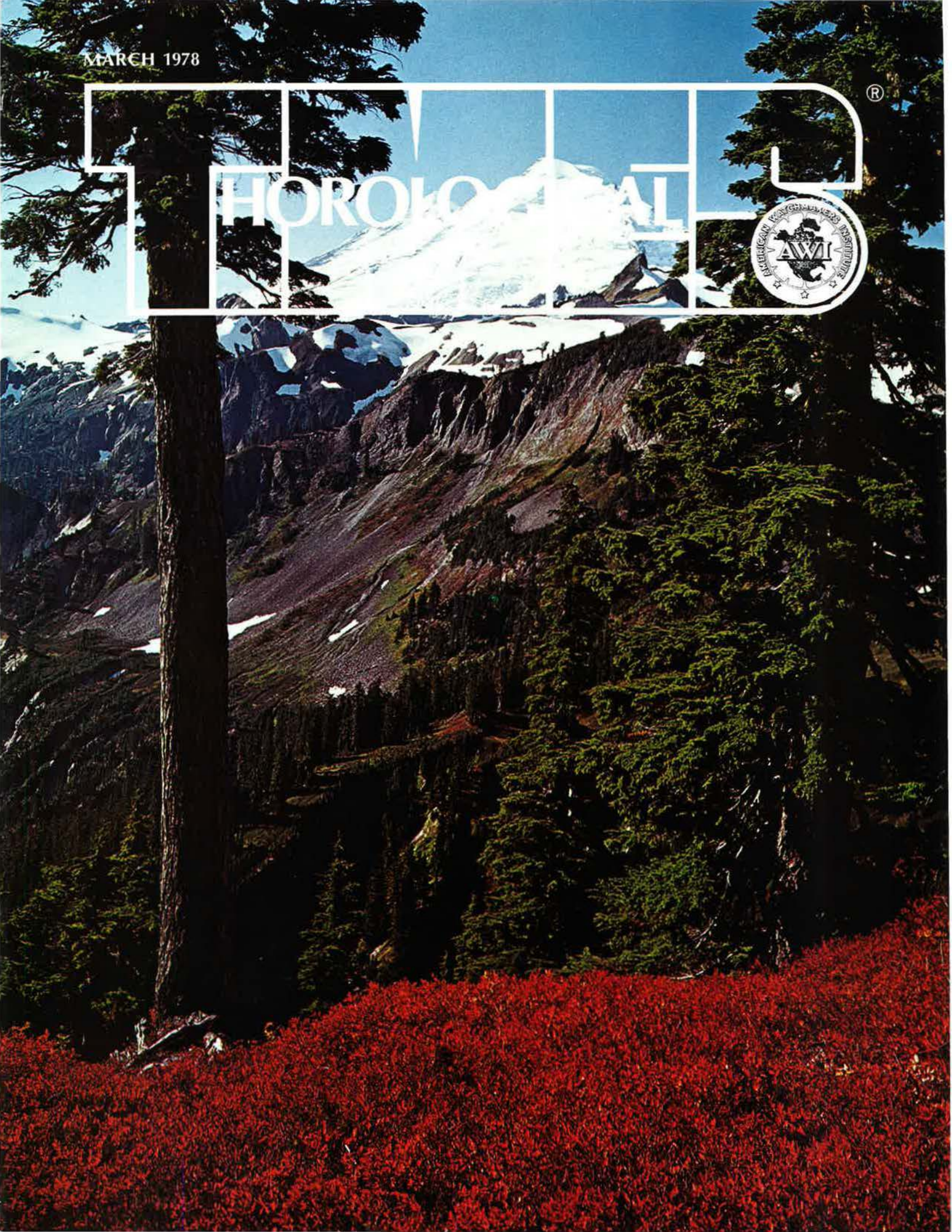
MARCH 1978

THE HOROLOGICAL JOURNAL®

AMERICAN WATCHMAKERS INSTITUTE AWI



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HOROLOGICAL TIMES®

Volume II, Number 3 — March 1978

Official Publication of the American Watchmakers Institute

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FEATURES

EXTRAS

Editorial

The first issue of *Horological Times* began with a skeleton crew of workers. Because of its content, it was accepted as *the* technical journal on the repair of watches and clocks. As our subscriptions grew in number, so did our advertisers; so much so that it is now necessary to increase our staff.

Thus, we now introduce Tom Herman, our new managing editor. While attending Berea College in Berea, Kentucky, he studied journalism and business and worked at the Berea College Press. He was supervisor there on paste-up, design, camera, stripping, and platemaking. During his stay at Berea College, he was freshman class president and yearbook editor. Since then he has become a journeyman with the Thoroughbred Press, Lexington, Kentucky.

You can expect subtle changes for the better in *Horological Times* in the future. The technical emphasis will not change.

Welcome to Tom, his wife Cindy, and their daughter, Angie.

ABOUT THE COVER

Pictured on the front of the March issue is Mt. Baker from Austin Pass, in the N. Cascade Mountains, Washington.

OUR READERS WRITE

Congratulations on the success of *Horological Times.* Mr. Smith's articles in particular are very interesting.

Jeffrey W. Moore
Champaign, Illinois

The articles in the *Horological Times* are very helpful to me, as they are explained in plain down-to-earth English. I look forward to receiving it every month.

Paul J. Caustio
Alhambra, California

I'm sure that the Officers and Directors of AWI are well aware of the excellent technical publication the *Horological Times* has become in the span of one year. Mr. Herman, Mr. Whitney, and the entire staff have done an outstanding job. I have found this magazine to be the best tool available for recruiting new members.

W.K. Owen
San Jose, California

To the Certina Watch Company, Grenchen, Switzerland: I am writing to express my thanks and appreciation for your kindness and promptness in sending me the automatic parts for your Model 17-351. Cooperation such as yours is unfortunately rarely found these days and the least I can do is to tell you of my gratitude.

A copy of this letter will be sent to a national publication for watchmakers, so that all who read it may know there are people in this world who consider the small jeweler important to their business.

Thank you once again.

Mervyn L. Figenbaum
San Francisco, California

Happy Birthday to the staff of the AWI and the *Horological Times* upon the first birthday of the magazine. I have talked to a few watchmakers and told them about AWI. When they asked why I need it, I told them it just might make them better repairmen.

I thought the index in the December 1977 issue was a good idea.

D. L. Hulse
Scranton, Pennsylania

The *Horological Times* is a fine magazine–keep it like it is–or make it bigger.

T. William Schroeder
Chicago, Illinois

CORRECTION

On page 11 in the January 1978 issue of Horological Times, *an incorrect price was printed for the Hammel, Riglander Polisher and Dust Collector. See page 40 of this issue for correct pricing.*

Some Things New — Some Things Old — from **MARSHALL-SWARTCHILD**

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The President's Message

by James H. Broughton

In the past three to four years, I have visited several states which have no watchmaker's organization at all. This is very bad. Every watchmaker should have the chance to belong to a local guild or state association.

My reason for being in such areas was to conduct a seminar and try to start an organization. Watchmakers in these areas are eager to learn and usually attend such a function. When we ask why there is no organization, we get the same answers we used to get years ago: it is impossible to start an organization in this part of the country; there is no cooperation among the watchmakers. Or, you may hear this one: watchmakers seldom speak to each other, let alone attend a guild meeting together. Here is my favorite: the watchmakers in this state are a different breed from those in other states. Then, there is the one about: we lost our licensing law, so what good is an organization to us? Then you have the opposite: we have a licensing law, what good is an association?

Usually the person making these statements is the one who talks the loudest and scares everyone else off. That is when everything sort of drops. If this same person would turn his or her attitude around about 180 degrees and put as much effort in building an association as he does trying to kill it, he may find there are more who want such a thing and his efforts would be greatly rewarded.

It is a known fact that watchmakers who belong to a local guild or association are usually better informed about technical information than those who are not members. The reason is that the guilds or associations have access to this type of information and pass it on to the membership.

Most organizations are started with a handful of watchmakers.Very rarely is a guild found that started with a large group. To build a large guild takes a lot of time and hard work. This is not done by one person alone; it must be combined effort by everyone. If your group is small, perhaps four or five watchmakers, don't give up. Have a regular meeting and let the other watchmakers know when and where the meeting took place and what type of program you had and what you plan on having at the next meeting. Sooner or later, you may be surprised at the results.

AWI has enough slide and tape programs to last a guild for two years, as long as your meetings are once a month. A program for your guild is not a problem.

If you are living in an area were there is no guild or organization, why not talk to a few of the watchmakers about starting one. AWI will assist wherever possible.

There is more to be gained by association than by individualism. □

SEIKO ANNOUNCES COMPLETE, SIMPLIFIED PARTS INVENTORY

A complete, simplified parts inventory has been established—and all parts are now readily available—for the 6¾ x 8 Ligne Calibre 8000 Series and 11½ Ligne Calibre 5000 Series seven and seventeen jewel movements.

These two groups of Japanese-manufactured watch movements were first introduced into the U.S. in 1973—the Calibre 8000 Series by Morioka Tokei, Inc., and the Calibre 5000 Series by Hamazawa Ltd., under the supervision of K. Hattori & Company, Ltd. Sold to watch importers and large retail chains nationally, the distribution of watches containing these movements has since accelerated rapidly throughout the country.

As a result of this proliferation, supporting materials and servicing of the two movements are of vital importance to jewelers and watchmakers—and extremely necessary in maintaining their customer loyalty. Unfortunately, it has not been widely publicized that the parts are readily available here and have been for the past few years. Watchmakers, sometimes told by their materials distributors that the parts are not available in this country, unfortunately take them at their word.

Although many materials distributors do not carry a complete inventory of these parts, they can easily obtain them

from their wholesale sources. The new simplified parts inventory for these movements constitutes one of the best organized interchangeability lists for both 7 and 17 jewel movements ever compiled. The movements have the calibre reference clearly stamped on the top plate for easy identification.

To order needed parts, jewelers and watchmakers should be sure to: (1) indicate the correct movement calibre number; (2) provide the correct parts description.

