Horologica

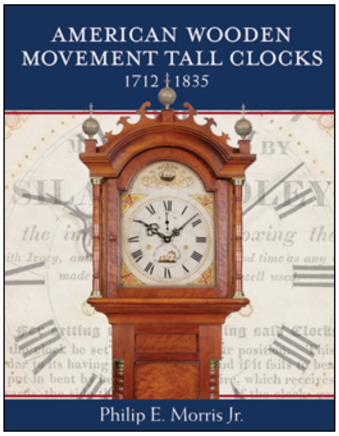
Contributors this issue are Fortunat Mueller-Maerki and Bill Ward.

Member submissions are needed! Share reviews and announcements of new and interesting books, websites, digital media programs, periodicals, exhibits, and all else pertaining to horology. Please send contributions to the editor at ddelucca@nawcc.org or NAWCC, Inc., 514 Poplar St., Columbia, PA 17512-2130, c/o the Publications Dept.

American Wooden Movement Tall Clocks 1712-1835

By Philip E. Morris Jr.

Foreword by Chris H. Bailey. Published 2011 by Heritage Park Publishing, Hoover, AL (USA). ISBN 978-0-615-44568-7. 512 pages, 28 x 23 cm, hardbound, cloth cover, dust jacket, over 500 illustrations (color photographs), glossary, bibliography, index. Available from the publisher for $89.95 plus shipping at www.heritageparkpublishing.com.



The basic story of the American wooden movement tallcase clock can be told in a few sentences: In colonial America, metal was too scarce and too expensive for clockmaking to flourish, so many of the first American clockmakers replicated the clock movement they knew—the British tallcase clock—from local woods. At the beginning of the nineteenth century Eli Terry invented mass manufacturing of mechanical goods using interchangeable parts, by making 3,000 identical clock movements out of wood for the Porters. By 1835 tallcase clocks had been replaced by ever cheaper (first from wood, later from brass), mass-produced, Connecticut made shelf clocks as the typical American clock.

As in most cases, however, behind the surface of a simple story is a more complex narrative of many ups and downs, countless detours, and dead ends, with numerous protagonists involved in a myriad of plots and subplots. This segment of horological history has been explored over the last 50 years in great detail in numerous publications, some as chapters of broader themed books, but mostly in countless articles in the NAWCC *Bulletin* and publications of the American Clock Museum. Over time, a circle of researchers around the late Ward H. Francillon (1928 to 2004), known as the "Cog Counters," became the focal point of aficionados of such clocks, and their informal newsletter a treasure trove of nuggets of information. What was lacking was one comprehensive publication on the subject.

Philip Morris has finally filled this void with the book under review. Inspired by Ward's credo of "let the documented facts speak for themselves" the book is more a "documentation" than a "story." The author has undertaken to build upon the Cog Counters' (and others') earlier publications and personally reexamine all the known surviving examples of American wooden tallcase clocks prior to 1835. That meant rephotographing all the clocks, measuring them, and describing them in detail. In addition, he spent years examining and reexamining all documentary evidence relating to these artifacts and their makers, including account books, diaries, genealogical records, local histories, probate records and period newspapers.

The collected material is presented in two major sections: The first is a 330-page section describing about 170 different clocks (in some cases only clock movements). There are 22 chapters in this part, nine for the handcrafted era (1712-1807) and 13 for factory production (1809-1835), organized basically along geographic lines. The two blocks of chapters are separated by an extra-long chapter devoted to the role of Eli Terry and the Porter contract in 1807-1809. Each of the clocks is pictured at least three times (movement, overall in case, and dial views), but often there are additional images, such as additional movement angles, labels or noteworthy construction details. Over 400 images and their captions in this 330-page section make up more than two-thirds of the book.

The second section of 130 pages is the "Biographical Directory" of "Wooden Tall Clock Makers and Those involved in their Trade 1712-1835." With over 625 short biographies of individuals, this unquestionably is the most complete list ever assembled on the subject. Entries vary in length from three lines (e.g., quoting a newspaper advertisement of an otherwise undocumented craftsman, to a full page of text devoted to some of the best known icons of the field. Illustrations (black-and-white photographs) of nameplates, dial signatures, or labels accompany the entry if relevant.

