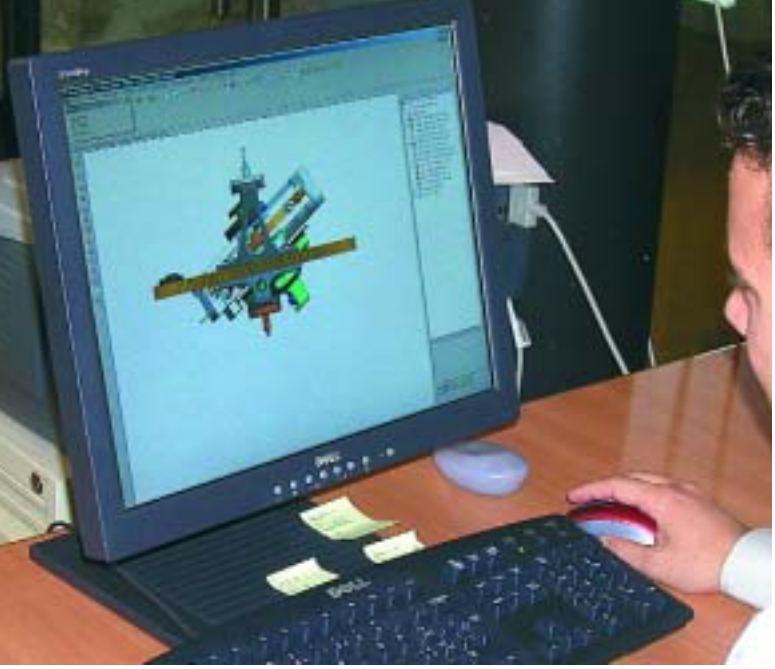
Stephen Forsey.

French trained Robert Greubel, and English trained Stephen Forsey, met when they both worked at RENAUD AND PAPI in Le Locle. RENAUD AND PAPI, initially independent but now owned by AUDEMAR PIGUET (a major client) are renowned complication specialists. Both Greubel and Forsey spent the early 90s in Le Locle working with grand sonneries, repeaters, carillons, perpetual calendars and tourbillons. Another English watchmaker, Peter Speake-Marin, now also independent, was in the same workshop.

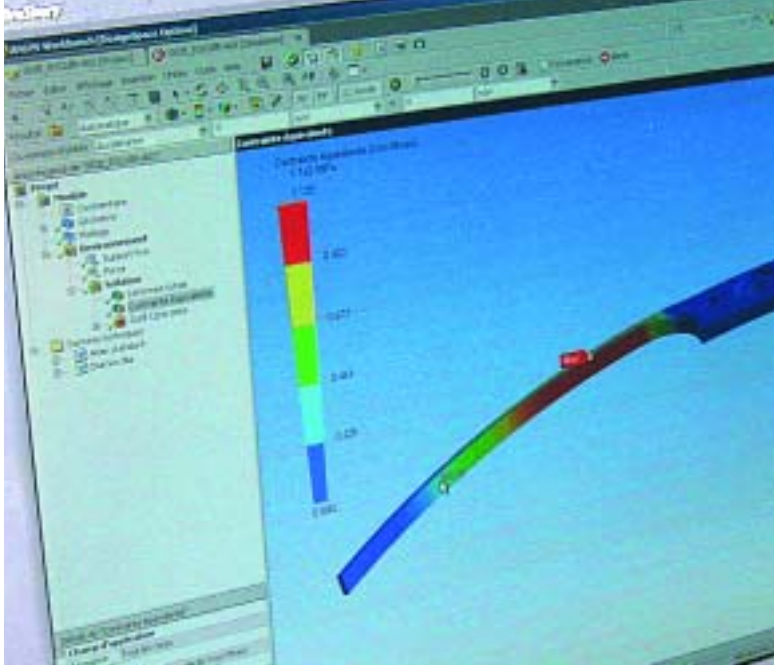
UK born Stephen Forsey is an honours graduate of the BHI course at Hackney College

Detail of the GREUBEL FORSEY 'Double Tourbillon 30°' (for other images see rear cover April 2004). The 11mm, free sprung, 3Hz (21600vph) balance with gold mean-time screws, rotates in a one-minute tourbillon inclined at 30° to the watch plate. The tourbillon is mounted in an outer carriage which turns in the plane of the watch plate once in 4 minutes. The manually-wound movement is driven by twin barrels (one of which has a slipping spring) with a power reserve of 72 hours. The domed and olived jewels are set in gold chatons. Conical gears with profiled teeth drive the tourbillon carriage.

A version in white gold.



Computer-based design and assessment systems play a major role in the development of new movements and have given rise to a system developed by GREUBLE FORSEY called 'Experimental Watch Technology' (EWT).