The 5000 and 8000 Calibre Series have many technical and servicing advantages. In the technical realm, they were produced by automation under extremely rigid quality control standards. Consequently, they are among the fine quality jeweled lever watch movements available. All movements in the watch "calendars" and "self-winds" have been simplified for easy servicing and maximum efficiency. The movement is sturdy. Plastic parts are used in certain areas in order to reduce friction. The movements are designed for easy after-sales servicing; cleaning fluids and ultrasonic-action cleaning devices can reach each part easily with minimum disassembly.

Calibre identification and listing of these two groups of movements are as follows:

Series 8000 Calibre–6¾ x 8 Ligne

	17 Jewels	7 Jewels
6¾ x 8 Regular	Cal. 8020 or A06A	Cal. 8000 or 80 or A03
6¾ x 8 Center Second	Cal. 8024 or A07A	Cal. 8004 or A04A
6¾ x 8 CS Calendar–Quick Change	Cal. 8027	Cal. 8007 or A05A

Series 5000 Calibre–11½ Ligne

	17 Jewels	7 Jewels
11½ Center Second	Cal. 5020	Cal. 5000 or 50 or A53
11½ CS Calendar–Quick Change	Cal. 5022	Cal. 5022 or A54A
11½ CS Day/Date–Quick Change	Cal. 5023	Cal. 5003
11½ CS Automatic–Calendar–Quick Change	Cal. 5025 or A57A	Cal. 5005 or A51A
11½ CS Automatic–Day/Date Quick Change	Cal. 5026 or A58A	Cal. 5006 or A52A

The calibre number will usually bear a letter suffix on the movement, e.g., 5020A, 5005C, etc. When ordering material, please refer to the complete calibre number including the letter suffix.

We wish to repeat that all movements have their calibre reference numbers stamped on the top plate of the movement for easy identification. Watchmakers will be able to obtain replacement parts through their regular watch material suppliers. □

THE GOULD COMPANY EXPANDS TO NATIONWIDE TOLL-FREE SERVICE

The Gould Company, a Dallas, Texas watch material and jewelry wholesaler, has announced a new service–a toll-free nationwide WATS line–1-300-527-4722. Texas customers should continue using 1-800-492-4104. No minimum order is required; watch material as well as jewelry orders are welcome on the Gould Company WATS. Phones are answered by trained personnel.

TERMINOLOGY

That customer who questions the word "watchmaker" is entitled to an answer. Webster defines it as a person who *repairs* or makes watches.

When the Swiss take the time to think something over, you can be sure they're preparing something important.

Like the new 960 Standard Quartz calibre.

11½''' 960 Standard Quartz calibre. H. 4.50 mm. Analog. Sweep-second hand. Date with corrector: 3-position stem. Standard battery, lasts 2 years.

The Swiss have a reputation.
Those Swiss are addicted to perfection. Fanatically precise. And very, very careful – hardly gamblers. They like sure things. Some people even consider them a bit slow. The fact is, they think things over quite a while before they act. When the Swiss invent or create something, they leave nothing to chance. Whatever they produce has to be absolutely right, durable, economical. Which is why Swiss products have always had such a reputation for quality. Especially when it comes to watches. The Swiss really value that reputation.

A specific example.
The Fabrique d'Horlogerie de Fontainemelon created a calibre, the 96 Standard – and sold 90 million of them, worldwide. Can you imagine anything surer than that?
Then one fine day, the first quartz watches appeared. The Swiss are very careful, we know that. So they eyed this new development with a certain skepticism, but with a certain interest as well. Because one of the first questions that a Swiss will ask in such a case is: "How can we make it better?"

Right then, he starts thinking about it.
Then he acts. He makes some trial runs, he keeps improving and improving – until he is finally satisfied with the result. That's the kind of approach it takes to make a calibre which is already used in 90 million watches. And, on the strength of that, to create a new quartz calibre:
The 11½''' 960 Standard Quartz.
It took some waiting? Well, yes. That's the very reason it will go so far.

The 11½''' 960 Standard Quartz calibre. Remember the name.
This new calibre has all the advantages of the 96 Standard. With its simple, robust design repairs are no problem; battery changing is easy. Another advantage: As it is produced in large numbers, the 960 Standard Quartz is economical; quality is uniform, thanks to strict controls at every stage of manufacture. In addition, you get Ebauches SA's excellent after-sale service. And that means fast delivery, original replacement parts – even training of *your* personnel. You can see what the new 11½''' 960 Standard Quartz means to you: satisfied customers, lots of them
So you see, Swiss perfectionism does have its good side.

Fabrique d'Horlogerie de Fontainemelon SA
Tel. 53 33 33
Telex 35 222
CH-2052 Fontainemelon
Switzerland

The 96 Standard calibre is used in 90 million watches. The 11½''' 960 Standard Quartz was designed to top that record.

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AWI NEWS

By Milton C. Stevens

EXECUTIVE SECRETARY

Neither rain, sleet, snow, or hail shall keep these couriers from their appointed rounds. You may think that by using this paraphrase, I'm referring to the U.S. Postal Service, but I'm not. They haven't delivered mail to us in the past three days. As I write this, the Midwest is digging out from a severe winter blizzard. I am referring to AWI's bench course instructors.

Businesses are closed, roads are impassable—everything is virtually at a standstill. The problem is, we have a bench course scheduled in Louisiana and our instructor, Les Smith, lives in a small rural community northeast of Cincinnati, Ohio. To compound the problem, our airport, located in Northern Kentucky, has geen closed for two days. People are stranded there and are sleeping on cots provided by the Red Cross.

At 7:00 AM this morning (Saturday morning), word came that the airlines will attempt to resume their schedules today. Good! It looks like the show will go on. Mike Danner, AWI's Administrative Director, and Les Smith got busy. Delta expected to get Les' flight off sometime in the early afternoon. Since travel on all Kentucky roads leading to the airport was restricted to four-wheel drive vehicles and those equipped with studded snow tires or chains, it became necessary for Mike, whose car is so equipped, to drive Les to the airport. They met in downtown Cincinnati and headed for the Kentucky-based Greater Cincinnati Airport.

After many frustrations and delays, Instructor Smith was winging his way toward his "appointed round" by mid afternoon. By 3:30 PM Mike Danner reached AWI Central (Saturday is Mike's day off). Thus a saga which began at 7:00 AM was coming to a successful conclusion—well, almost!

When Instructor Smith arrived at his motel he found complications with the meeting room threatened his ability to conduct the bench course. But that's another story—the bench course was held.

The week just prior to this, AWI President Jim Broughton encountered similar obstacles when he braved 21 inches of drifting snow to present a Citizen LCD bench course in Cincinnati, Ohio. AWI Instructor Jerry Jaeger had the same experience: it took him eight hours to fly from Sheboygan, Wisconsin to Philadelphia, Pennsylvania to conduct his ESA Quartz bench courses. We not only salute our diligent instructors, but those hardy watchmakers in Cincinnati and Philadelphia who braved the elements to gain the knowledge these bench courses can give.

My purpose in relating this entire story is two-fold. First, to point out the total dedication exhibited by AWI personnel. I am proud of them! Second, to chide, just a little bit, those who complain: about having to drive a number of miles to attend a bench course; having to pay a modest registration fee to defray the instructor's expenses; or, perhaps the beef on the noon luncheon was a little tough, or the mashed potatoes were cold. Fortunately, these people are in the minority, but they do exist. I've heard from quite a few of them during my years as AWI's Executive Secretary. For the most part, bench course participants have been just as dedicated and enthusiastic as our instructors.

When Ewell Hartman was President of AWI, he pioneered the bench course concept. It has proven so beneficial that AWI has scheduled 57 bench courses the first six months of 1978. A bench course has been made available to virtually every AWI member, who, like our instructors, is willing to make an effort to attend.

The calendar of coming events on page 54 of this issue of *Horological Times* lists those bench courses scheduled after March 15. If you plan to remain in the watch repair business, you cannot afford not to attend these seminars whenever they come your way. AWI will cooperate with any group of twenty or more to establish a bench course in your area. □

THE NEW SEIKO BATTERY REPLACEMENT KIT:

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Order the New Seiko Battery Replacement Kit, (STC-30), today from your Authorized Seiko Material Distributor. Price: $39.50.

SEIKO

HOW LONG WILL A WATCH BATTERY LAST?©1978

By Louis A. Zanoni

Part 2

Battery cell size is a predominant factor in watch design. The physical size of the cell usually determines the size of the watch. Since ladies' watches are traditionally smaller than men's, it has been necessary to use smaller energy cells in the ladies' LED and LCD watches. This has done wonders for styling, but it has been disastrous for battery life.

The charts in this report are designed to assist the digital watch repairman in determining the theoretical life expectancy of a small, low-capacity energy cell. For energy consumption charts of the higher energy consumption watch cell, refer to Part 1, *How Long Will a Battery Last?, Horological Times*, February 1978.

The life expectancy of a new watch cell is dependent on two important factors: (1) the milliampere hour (mah) rating of the cell, and (2) the amount of current consumption of the module. The mah rating of a cell is predetermined by the cell manufacturer. This information is available from the manufacturer's technical data books and specification sheets. Refer to Part 1 of this article for additional information regarding the mah rating. Once the mah rating of a particular cell is determined, it becomes a matter of record. Therefore, the only other test necessary is to determine the amount of module current consumption.

Although most watch modules of identical design consume approximately the same amount of current, it is possible to have wide variations in current drain, especially in older modules. Therefore, it is necessary to measure the current consumption of every module prior to replacing the energy cells. Replacing batteries without measuring the current drain of the module is like filling a water bucket without checking to see if it has a hole in it. High current modules cause premature cell failure. If a module is draining excess current, the customer should be notified so he can make the choice of replacing the module or constantly replacing the cells. Premature cell failure causes mistrust. Notify your customers of premature cell failure due to high current.

The answer to "How much current is too much current?" depends on the expectations of the customer and how she uses her watch. If the customer uses her watch often, she can expect the cells to die soon and vice versa.