The resulting book, even the first section, is a reference work rather than a book that anyone will read cover to cover. But this reviewer found it the kind of reference book that is most pleasant to "browse" in aimlessly and digest random little facts, even when not searching for a specific piece of information. The focus is on "facts" rather than on anecdotal evidence or cute stories. The book is well produced, with clear text, great pictures, good organization, thoroughly indexed and cross-referenced.

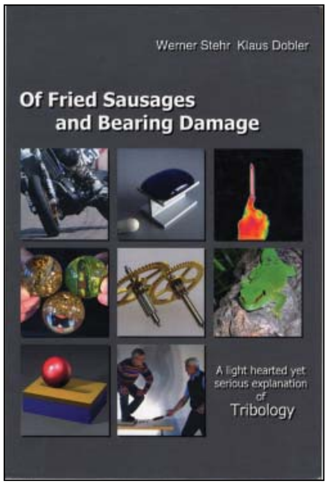
The late Ward Francillon would most certainly be proud of his successor: The book firmly establishes Philip Morris as the leading wooden tallcase clock expert, and current intellectual leader of the human subspecies "homo cog-counterensis."

Fortunat F. Mueller-Maerki (NJ)

Of Fried Sausages and Bearing Damage – A Lighthearted Yet Serious Explanation of Tribology

By Werner Stehr and Klaus Dobler (Dr. Tilwich GmbH Werner Stehr, Horb-Ahldorf, Germany)

First English expanded edition, 2008. Translation: Ubersetzungen Hanns Schiefle, Bad Reichenhall. Available from the NAWCC Library, or the authors' website, www.tillwich.stehr.com, 6" x 8.5" (15 x 21.5 cm) Hardcover, 224 pages with index.



To Breguet is attributed the aphorism "Give me the perfect oil, and I will give you the perfect watch." This gives some idea of the horological importance of tribology. Tribology (from the Greek "tribos," rubbing or friction) is the study of interacting surfaces and their systems, including solid, liquid, or gaseous lubricants. This word was introduced in the mid-1960s to avoid the unpleasant connotations of the word lubrication or anything suggesting grease. It's a subject relatively underrepresented in the horological literature of recent decades.

This book is a popularized overall look at the engineering subject of tribology. It explores many amusing (at least to engineers) problems of friction and lubrication, along with a dollop of Germanic humor. Therefore, the book is heavily larded with little stories, but this is infinitely better than pages of dull academic prose frequently punctuated with the terror of unfathomable differential equations. One of the minor irritations of this book is that the labels on graphs and the text integrated into illustrations are still in German, with these phrases translated in footnotes in small type. But for the most part, though, the font is readable, and there are color photos on almost every page.

The authors operate a commercial tribological laboratory in Germany and sell lubricants, some with horological uses. In fact, after many requests, they have analyzed the famous Elgin Oil, and reconstituted it, so this long-vanished lubricant is now available once again.

The book starts out with a few explanations and definitions of basic concepts in physics (force, work and energy, power, efficiency). The basic relationship that the force of friction is proportional to the normal force of the interacting surfaces is discussed and the Stribeck curve (illustrated below) is introduced and discussed. Things are not really so simple as you might think from the basic high school formula:

$F_F = \mu F_N$

where F_F = frictional retarding force

μ = coefficient of friction, and

F_N = normal force

i.e., that the force of friction is directly proportional, via the coefficient of friction, to the normal force.

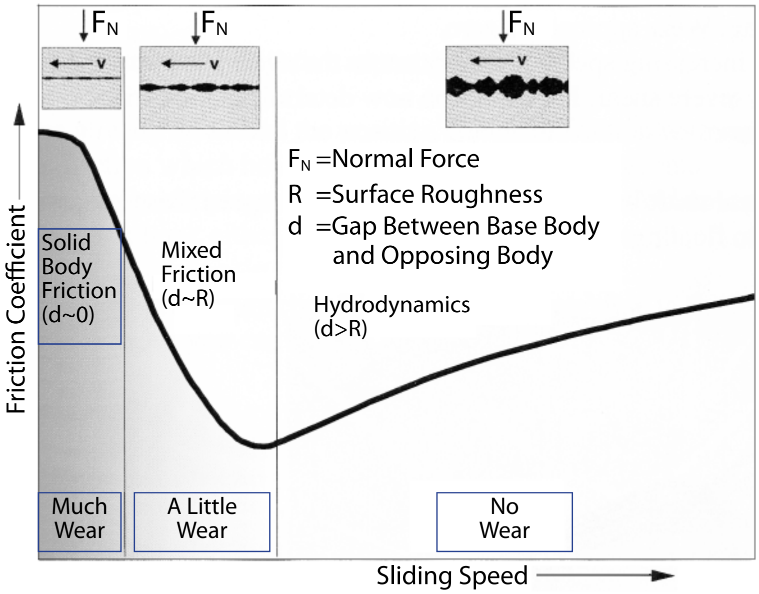
Now, the Stribeck curve (see below) is a graph of the coefficient of friction versus the relative velocity of the moving surfaces; it shows how the coefficient of friction Mu varies with velocity (no, it's not a constant!). It is fundamental to the study of tribology and can be divided into several areas:

1. Static friction is shown at the left-most side, at the beginning of the curve where the velocity is zero, or almost zero, and there is almost no lubrication (because it's the motion of one surface against the other which "pulls" the oil into the gap

2. Just to the right of this, at low speed, or very low speed, is the sliding body friction, where there is typically very little lubrication

3. Mixed friction, further to the right, is where there is a small amount of lubrication

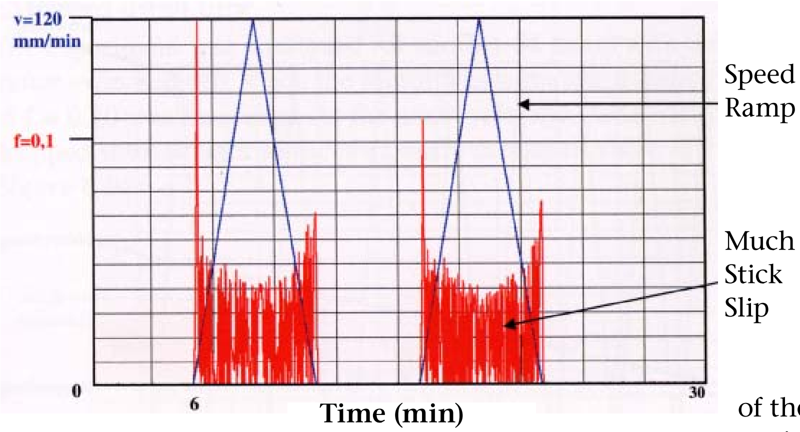
4. Hydrodynamic friction, seen in the right-hand section of the graph, where there is higher velocity with full lubrication



Stribeck Curve. (Reproduced here with permission of the authors, p. 33. Labels appear in English for this review.)

Typically, the highest friction is seen when the velocity is zero (static friction), and this is where the wear is also the greatest. As the velocity increases, and oil is drawn into the interface between the surfaces, friction drops precipitously, but rises slowly again in the hydrodynamic area of the graph as the internal friction of the lubricant (related to its viscosity) becomes predominant.

These areas are explained in the "water skiing analogy," in which we consider the friction that a water skier experiences as he accelerates from a standstill. At the beginning, somewhat improbably, he is standing on the dry rocky shore. This is where static and dry solid body friction is experienced. As he is unceremoniously yanked into the shallows, there is a small amount of water easing his path, but he still bumps along the bottom; this is the area of mixed friction. Finally, as he begins to ski on the water proper, he is in the area of hydrodynamic friction. The areas of mixed and hydrodynamic friction have been the major focus of tribological studies for many years. Horologists, on the other hand, are almost exclusively interested in the left-most area of the graph where static friction and solid body friction are at work. More recently, advances in materials (e.g., the use of polyglycol oils and Teflon-like solid bearing materials for decreased static friction) have produced more interest in the static and solid body friction areas of the Stribeck curve.



Very high static friction with 16 h dwell time.
(Reproduced here with permission of the authors, p. 99. Labels appear in English for this review.)

The book continues, explaining how tribologists measure the friction in various systems, such as with the experimental friction test bench, using various geometries such as a rotating ball on a plate. The results of these experiments are graphed, and sometimes show interesting results. For example, it appears that static and low-speed friction, as seen in clocks and watches, is generally stick-slip motion. In addition, after a component has moved, the static friction value when it moves again depends on how much time has passed since it last moved. Perhaps this is due to the fact that as one part is still as it presses upon the other, the lubricant is pressed out from between the surfaces. In any event, it is quite clear that standing still for any appreciable time (seconds) increases the static friction when the system finally begins to move again.