EWT extends use of CAD to analysis of the behaviour of components. Here, given the alloy used, an ANSYS program predicts the distribution of stress in a spring as it deforms under load. The design can be modified to produce the desired result; minimizing the 'trial and error' required to produce prototype movements.

and he received further watchmaking education during 1988 and 1990 at WOSTEP, becoming head of watch repair for ASPREY in London. Robert Greubel grew up in a watchmaking family in Alsace, trained at *l'Ecole d'Horlogerie*, Morteau, and later in Dreux. From 1987-90 he was '*prototypist*' at IWC Schaffhausen, participating in the Grand Complication project.

In 1999 equipped with first class training and extensive experience, the two friends started working together in la Chaux-de-Fonds, and in 2000 set up an independent company, COMPLITIME, dedicated to the development of complicated movements for high-end brands.

There are 12 employees developing ideas and making pre-production prototypes for COMPLITIME, and 8 who work on the 'Double Tourbillon 30°' for GREUBEL FORSEY and to develop and market it as an exclusive creation.

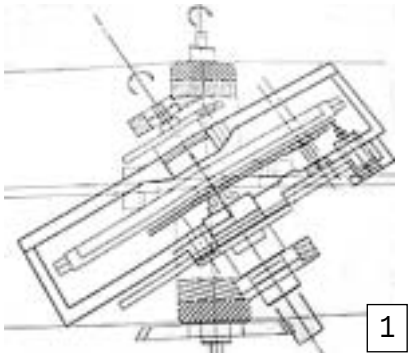
The COMPLITIME-GREUBEL FORSEY office and workshops are part of a restored three-storey residence built in 1855. The "*Ancien Manage*", was designed for instruction in dressage and the internal courtyard is just large enough for exercising horses and elementary training. Today this courtyard is glassed over and the high frescoes on the walls, over 100 years old, give colour and bright personality to this most interesting building, part of which is now a restaurant, a great convenience for clients and visitors. The Swiss seem to have a talent for integrating industry within its towns and villages and watch companies have proved very effective at bringing new life to old buildings.

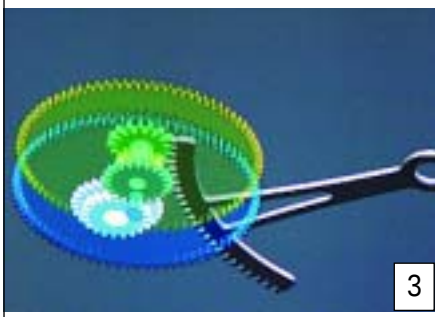
The idea for multi-axis tourbillons arose from the fundamental research carried out by Anthony Randall and Richard Good. In both cases, theirs were at 90°, much larger, and incorporated into carriage clocks.

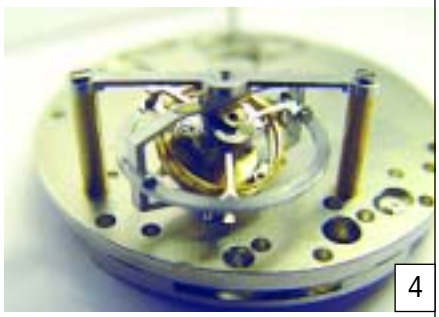
It has taken GREUBEL FORSEY five years to develop the Double Tourbillon 30° project – the more impressive considering that the company is internally financed. All the watch components were developed using SOLID EDGE® CAD software to deliver the necessary innovative designs. This software is widely used in the Swiss micro engineering industries as it provides a superior degree of 3D operational simulation. Checking for dimensional and operational clearances can be accomplished observing the components running from any angle. It is also possible to model the behaviour of components.

As is the case with even the most independent watch company, however big or small, some of the components are bought in. Nevertheless GREUBEL FORSEY is equipped to make more than 90% of the completed watch. In practice however, having perfected the design, it is more efficient for the case, bracelet and escapement elements to

Experimental Watch Technology







*New designs can still start (and often do) with a sketch on the back of an envelope or on a dinner napkin but the next step is on to the computer for a CAD drawing, **1**. With Experimental Watch Technology (EWT) this is transformed into a three dimensional assembly, **2**, which can be given 'life', with parts moving in their proper relationship; gears meshing, levers engaging and springs flexing. The behaviour of subsystems such as the gearing of an up-and-down mechanism, **3**, can be investigated. Finally, rejoining tradition, a prototype can be made by translating the CAD programs to CNC to produce the components, but contrary to tradition, it will be 'right first time' – or very nearly so.*

A 5-axis PRIMACOM CNC machine can produce virtually all the components required. Such machines give small firms unprecedented opportunities for creativity.

Many man-hours of traditional hand-work are still required to produce a fine watch. The inset shows a portion of the tourbillon bridge, before and after finishing.

be produced by specialist suppliers. This enables more watches to be made.

The Tourbillon Assembly

The tourbillon assembly has two carriages. It has 128 components and weighs just 1.17g. The outer, larger carriage is 15mm in diameter and rotates in four minutes. The smaller inner carriage is inclined at 30° to the first, and turns in 60 seconds. It contains the escapement, free sprung balance system with flat spring and Phillips terminal curve.