The following charts are a guide for you and your customer. They will help you determine how often the watch can be used and how long the cells will last, providing the cells are new and are properly rated.

The graphs published in Part 1 of this series were based on 12-month usage. When examining the 12-month charts, you will note that the lower mah rated charts (50 mah to 20 mah) do not have provisions to evaluate quiescent current drains higher than 5 microamps (μa). The 25 and 20 mah charts don't even allow 3 μa of quiescent current for 12 months. Therefore, new graphs were plotted to show how many display seconds are available for 3 and 6 months of expected life. These graphs allow you to evaluate lower mah rated cells even if the module is consuming large amounts of current.

It is possible, after examining these charts, to make a judgment of how much current is too much current.

How to Use the Watch Battery Energy Consumption Chart

1. Select the energy consumption chart which corresponds to the true mah rating of the cell being evaluated.
2. Measure the quiescent current of the module which is being evaluated.
3. Select the diagonal line corresponding to the quiescent current.

4a. For LED: measure the display current with 15 segments on, and draw a vertical line corresponding to the display current.

4b. For LCD: measure the lamp or alarm current and draw a vertical line corresponding to the lamp current. (Note: if a separate cell is used for the lamp only, its quiescent current is zero.)

5. At the intersect of the diagonal quiescent current line and the vertical display current line, draw a horizontal line to the left edge of the graph and read the number of display seconds per day on the left hand vertical scale.

Conclusion

When evaluating the life expectancy of any cell in any watch, keep in mind the mah rating is accurate to within ±10%. It is also possible for a cell to fail prematurely due to faulty or mishandled cells. If you know the module current drain is normal, be sure the case back or the battery spring is not shifting position and short-circuiting the cells. Also check the pusher positions. If they are too close to the contact pad, they may make unwanted contact. Only after a complete technical evaluation should you blame the customer for pushing the bottom too often.

Acknowledgement: I'd like to thank Diana Zanoni for preparing the charts for this article.

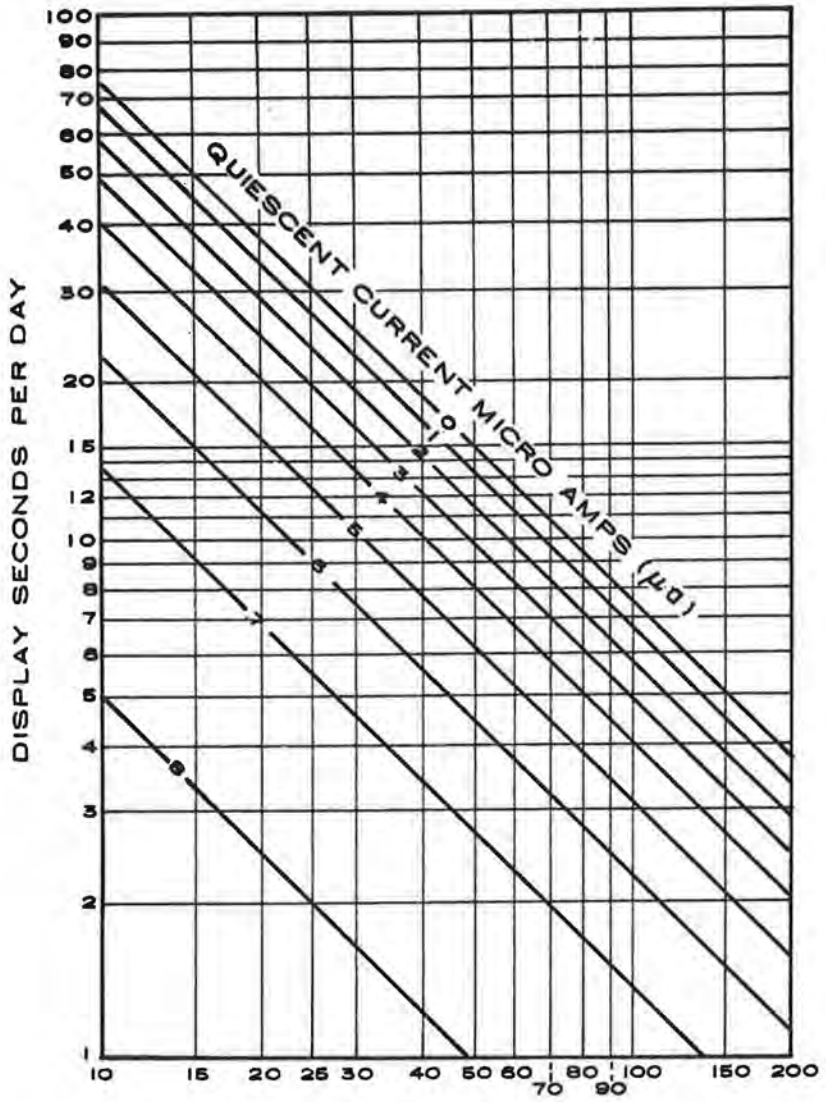
(Graphs for this article begin on page 12.)

DELAYS AT FTC SLOW GOLD MARKING RULE

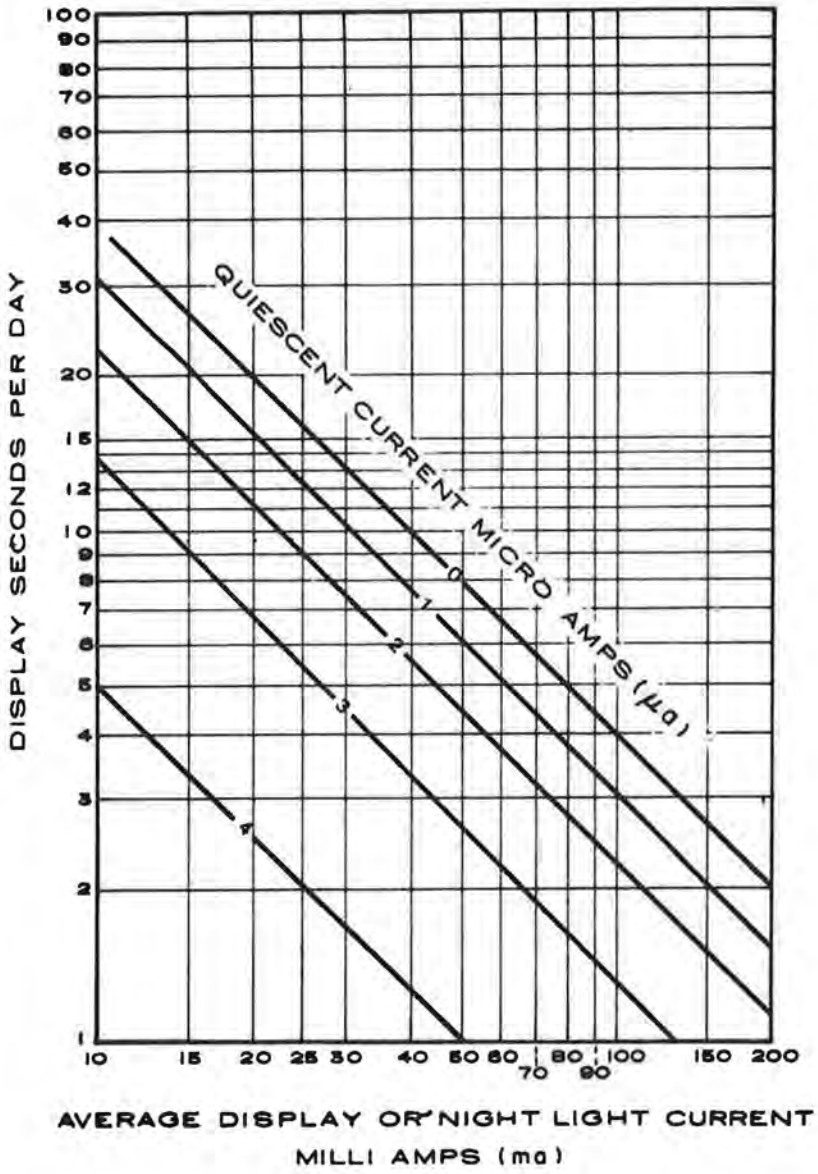
Key personnel changes and organizational reshuffling has slowed the staff's consideration of the proposed gold and silver marking rule. Key FTC staff advised RJA that they did not expect to complete their analysis until late in February. RJA remains "guardedly optimistic" that the full Commission will reject the proposal and keep the present 10K standard for gold jewelry.

(From the RJA Bulletin.)

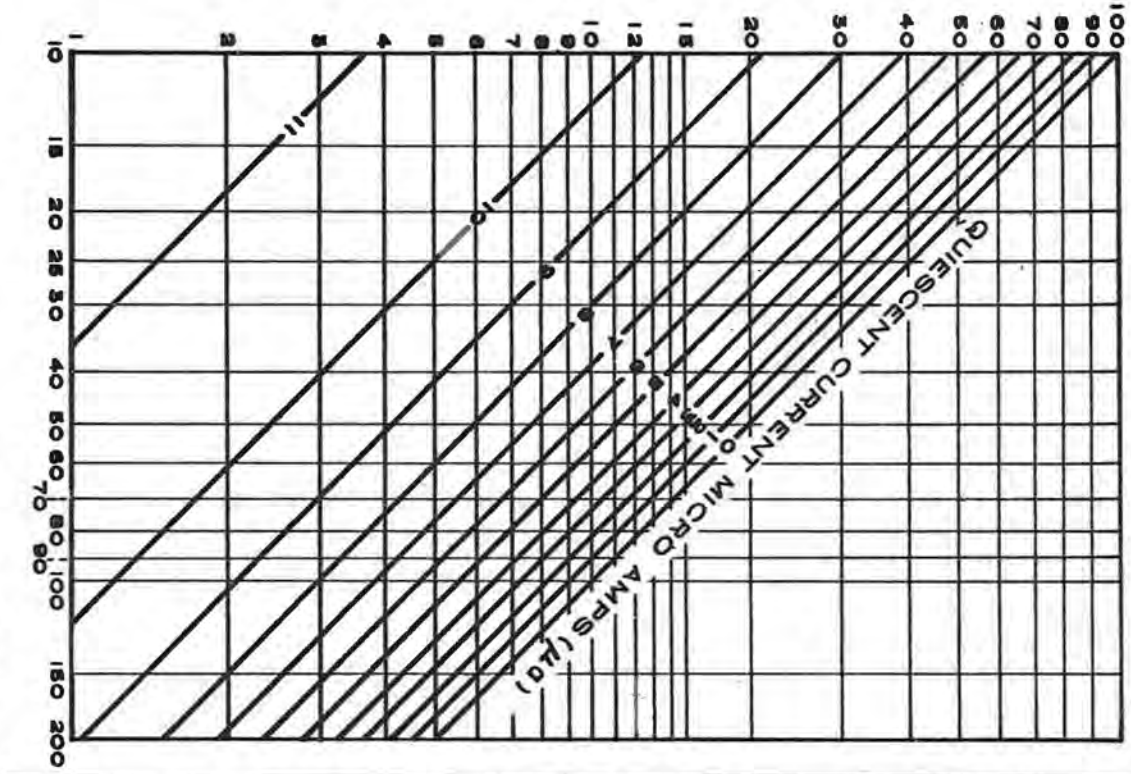
WATCH BATTERY ENERGY CONSUMPTION CHART
20 mah
3 MONTHS USAGE