The stick-slip effect appears to be caused by the fact that, as a moving force is gradually (relatively speaking) applied to the static system, parts flex until the force at the interface builds up above the static friction force; then the part moves and the dynamic friction, being lower, allows it to release most of the pent-up elastic force. Then, however, it stops and the force required to move it again (i.e., to overcome the static friction) is higher. Therefore, the part moves in fits and starts.

A few years ago an article appeared in the *Horological Science Newsletter* that showed conclusively that the start-stop motion from the deadbeat escapement of a pendulum clock is propagated all the way back through the train to the falling motion of the weight. This appears to be the case for all clocks and watches. The stick-slip motion is superimposed at a much higher frequency upon that start-stop motion. The stick-slip effect appears to disappear if the velocity exceeds about 70 millimeters per minute. That would rarely be the case with horology, except in large striking trains.

The book avoids discussing the microscopic or molecular geometries or structures that give rise to these effects, even when these proposed explanations might make it easier to understand the phenomena. Perhaps this is because that would require advanced mathematics, or perhaps because of a fear that future developments might make such models irrelevant.

Another aspect of tribology is that of wear. Wear is considered as a system property (i.e., consisting of the moving materials, plus the lubricant, temperature, environment, etc.). There are various types of wear:

- adhesive wear – where portions of the moving surfaces come in contact with no lubricant
- abrasive wear – where an abrasive material, such as silicon dust from the air, perhaps imbedded in the lubricant, produces degradation of the moving surfaces
- surface fatigue – where repeated pressure of one surface upon another causes deformation, which results in pitting or scaling
- oxidation/corrosion wear – caused by acids or oxidizing agents, often found within the lubricant
- brinelling wear – this is caused by micro-movements such as vibrations for extended periods

In adhesive wear, portions of the surface layer are torn away, perhaps due to actions such as micro-welding, which occurs when materials are pressed together. It is worst when the two moving materials are similar or identical (thus the use of pivot jewels in horology). One wonders, however, whether cuprous alloys such as brass or bronze are the best choice for pivot-bearing materials, because brass and bronze can be fused to steel by brazing, which is a form of welding. Adhesive wear occurs where the lubricant is forced out of the bearing space or runs out. This is a frequent occurrence in horological devices. It frequently also produces loose particles, which themselves can cause abrasive wear, especially when those particles become corroded (as rust is much harder and more abrasive than iron).

Abrasive wear occurs even when the lubricating film is intact, but it can also occur dry. Dust in the air is an almost inevitable source of silicon dioxide, which is a pretty effective abrasive (think sandpaper). Some lubricants appear to attract abrasives and hold them in suspension.

Surface fatigue is caused by alternating, usually heavy, mechanical loads and produces microcracks that develop into pits and fissures in the surface. It is seen in rolling elements (ball bearings) as well as in sliding friction. It is probably a major factor in the wear seen in escapements, where one part is hammering constantly upon another. It is related to surface tensile stress (e.g., from work-hardening, from, say, burnishing a pivot). It can be reduced by techniques such as nitriding, which relieves surface compressive stress.

Oxidation/corrosion wear is usually caused by corrosive products in the lubricant. In the days of natural lubricants, such as whale oil, it was common for certain components of the oil to break down into organic or inorganic acids. In fact, part of the testing for horological oils was to measure their acidity increase with time when exposed to air. It can also occur from simple oxidation when atmospheric oxygen is dissolved in the lubricant (of course, one of the functions of an oil lubricant is to prevent the bearing surfaces from coming into contact with atmospheric oxygen, so it is important that oxygen not dissolve in the lubricant to any great extent. However, this has not always been the case.) When the material being oxidized is a ferrous material such as steel, the oxidation particles are always red, unless lubricants are involved, when they are sometimes black. If the oxidized material is a cuprous alloy, the gunk might be green. These chemical effects show why it is important in horology to use modern lubricants dedicated to the purpose. The use of "legacy" lubricants, such as whale oil, are likely to produce chemical destruction of fine pivots by oxidation/corrosion in short order. Use of materials such as the alcohols found in transmission fluids are likely to produce oxidation, due to dissolved oxygen.