The performance of this remarkable watch flies in the face of current debate about the value of a tourbillon given what we now know about minimising position error and its effect on good isochronism. The isochronal error arising from different positions (pendant up, pendant down etc) is theoretically compensated in a tourbillon by rotating the balance assembly through every conceivable position on a regular cyclic basis – that cycle period being the rotation period of the tourbillon.

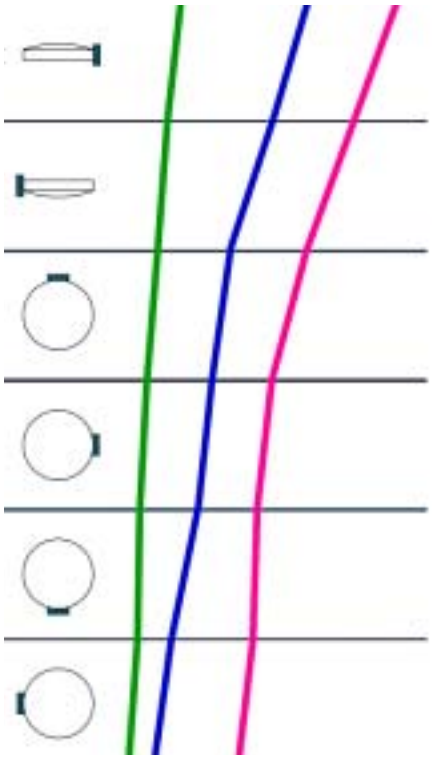
But a modern high frequency (4 Hz or 28,800 vph) beryllium balance with an overcoil hairspring, if dynamically balanced, delivers negligible position error. Consider here the legendary GYROMAX balance wheel for which PATEK PHILIPPE was granted patents in 1948 and 1951 where dynamic poising and rating are achieved with eight movable poising weights (masselots) and <4 seconds of daily rate is achieved. Thus the function of the tourbillon has been largely overtaken by the greater knowledge we have to achieve the same result with simpler mechanics. But achieving precision by 'simpler mechanics' is no longer the goal, that ended with the cheap quartz watch!

In any case, contradicting current argument, the GREUBEL FORSEY 'Double Tourbillon 30°' pares a margin of 4sec/day off an already impressive performance and the daily rate worn on the arm is targeted at -0.0/+4.0 sec.

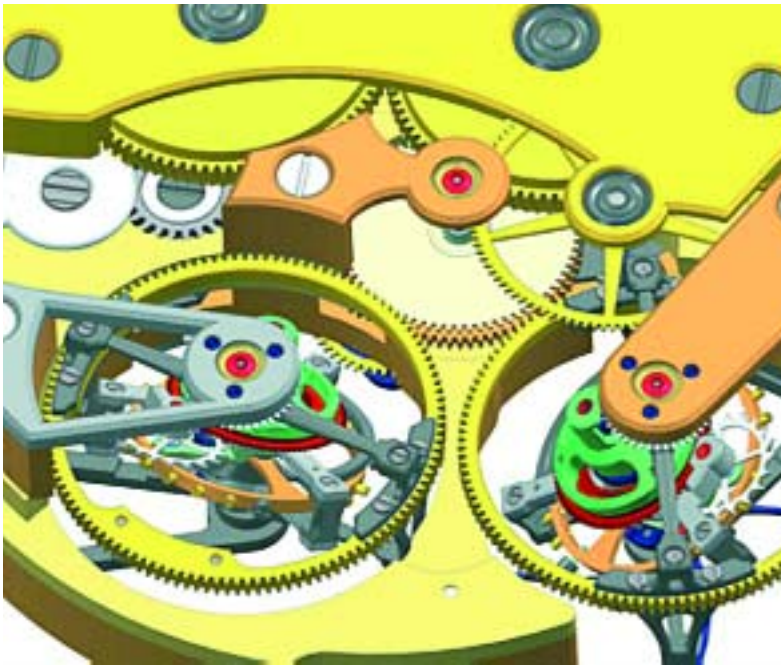
The amplitude variation between the wound and the unwound condition of the 3-day mainsprings is about 50°, well within normal limits for a going barrel movement. Note especially that the balance is free sprung which removes one of the impediments to good isochronism but also removes one of the tools for its correction!

The promotional material says: "In order to appreciate the mechanical ingenuity and the nobility of this new mechanism, the architecture of the movement as well as the organisation of the dial allows direct and total visibility of the aerial ballet of the coupled Tourbillon carriages, cradling the system of the balance wheel." That about sums it up! ❐

T. Treffry - Company



Performance 'in positions' of the same escapement/balance assembly operating in a fixed plane, ●, in a single axis tourbillon, ●, and in the 'Double Tourbillon 30°', ●.



The latest creation of the EWT system is the 'Quadruble Differential Tourbillon'. The two tourbillon assemblies are driven by a differential which could, in principle, drive even more. The effect of the varied positional relationships possible on time keeping are being investigated. A real, rather than virtual version is promised for BASELWORLD in April.