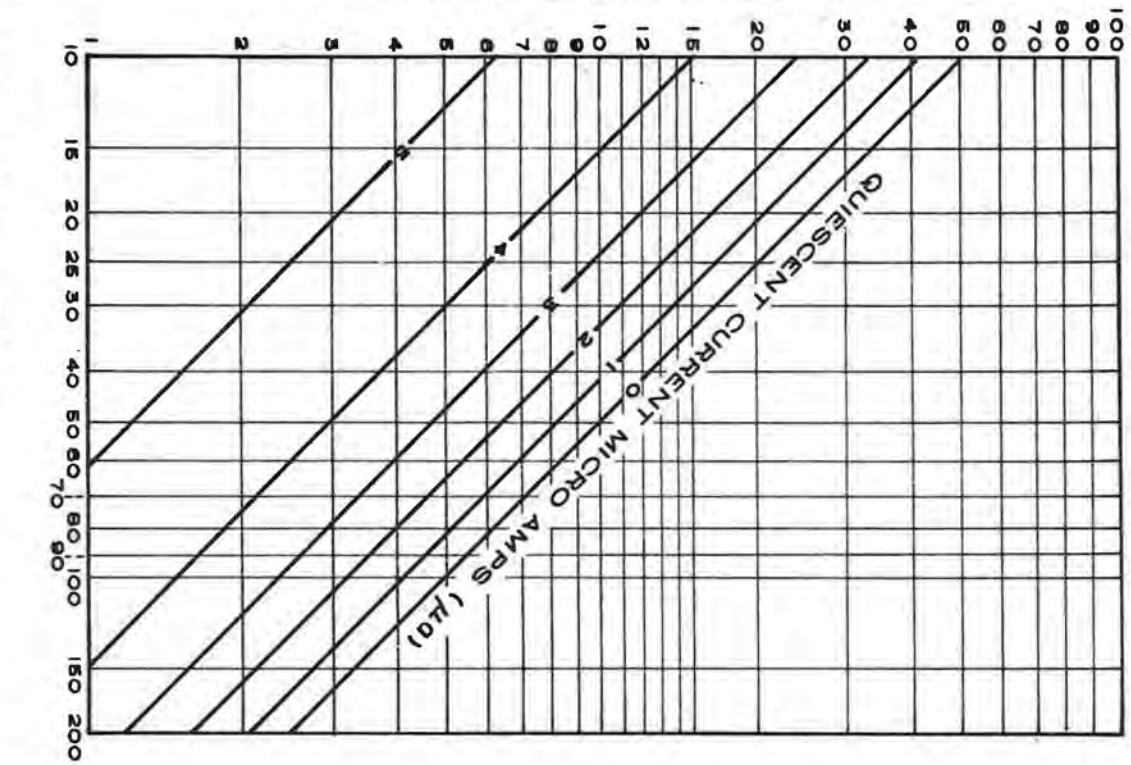


WATCH BATTERY ENERGY CONSUMPTION CHART
20 mah
6 MONTHS USAGE

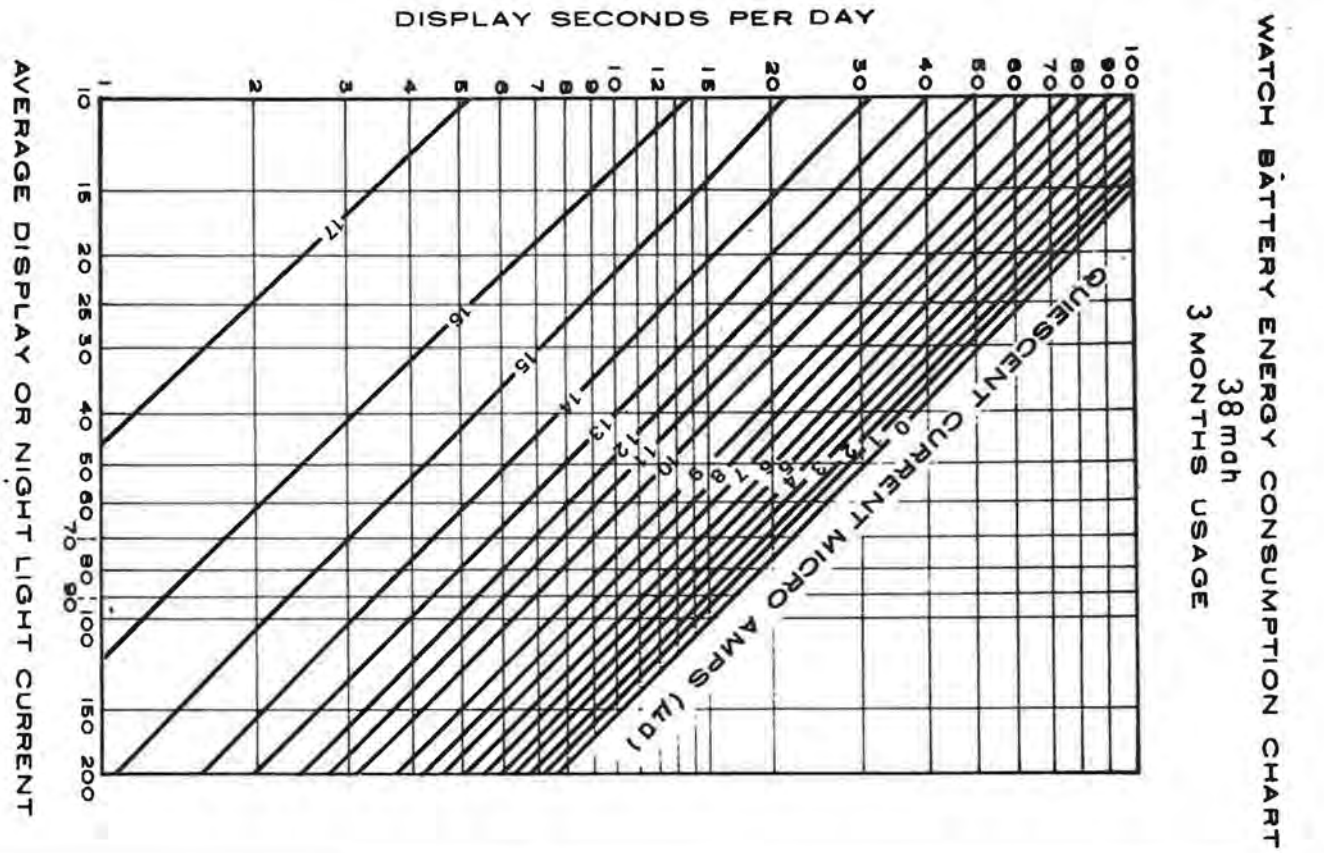


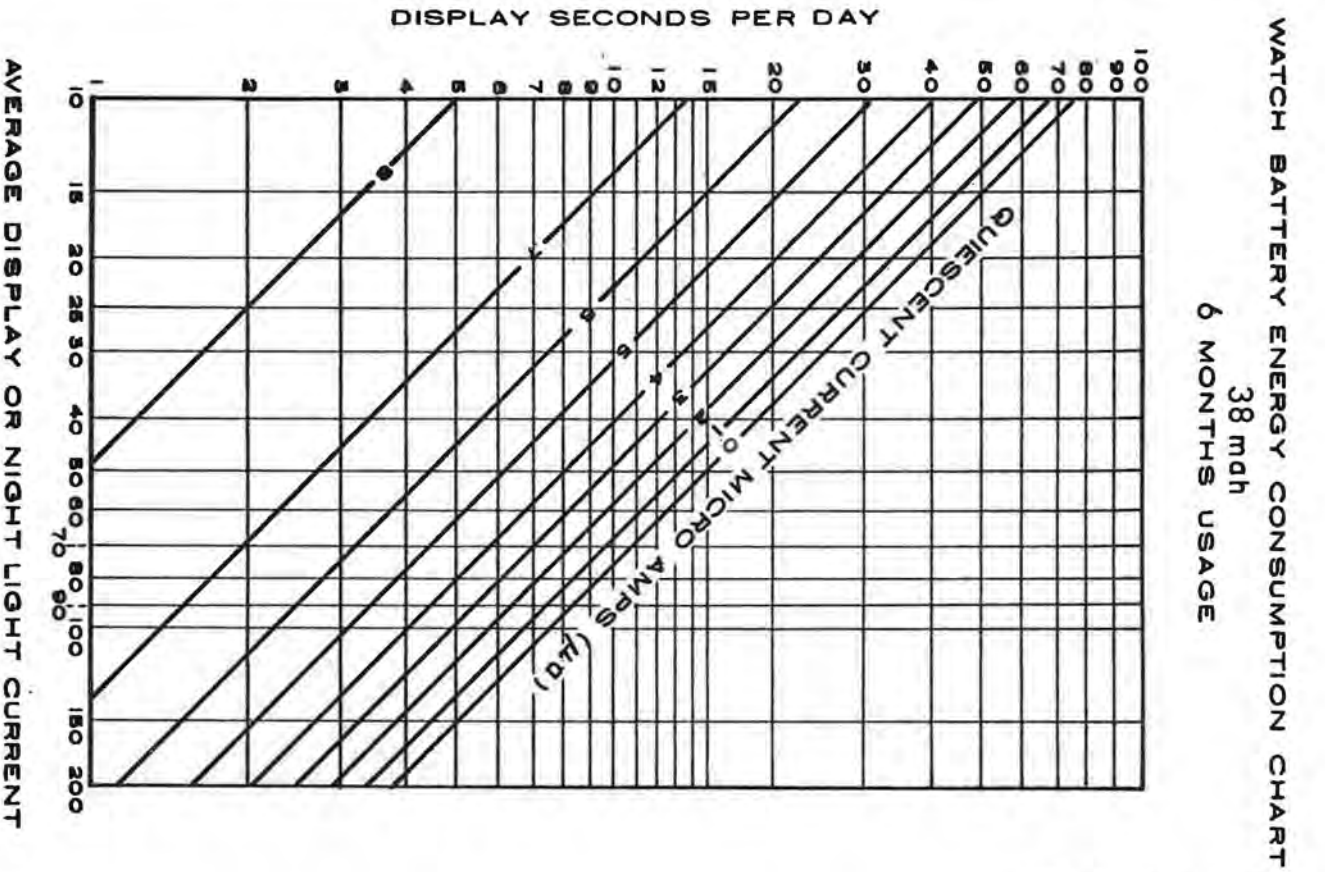
WATCH BATTERY ENERGY CONSUMPTION CHARTS





AVERAGE DISPLAY OR NIGHT LIGHT CURRENT
MILLI AMPS (ma)





(Continued on page 48.)

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In the Spotlight

by Orville R. Hagans

CMW CMC FBHI

FROM THE ORVILLE R. HAGANS MANUSCRIPT AND PHOTO LIBRARY

THE IDLE-TYME CLOCK

by Orville R. Hagans, CMW, CMW, FBHI

This is not a Congreve and I doubt the inventor, Harley Mayenschein, knows what a Congreve is. His rolling ball clock creation, "Idle-Tyme" is ingenious. It is fascinating and entertaining . . . . . and it tells time!

Mr. Harley Mayenschein, of Sextonville, Wisconsin, always worked for others and has to his credit seven or eight patents, but as he worked for others, his inventions belong to

Front View

former employers. He is self-trained and has always worked in engineering and automation and with high speed production. He reads a lot of books, but mostly just keeps his eyes and ears open and mouth shut, and his inventive mind ever alert.

During a period when not steadily employed, but seeking permanent employment, he had considerable "idle" time on his hands, and one day while repairing his granddaughter's gumball machine in his workshop at home, someone asked him the time while he had a handful of gumballs. It was 8, and as he replied, he realized that he had lined up 8 gumballs in a row. Something clicked and he came up with the idea of a clock.

He used no drawings to turn his idea into substance. After four months of evening and weekend work, making and assembling 300 pieces of wood, his "Idle Tyme" clock became a reality.

The clock has no hands, but it does have one arm which has a scoop attached and is run by a small electric motor.

The arm takes precisely a minute to go around. When it does, it drops a ball bearing on the top ramp. That ramp

Top View

represents minutes and tips when it receives the fifth ball. The middle ramp represents five-minute intervals. The bottom ramp represents hours. The middle and bottom ramps tilt under the weight of 12 bearings.

When a ramp fills and tips, the ball bearings rush around a curve to the side, one of them dropping onto the next ramp below. At 12:59 all of the ramps are filled. When the ball drops, making it 1 o'clock, all the ramps tilt and clear in what Mr. Mayenschein refers to as the "big dump."

This venture is a family affair. Mayenschein, his wife Pat, their grown children Patrice and Jo, plus three young

Left End View

trainees comprise the production personnel. They are a happy family and Harley constantly whistles while he works.

When they got into production of the clocks, Harley found that testing the clocks was taking too much time, so he invented a timing machine which speeds up time 30 times to check accuracy. (This timing machine is not in competition with Watchmaster, Vibrograph, etc., nor can these existing timing machines be used to time "Idle-Tyme" clocks.) Harley has the only such timing machine for his clock.

During the company's short existence, it is amazing how unsolicited publicity has spread throughout the world. They have shipped clocks to Minnesota, Florida, Texas, Colorado, Louisiana, Puerto Rico, Canada, and Japan. Recently, the Queen of England's head guard wrote and ordered one.

For personal use or as a customer attraction in stores and shops, the clock's power to stop people cannot be estimated.

The clock is available in three types of wood—butternut, cherry, or black walnut—and a plastic cover for the clock is also available. Further information is available from Idle Tyme Co., Box 117, Sextonville, WI 53584; Texas and California representative, David Tips, 7012 Blackwood Drive, Dallas, TX 75231; or AWI Museum, P.O. Box 11011, Cincinnati, OH 45211.

Mr. and Mrs. Harley Mayenschein have given an "Idle Tyme" clock to AWI, ELM Trust Museum. □

HEAT TREATING CARBON STEEL

by Gerald G. Jaeger
CMW

Conclusion