Brinelling is best known as the cause of bearing destruction during shipment of machines before actual use. The constant microhammering of, say, a ship's engine on a ball bearing when it is not rotating expels the lubricant and digs small indentations in the raceways.

Although the best method of studying a tribological system is to actually build it and try it out, this is usually very time consuming. Thus, the authors of this book discuss various friction test benches and how they are used in their laboratories. The data on various systems are presented using traditional and modern materials, such as PTFE (Teflon™), diamond-like carbon (DLC) coatings, or PI (polyimide), which has a very low static friction. Polyimide has a static friction dry, which would be impossible to attain with friction bearings.

Unfortunately, not (nearly) all the data from the authors' tribological database are presented (nor could it be- but see their website). However, one of the more interesting asides, from a horological standpoint, is the section on oscillating motion, because this is encountered in clocks with recoil escapements. It seems that, with movement in one direction, the microscopic peaks (in tribological terms, the "asperities") are bent over in that direction. Reversing the motion bends them in the other direction, and it doesn't take many repetitions of this regimen to break them off entirely. In addition, this action sweeps the interface of lubricant, and the result is greatly increased friction, production of abrasive particles, and wear.

The subject of lubrication is discussed extensively. The amount of oil necessary for lubricating a watch is mentioned as the "unimaginably" small quantity of less than eight microliters. This is approximately about one-fifth the volume of a single human tear. The authors are adamant that the cause of loss of lubricant in clocks and fine mechanisms is not evaporation; rather, it is dispersion (i.e., spreading or migration). The subject of how the surface tension of oil combines with the geometry of the oil sink to retain a tiny amount of oil (or not!) is carefully considered. This discussion might have a major effect upon the design of oil sinks. I have never before seen, in the horological literature, a scientific discussion or explanation of these effects. Suffice it to say that oil is repelled by points, sharp edges, and wide spaces and is drawn into narrow spaces (by capillary action). So, to keep the oil off the plates, the pivot hole should narrow with depth, and the edge of the oil sink or pivot hole should have as sharp an edge as possible. The authors believe that the proper design of a pivot hole enables the bearing to be lubricated for life. Unfortunately, once the oil has wetted the plate (e.g., by overoiling), all the oil can freely run out of the pivot space.

The modern process of epilamizing (from Greek, "top layer") can help prevent this loss of lubricant. This consists of applying an invisibly thin layer (.01 to .04 micrometers) of PTTF around the oil sink, which reduces the surface tension there. The process is simple (dipping, spraying, stamping), cheap, nondestructive, and effective on most materials, including metals, glass, and sapphire.

Lubricants themselves are also discussed. The most important property of a lubricant, of course, is its presence (as opposed to its absence!) Even the slightest submicroscopic film of oil can be effective. A grease is defined as an oil with a thickener (e.g., a solid lubricant like teflon or a metallic soap like lithium stearate, or even cornstarch) added. Greases should be used where there is no capillary space to hold an oil. Because greases have such a high viscosity, which itself increases friction, they should be avoided where a simple oil would suffice.

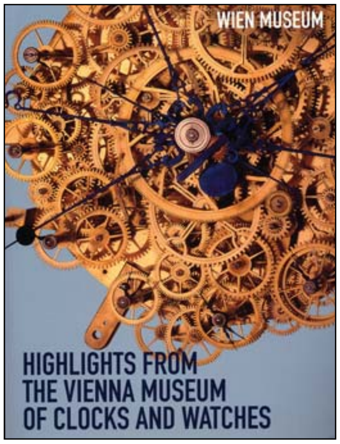
This is a very readable book that could, and should, be read by all professional horologists and by all amateurs with an interest in the scientific side of their avocation. It provides a glimpse into a field that is often obscure and hard to find information on.

Bill Ward (PA)

Highlights from the Vienna Museum of Clocks and Watches

By Wolfgang Freitag

Paul Kolp (photography), with essays by Rupert Kerschbaum, Sylvia Mattl-Wurm, Eva-Maria Orosz, and Peter Stuiber, and an introduction by Wolfgang Kos. Published 2011 by Wien Museum, Vienna, Austria. ISBN 987-3-902312-23-5. 120 pages, 24 x 18 cm, paperback, 77 color illustrations, glossary. (Published simultaneously in a German language edition *Highlights aus dem Wiener Uhrenmuseum,* ISBN: 978-3-902312-22-8). Available for Euro 14 (plus postage) online from the Uhrenmuseum Wien at www.wienmuseum.at.