To many people, tempering suggests a hardening process, but this is not true. Tempering, or "drawing," as it is often referred to, is a controlled softening process. Steel hardened to its maximum is very brittle because it is in a stressed state. Upon the application of heat to hardened steel, it becomes tougher, the stresses are relieved, it becomes softer, and the structure is stabilized.

The tempering operation can be accomplished in many manners. We will deal with tempering in air, as it is the least complicated, and can be done with the equipment already in the possession of most watch and clock makers. A heat source such as an alcohol lamp or Bunsen burner will suffice. A blueing pan, which is a flat or slightly rounded piece of brass or copper with an attached handle will suffice to hold the pieces being tempered. A series of graduated holes will do well to hold screws, etc. The piece of steel being tempered is merely placed on the blueing pan and the pan heated, with caution taken to move or rotate the pan over the flame to assure a more even distribution of the heat. We use brass and preferably copper to make the pan, because its conductivity tends to eliminate hot areas and cool areas, as does applying the heat over the area of the pan where the steel is being tempered. This is the "old blacksmith technique" and when we learn to recognize the color keys and their relation to the temperature range of approximately 400° F to 700° F, shiny surfaces of steel will assume a number of different colors. This color change is due to oxide films that form on the surface of the steel and the color changes as the temperature varies. Although not laboratory perfect, Figure 1 can be used to determine tempering temperatures.

A point we must make here is that the color attained in tempering steel is not valid unless the steel we are working with has been brought to full hardness by the procedure outlined in the previous article on hardening steel. The polished surface of carbon steel, whether it has been hardened or left soft, will exhibit the same color change as it passes through the temperature range from approximately 400° F to 650° F. It is good to be aware of this color phenomenon as there may be times we want to color metal through heat treat and the metal may not require a specific hardness. It may be only the color we wish to attain. Some examples may be hands, or other attachments, some of which are for ornamental or decorative application only. The finish of the metal prior to tempering is also critical. The finer the surface and the brighter the polish, the more pronounced will be the color. The metal must also be clean and lacking in fingerprints or the color will not be even.

Approximate temperature, °F	*Color*	*Application*
430	Light straw	Gravers, tool bits, etc.
460	Deep straw	Dies, punches, etc.
480	Bronze	Taps, screwdrivers
530	Purple	No practical application
570	Deep blue	Staffs, stems, pinions, screws, heavy springs
610	Light blue	Springs
630	Steel gray	Soft springs

Figure 1.

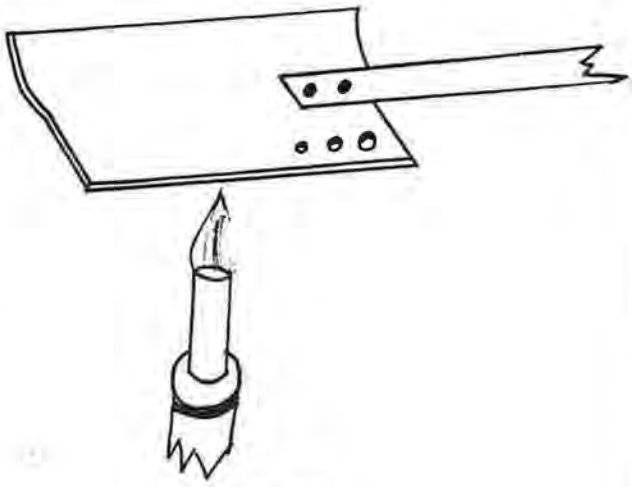

Figure 2.

A good experiment to familiarize oneself with the color change is to cut five pieces of approximately 2 mm-diameter drill rod into 1½ in. lengths. Harden them to full hard and polish about 1 in. of the length of the drill rod by placing it in a lathe and polishing with crocus cloth. Using care not to get fingerprints on the polished portion, lay it in a blueing pan (Figure 2). and heat until it reaches a light straw color. Quench the piece immediately when it reaches the light straw color. If we gently roll the piece of drill rod in the slightly rounded portion of the blueing pan (Figure 2A), it will heat

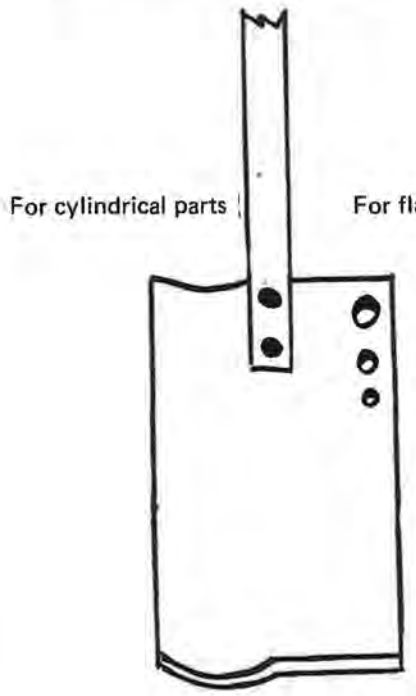

Figure 2A.

more evenly throughout and consequently be tempered evenly throughout. Proceed with the remaining four pieces of drill rod, heating them until they reach the colors of bronze, purple, light blue, and gray. You will now have five pieces of drill rod, each tempered to a different hardness and color. Perform the saw and file test on each piece as indicated in Figure 3.

I have indicated the expected results. We are working here again with visual perception, so the result may not be exactly as indicated. The point is that through experimentation of this type, we will become familiar with both hardening and tempering processes in heat treat. The graph in Figure 3 shows areas wherein the results may vary, as we do not have a tempering oven, and are relying on visual perception. The bronze color may file and it may not file. The light blue color may saw and it may not. We must keep in mind that we are reaching approximate degrees of hardness in the steel with this method, but once it is mastered, you will do very well. If you begin the tempering experimentation without testing and confirming the full hard state of the drill rod, your chart will have little resemblance to Figure 3.

I recommend quenching steel when it reaches the proper color, as if we air cool it, in most cases, it will go beyond the color and reduce the degree of hardness we are seeking. Keep in mind that this quench cannot induce hardness as hardness can only be induced when cooled from the critical (cherry red) temperature. In tempering, we are reducing hardness by degrees, and when we reach the desired state of reduced hardness, we must stop the softening process immediately. This can best be accomplished by quenching. Tempering temperatures are subcritical temperatures; that is, they are performed below the critical temperature. Since the temperature is below the critical, the manner of cooling is relatively unimportant so long as we can stop the temperature and do not let the steel reach a color beyond the color we are seeking. Hardness is lowered almost instantaneously as the tempering temperature is reached, but the toughness can be increased by giving additional time at the desired tempering temperature. Without sophisticated equipment, we will be unable to be quite this scientific.

Steel tempered to	*Will not file*	*Difficult to file*	*Easy to file*	*Will not saw*	*Will saw*
Light straw	X			X	
Bronze	X?			X	
Purple		X		X	
Light blue		X		X?	
Gray			X		X

Figure 3.

I would be remiss if I did not again point out that without attaining the proper hardness and the proper atomic structure within the steel in the hardening processes, tempering will do little to correct these errors. I can assure you that carbon steel, properly hardened followed by proper tempering, will give you the desired result, whether you are making springs, pivots, screws, gravers, or whatever. The time spent mastering these techniques will be well worth your effort as the result can only mean better performance of the tools and parts you make and a more professional result in whatever you attempt. □

THE WAY IT USED TO BE

148 years ago, watchmaking was learned by serving an apprenticeship. The following is a contract entered into by John Erb, grandfather of Mrs. Esther Bowman of Bowman Technical School, Lancaster, Pennsylvania, when he was 15.

For five years and two months from 26th June, 1830. Received satisfaction for the within obligation in full August 26, 1835.

THIS INDENTURE WITNESSETH

That John Erb aged fifteen years and ten months on the 2nd day of August 1830, son of Joseph Erb of Lampeter township, Lancaster County, and by and with the advice and consent of his father hath put himself and by these presents doth, voluntarily, and of his own free will and accord, put himself Apprentice to Joseph Bowman of the Borough of Strasburg, County of Lancaster, Clockmaker to learn clockmaking art, trade, and mystery; and, after the manner of an apprentice, to serve five years and two months from the day of the date hereof, for and during and to the full end and term of five years and two months . . . . .next ensuing. During all which term, the said apprentice his said Master faithfully shall serve; his secrets keep, his lawful commands everywhere readily obey. He shall do no damage to his said Masters goods, nor lend them unlawfully to any. He shall not commit fornication nor contract matrimony, within the said term. He shall not play at cards, dice or any other unlawful game, whereby his said master may have damage. With his own goods, nor the goods of others, without license from his said Master he shall neither buy nor sell. He shall not absent himself day or night, from his said Master's service, without leave; nor haunt alehouses, taverns, or playhouses; but in all things behave himself as a faithful apprentice ought to do, during the said term, of five years and two months.

And, the said Master shall use the utmost of his endeavors to teach or cause to be taught or instructed, the said apprentice, in the trade or mystery of Clocking. . .and procure and provide for him sufficient meat, drink, lodging, and washing, fitting for any apprentice, during the said term of five years and two months and said Master shall give said apprentice within said apprenticeship six months schooling in an English Day School and at the expiration of said term, said master shall give said apprentice twenty-five dollars good and lawful money which is to be in "lue" of his freedom suit.

And, for the true performance of all and singular the covenants and agreements aforesaid, the said parties bind themselves, each unto the other firmly by the presents.

In Witness whereof, the said parties have interchangeably, set their hands and seals hereunto. Dated the twenty-sixth day of June in the year of our Lord, one thousand eight hundred and thirty.

Sealed and delivered in the presence of John Erb, William Black, John Markley, Joseph Erb, and Joseph Bowman, Lancaster County, S.S.

I John Markley one of the Justices of the Peace in and for said County, do certify that the Parties within named appeared before me and acknowledged the within Indenture to be their act and deed and desired that the same might be recorded, witness my and Seal at the Borough of Strasburg, the 26th day of June, 1830. □

MARVIN WHITNEY HONORED

A few hundred friends and associates gathered recently at the Almas Temple Ballroom in Washington, D.C. to honor Marvin E. Whitney on the occasion of his retirement as principal of Chamberlain Vocational High School. The guest list resembled a "who's who" of Washington, D.C. The highlight of the evening was a "Roast N'Toast" of Whitney. The various facets of his life were revealed during this entertaining program.

Mr. Whitney came to Washington, D.C. when he was appointed a Page from the State of Washington. Later he completed a watch and chronometer apprenticeship at the Naval Observatory. After service overseas in the Army, Whitney returned to head various departments at the Observatory.

For a while he taught watch repairing at Peters School of Watch Repair. In 1950, he became watch repair instructor at Chamberlain Vocational High Scool, and then served the school as Night Principal from 1957 to 1963. In March of 1963, he became Chamberlain Day School Principal.

Whitney has a Bachelor of Science degree, having been graduated *cum laude* from D.C. Teacher's College. He has amassed graduate credits at George Washington University and on several occasions, he has taught classes at that university.

Marv Whitney's professional excellence is well known in Washington, D.C., where he has been called upon to service clocks in the White House. He was singled out to repair the personal watches of Dwight Eisenhower and John F. Kennedy when they were serving as President.

His work in AWI is well known. He has headed AWI's Certification and Education Committee since AWI's inception. Marv has served AWI as President and Treasurer. Recently, he compiled the AWI History which is published in booklet form. The AWI home study course came into being under his guidance. He and Jim Tigner are currently collaborating on a book, *Questions and Answers in Clock Repairing.* Marv has been the behind-the-scene "can do" guy for AWI. He has taken on many volunteer tasks requiring many, many manhours of research and work.

Marv Whitney's "retirement" in his mid-fifties may be a blessing for AWI; already he has begun to tackle the many projects that he has been "meaning to do" for so long. The fine series of articles on the chronometer (now appearing in this magazine) is evidence of this. Because of Mr. Whitney's association with the Naval Observatory, the articles contain information available from no other source.

All of us at AWI join in celebrating Marv's early retirement and wish him much success and happiness in the future. □

Inside the Clock Shop

with James L. Tigner

CMC

THE STRIP PALLET HALF DEAD BEAT ESCAPEMENT

Despite its wide use in American and German clocks over the past 80 or so years, the strip pallet half dead beat escapement has been totally neglected in the standard literature. The only authority that even mentions it, to my knowledge, is the AWI's home study course in clock repairing.

Yet, in short pendulum clocks, and when correctly designed, this stepchild of the escapement family delivers an excellent performance. True, the American clocks in which it's usually found–imitation black French marbles, walnuts, tambours, etc.–aren't exactly beauties. But when they enter clockmakers' shops by the thousands every year, the profits to be realized from their repair can hardly be disregarded.

So let's have a go at adjusting this strangely ignored escapement.

Figure 1 illustrates the device we're talking about. Figure 2 shows a number of different designs the pallets may take, which we'll examine later in detail. Essentially, this escapement is the same as the dead beat, the only real difference being that the locking faces indicated at A and B in Figure 1 aren't concentric arcs of a circle swung from the pivoting point of the pallet, as in the dead beat. The slight eccentricity of the locking faces is intended to avoid a losing rate in the long arcs, which would normally be expected in a spring-driven, short pendulum clock fitted with a dead beat escapement. But more on this later.

There should be no need to redefine general escapement terminology, since this was covered in the October '77 session of The Shop. However, in addition to the locking faces A and B already referred to in Figure 1, perhaps it should be said that C and D are the impulse faces.

Let's begin with the easiest and most common adjustment needed, equalizing the inside and outside drops. This is done simply by moving the pallet closer to, or further away from, the escape wheel. That is, decreasing or increasing the center distance. Decreasing the center distance decreases the outside drop, but increases the inside drop. Increasing the center distance increases the outside drop, but decreases the inside drop. Contrary to what we learned on recoil escapements, both drops are affected by a change in center distance, and the effect on the respective drops is opposite.

Now, altering the center distance also alters the drop locks (the lock at the moment a tooth drops onto a locking face). However, if the pallets show no wear and haven't been tampered with, equalizing the drops should result in the correct amount of both drop and lock. This is usually all there is to adjusting the strip pallet half dead beat escapement.