The Uhrenmuseum Wien, a clock museum in the center of Vienna in a charming, small historic building, is one of the municipal museums of that city, and one of the oldest stand-alone, specialized horological museums around. Opened in 1921, it originally housed three private collections (one of clocks and two of pocket watches). Spread over three floors, there are hundreds of timekeepers—more clocks than watches. The collection is especially rich in the typical Viennese clocks of the Biedermeier era, in "picture" clocks, in decorative pocket watches (the former collection of nineteenth-century novelist Marie von Ebner-Eschenbach), and astronomical clocks, but beyond that offers a broad view of world horological history.

The museum has also been a pioneer in publishing comprehensive catalogs of its collection. The first appeared in print in 1929 by its founding curator Rudolf Kaplan, a 112-page book with 85 illustrations, and in 1974 Heinrich Lunardi wrote a nice hardcover 138-page catalog with color illustrations. Sometime in the late 1970s Stringer/Werner wrote an undated 186-page (plus 24 color plates) catalog, that in 1980 was also published in an English language version. All of these books have long been out of print.

Fortunately, that has just been remedied by the book under review. The publishers made the wise decision to limit themselves to describing only 40 particularly significant objects of their vast collection, but doing this in greater depth than any of the earlier catalogs. The actual catalog section is preceded by three introductory essays on the history of the museum (2 p.), the Ebner-Eschenbach collection of pocket watches (4 p.), and an interview with Rupert Meerschaum, the current curator (8 p.).

Each of the 40 catalog entries consists of one full page of mostly text, facing typically a full page color photograph of the object. In some cases, a second, smaller image of a detail appears on the text page, and four particularly significant objects are allotted an additional double-page image. Text entries consist of a column of hard facts (e.g., maker, date, dimensions, technical details, inventory numbers, and provenance) and a few paragraphs of narrative, explaining the significance of the object and its role in the history of horology. Typically, one particular feature of the clock or its use takes up a significant part of the short narrative. A six-page glossary of technical horological terms concludes the book.

The book is well produced and the images are very clear. This reviewer is most pleased that the book follows what seems to have become a trend in horological museum catalogs: Focus on fewer objects, but say more about each of them. David Thompson's two books on some of the watches and some of the clocks in the British Museum were earlier examples of that style, and the recent catalog series of the Deutsches Uhrenmuseum uses a similar approach. This method allows the publication to not only serve as a reference or a souvenir of a museum visit but to imbed a small educational lesson in each entry by conveying a thought or idea about horological history to the reader through that particular object. The reader who reads through all 40 catalog entries gets introduced to a diverse and entertaining potpourri of horological themes and issues.

The result makes for pleasant reading and is highly educational. I wish more horological museums would do what the Uhrenmuseum Wien has done so well through this new book.

Fortunat Mueller-Maerki (NJ)

Mosaic Addition—*About the International 400 Day Clock Chapter*

Chapter 168 received its NAWCC Charter in November 1995 as the National 400 Day Clock Chapter. Because many members are from outside the United States, the name was eventually changed to International 400 Day Clock Chapter.

The Chapter was formed to bring together all those NAWCC members who were interested in collecting and repairing 400-day clocks, and to educate the public and noncollectors about the history and operation of these fascinating timepieces. From the beginning 56 members, Chapter membership rose to over 500, with current membership slightly below that. One of the largest contingents of the Chapter are Australia members, who hold regular monthly meetings to discuss and repair 400-day clocks.

*The Torsion Time*s, the Chapter 168 newsletter, is published bi-annually and contains a wealth of information relating to collecting and repairing 400-day clocks

Chapter 168 meetings are held whenever possible at NAWCC regionals and national conventions and are usually highlighted by a presentation on a facet of the history and development of these clocks, hints on collecting, or valuable tips on repair.

For further information about Chapter 168, or questions regarding joining the Chapter, please contact either officer listed below.

President John Connolly, joco@dccnet.com
Secretary John Hubby, pastimes@juno.com