But suppose the pallets are badly grooved or pitted. The wear marks must first be ground and polished out with

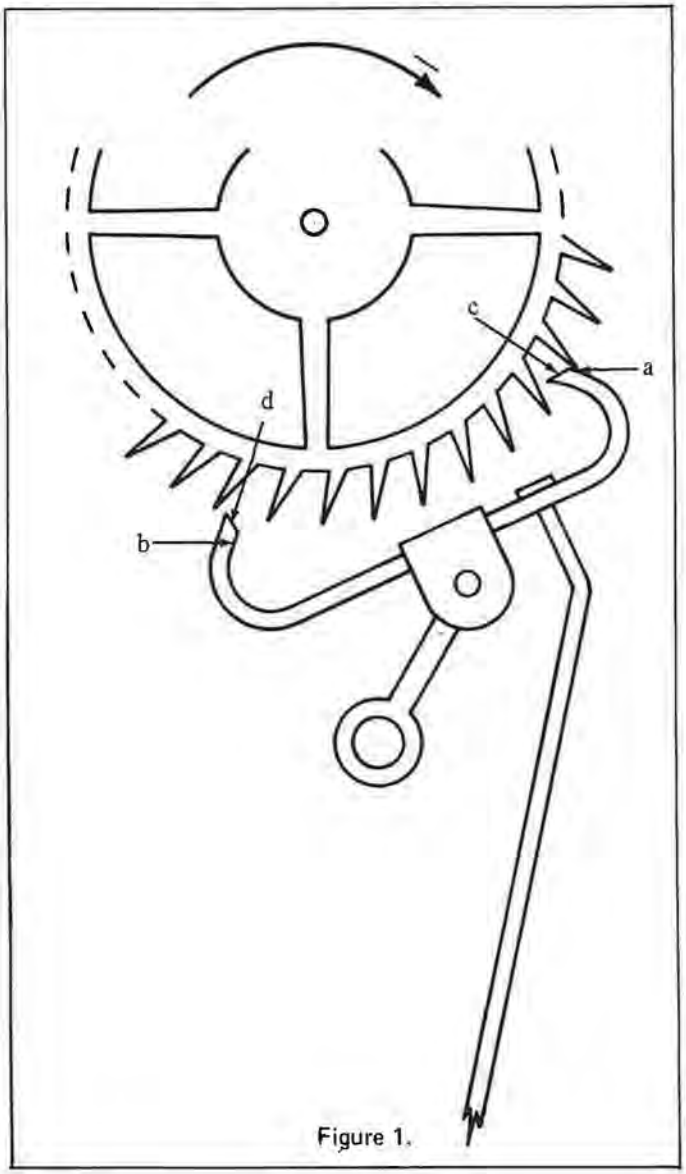

Figure 1.

Figure 2.

emery sticks, both on the impulse and locking faces. Then when the drops have been adjusted for equalization, it will likely be found that the locks are too small. It's even possible the wheel teeth may be mislocking, dropping on the impulse faces. In this case, the drops will also have changed, and are now too large.

The remedy is to close the pallets. This is done by bending the pallet at its midpoint, as in Figure 3, the same way we did with recoil pallets. While the pallet pads, or nibs,

Figure 3.

should be hard, the body is nearly always soft and can be bent with safety. However, as in all escapements, first test for hardness with a file. Better safe than sorry!

The locks on the strip pallet half dead beat escapement are fairly critical. They should be as small as possible, without danger of mislocking on any of the teeth. When they are heavier than necessary, it means the pendulum must make a wider arc for the wheel to escape, and this, in turn, means the clock will be more sensitive to an out-of-beat condition, dirt, gummy oil, etc. A study of Figure 1 will give a pretty good idea of the correct lock.

Incidentally, while the drops can be equalized, their size is a matter of tooth tip and pallet thickness, and can't be changed by any ordinary adjustment. The reason that drops increase in a mislocking condition, as earlier noted, is that in effect the pallet thickness has been reduced.

Back to locks again. If they are too deep, they can be made more shallow by opening the pallets as shown in Figure 4, again just as we did with the strip pallet recoil. The pallets are rested on 1/8 inch short lengths of drill rod

Figure 4.

placed across the jaws of a vice, to protect their hardened nibs from possible disaster. Light taps with the hammer do the trick.

Sometimes the locks will be found uneven. In that case, grind and polish the impulse face at a slightly steeper angle on whichever pallet has the deeper lock. You may then have to close the pallets slightly to deepen the locks on both pallets.

To sum up the adjustments for this escapement, they are exactly the same as for the dead beat. This being so, anyone who owns The Horolovar 400-Day Clock Repair Guide can always refer to the adjustment and troubleshoot charts devised by Henry Fried, when a problem arises. Of course, Henry's charts were tabulated for the Vulliamy (adjustable pallet) dead beat escapement, usually found in the 400-day clock. But to use them for the strip pallet half dead beat, all that's necessary is to substitute under the entrance and exit pallet headings the directions "Close" or "Open" in place of "Move Down" or "Move Up."

So much for the ordinary adjustments. If you like, we can go a little further. The earlier escapements of this kind, both German and American, are plagued, even more often than the strip pallet recoil, with a large isochronal error, exasperating to owner and repairer alike. That is, a good many of them will gain 4 or 5 minutes in the early part of the week, and toward the week's end lose about the same.

This, of course, is an escapement error. And escapement errors, as you know, can be very complex. Needless to say, I'm no engineer or mathematician, but just a bench mechanic. And when the discussion revolves around Q factors, phase angles, time constants, etc., the mixture gets a little heady for me, and I find myself falling back on the pragmatism of the old clockmakers. Which is to say, when I get an idea, I try it out. If it works, fine. If not, well, I look for a better idea.

In changing a dead beat escapement to a half dead beat, or half recoil, as it might just as well be called, the manufacturers' objective was to correct a bad losing error in the long arcs. But in practice, as we've seen, a good many of these escapements have a bad gaining error in the long arcs. It makes sense to me that the maker has gone overboard in departing from the dead beat design.

So if, without too much work, we can bring the locking faces more nearly back to the dead beat form, it should result in a better isochronal rate. I do the job in about 30 to 45 minutes. And it works. In most cases, spectacularly so!

If you are still with me, let's have another look at Figure 2. The upper pallet with the curved locking faces is a Seth Thomas. When the pallet is placed in the movement, the escape wheel can be observed with a loupe to recoil slightly as a tooth slides up the locking face of each pallet.

Again in Figure 2, the lower right hand pallet is an E. Ingraham, the lower left hand an early German. Notice that both of these have practically straight locking faces. When placed in their respective movements, the escape wheel of each recoils on the exit pallet, but revolves forward on the entry pallet, with a light draw.

In spite of their differences in form and action, all three of these pallets show a large gaining rate in the long arcs. Why? I don't know. I do know that when I change them as nearly as I can to a dead beat form, so that the escape wheel shows practically no motion during the slide on either entry or exit pallet, I get a good rate.

I note that the new German imports with this escapement are virtually dead beat, and have excellent isochronal rates.

Figure 5 shows the method of reshaping the pallets—after they have been softened, of course. I use a brass-headed hammer to avoid bruising the pallets, but a nylon one might be even better. When both pallets are to be curved inward, as in the two lower examples in Figure 5 where there was recoil

(Continued on page 49.)

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THE SHIP'S CHRONOMETER

by Marvin E. Whitney
CMW CMC

SHIP'S CHRONOMETER TRIALS

Since the observatories of the world were known as the repositories of time, it was only natural that they be given the responsibility of testing timepieces. In the earlier days, the testing of chronometers was referred to as "trials." The merit of each chronometer was determined by trial numbers, derived from an empirical formula which varied at different observatories as all of them use a different set of values or factors. This trial number indicated the ranking or accuracy of a chronometer. Some observatories offer several different classes of certificates based on the length of the trial, rate, temperature, and isochronism. Soon after its creation in 1859, the Astronomical Observatory of Neuchatel, Switzerland issued certificates for ship chronometers.

The trial number system originated at Greenwich, England, and was based on the weekly sums of the daily rates. The formula was "a + 2b," where "a" equaled the difference between the greatest and the smallest weekly sums over a period of twenty-nine weeks within a temperature range from 37° F to 103° F, and "b" equaling the greatest difference between one week and the next. Hence, the smaller the trial number the higher ranking the chronometer received.

Up until 1849, the trials were carried out at room temperature, which was far from being satisfactory because of temperature fluctuations. During that year, the oven test was introduced, covering a period of six weeks at a temperature ranging from 75° F to 100° F, but it was not until the 1900's that the cold box was introduced.

During these early years, many makers questioned the value and method by which these chronometer trials were conducted. Also, it was felt that some makers were submitting such poor instruments that the trials had become a mockery; in fact, to such an extent that the British Admiralty issued an order that makers who wished to submit an instrument for trial had to certify in writing that the chronometer was made entirely by himself and did not incorporate any other maker's component parts. For those makers who had a chronometer purchased by the Admiralty, they were entitled to use the title, "Maker to the Admiralty." This is often found engraved on the dials of many European chronometers.

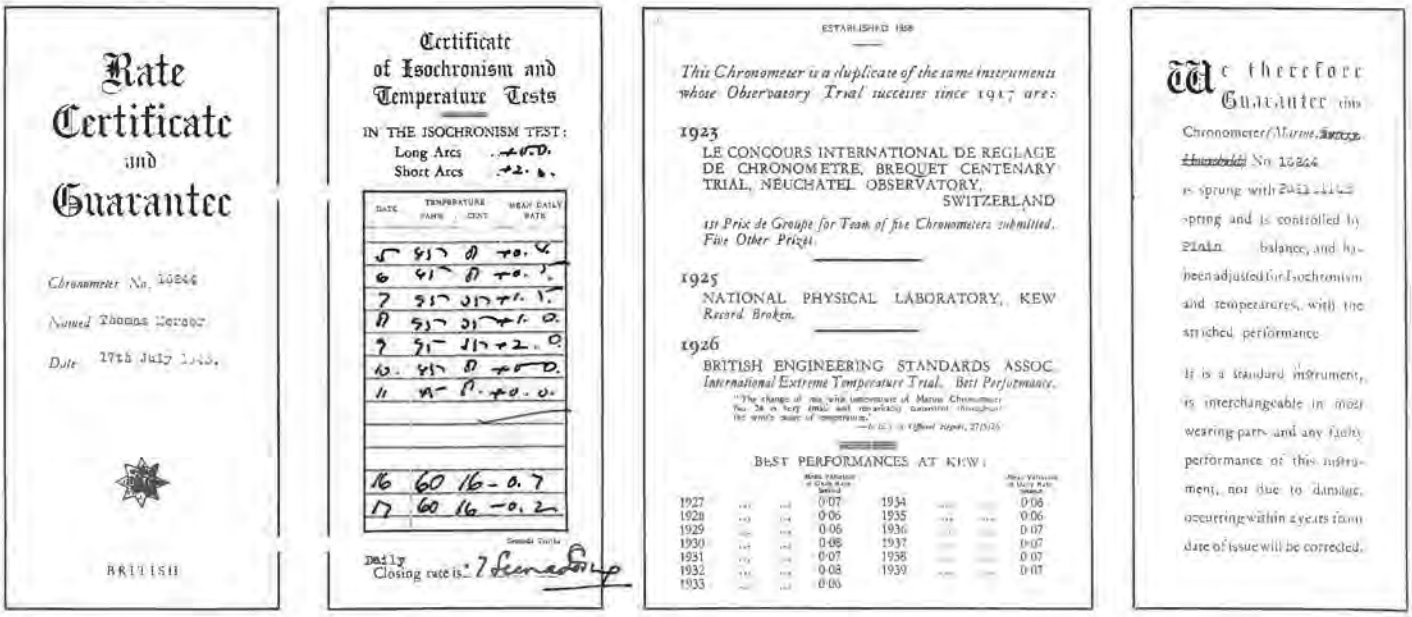
Although the trial number method was used for years to rank chronometer performance, in the early 1940's the trend was to state the performance requirements in more specific and discernible language which lessened to some degree the complexity of calculating the results.

The British Admiralty timing specifications in 1944 for chronometers were:

1. The chronometers were subjected to tests for periods of five (5) days in temperatures of (a) 5° C; (b) 15° C; (c) 30° C; and (d) 35° C.
2. The mean rate at 15° C was not to exceed two (2) seconds in 24-hours.
3. The difference of daily rate between periods b-a, b-c, and b-d, not to exceed plus or minus 2.8 seconds. The mean rate for each period will be used to determine the difference.
4. During any period of the test the daily rate shall not differ from the mean daily rate for that period by more than 1.0 seconds.
5. Chronometers were considered unfit for service if the daily rate exceeds six (6) seconds or was irregular.

At that time, the conditions of test of marine chronometers at the National Physical Laboratory for a Class "A" KEW certificate were as follows. (Also see Figure 1.)

1. The test of a marine chronometer occupies 55 days, and was divided into five (5) periods of eleven (11) days as follows:



Cover Interior

Figure 1. KEW Rate Certificate for a Mercer Chronometer.

1st Period–chronometer at about 70° F
2nd Period–chronometer at about 45° F
3rd Period–chronometer at about 70° F
4th Period–chronometer at about 95° F
5th Period–chronometer at about 70° F

Owing to the changes of temperature between the different periods of test, the rate obtained on the first day of each of periods 2, 3, 4, and 5 was not used for the purpose of the test.

2. Certificates were issued for chronometers whose performance was such that–

a. The mean variation of daily rate, i.e., the numerical average of the daily departures from the mean daily rate, during any one of the five periods of test, did not exceed 0.5 second.

b. The changes of mean daily rate, caused by the alteration of temperature from period to period, did not exceed one-tenth (0.10) of a second per 1° F.

c. The mean daily rate did not exceed 7.5 seconds in any period of the test.

Below is the record of a K. & W.O. White No. 14830 which was rated from 6 September to 30 October, 1938. and was award a class "A" KEW certificate.

Test period	Approx. temp., °F	Mean daily rate, sec	Mean variation of DR for Pd, sec
Period I	70	1.1	0.12
Period II	45	0.7	0.18
Period III	70	0.8	0.07
Period IV	95	0.4	0.10
Period V	70	0.8	0.07

Mean change of daily rate per 1° F–0.014 seconds. One can readily see that this was a very fine instrument.

At the U.S. Naval Observatory, the specifications stated that chronometers were to be subjected to a test at special temperatures and also to a trial of five weeks at ordinary room temperature. The range of temperature for the trial was 90° F to 55° F with the chronometer being subjected for a period of five days in each of the following temperatures in succession: viz.; 90°, 72½°, 55°, 55°, 72½°, and 90° (all Fahrenheit).

After the chronometer was placed in the temperature

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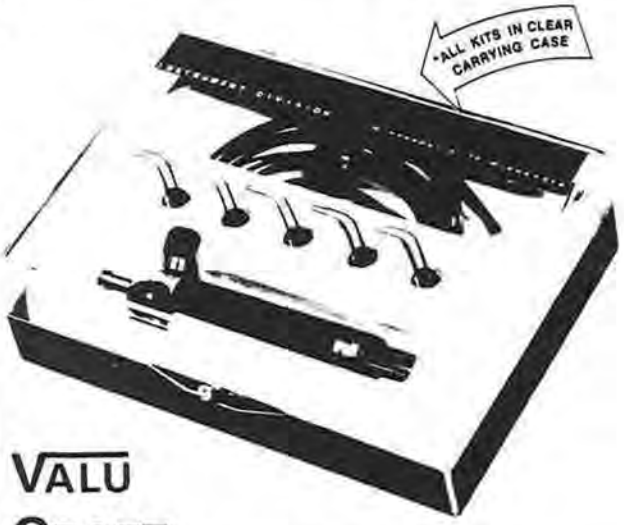

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room, the temperature was to be raised to 90° F, and after one day at that temperature, their errors were recorded and the trial was under way. At the end of five days, the errors were determined again. An interval of two days was allowed to change the room to the new temperature, and further intervals to settle to their new rates, after which their errors were determined and the test for the second temperature began. The tests for the other temperatures were to follow in the same manner, all changes in temperature being made gradually.

Comparisons were to be taken daily by a standard meantime clock, which was rated by transit observations. The errors being determined at the beginning and end of each temperature, the daily rates for the several temperatures being deduced from them.

After the temperature room trial, the chronometers were to be rated for five weeks at ordinary room temperature to determine the regularity of their rates or the degree of accuracy with which they followed their curves.

The method of determining the trial number of each chronometer was derived from the following formula:

90°	72½°	55°	55°	72½°	90°
c_1	b_1	a_1	a_2	b_2	c_2

$$a=\tfrac{1}{2}(a_1 \div a_2) \qquad b=\tfrac{1}{2}(b_1 \div b_2) \qquad c=\tfrac{1}{2}(c_1 \div c_2)$$

$$m = a - b \qquad n = b - c$$

$$a' = |a_2 - a| \qquad b' = |b_2 - b| \qquad c' = |c_2 - c|$$

$$\sum_2 = a'^2 \div b'^2 \div c'^2$$

Ordinary temperatures.

t = one of the six temperatures
R = corresponding observed rate
[R] = sum of the five values of R.

$$V = \frac{[R]}{5} - R$$

$[V^2]$ = sum of the five values of V^2

Trial number $I \div II \div III$

$$I = \frac{25}{7}\left[|m \div n| + \frac{64}{63}(m-n)^2\right]$$

$II = 50\ V^2$

$III = 25\ V^2$

The Navy specifications stated that as many chronometers as were desired would be selected in order of merit. Ordinarily no chronometer would be selected which had a trial number greater than 16, but the department, in its discretion, may extend this limit to 25.

Although, even today, the chronometer, ships' specification No. JAN-C-1196, dated 30 June 1949 and approved by the Departments of the Army, the Navy, and the Air Force, still states that a ship's chronometer will be selected by trial numbers, in the early thirties the trial method was disregarded. Instead of trial numbers, they were given a Class rating. Five classes were established: Superior, Excellent, Very Good, Good, and Fair.

Portions of the original formula were used to determine the chronometer's performance, whose rates had to fall within certain specified tolerances before achieving a specific class rating. See Figure 2.

In 1942 when the number of chronometers being submitted for trial increased, a new Ship's Chronometer

CHRONOMETER TESTS
U. S. NAVAL OBSERVATORY
PART I

5 days at each of 3 Temperatures
90° to 55° and 55° to 90°

Test Temp.	OBSERVED RATES		CURVE $\frac{1}{2}(a_1+a_2)$ etc.	m=a−b n=b−c	Half Range $a^1=\frac{1}{2}a$ etc.
55	a_1	a_2	a		a^1
72.5	b_1	b_2	b	m	b^1
90	c_1	c_2	c	n	c^1
				m+n	

For STANDARD not to exceed

CLASS	Obs. Rates	m+n	Half Range
SUPERIOR	0.75	0.50	0.25
EXCELLENT	1.10	0.80	0.30
VERY GOOD	1.55	1.20	0.35
GOOD	2.00	1.60	0.40
FAIR	2.10	1.60	0.50

Figure 2.

Trial Record Card (see Figure 3) was developed which greatly simplified those mathematical computations. You will note that several of the tolerances on the new record card were the same tolerances a chronometer had to meet to receive a class rating of "Very Good" shown in Figure 2.

From the record card, you will note that the temperature periods are arranged so that the two 90-degree periods are at the beginning and at the end of the test and that the two 72½-degree periods are placed between the 90- and the 55-degree periods.

The purpose of arranging the temperature periods in the above described manner is to provide a method of checking the chronometer for recovery, that is, to determine whether or not the chronometer will repeat the rating result for periods of like temperature after having been subjected in the interim to one or more different temperatures. While the arrangement of the temperature periods provides means of checking the recovery, the different temperature periods' primary purpose is to discover the temperature error.

To determine the rate for the various periods of the test, the five daily rates are added and then divided by the number of days (five) in the period, which gives the mean daily rate for that particular period. From these six mean daily rates is determined the value of the chronometer's most important criteria.

These factors, which are vital in determining the

MAKER Hamilton
SERIAL NO. 6721
CONTRACT 85310
CALL NO.

SHIP'S CHRONOMETER TRIAL RECORD
PRNC-NObsy-109

RUNNING TIME 56+
TRIAL STARTED 3-11-45
TRIAL FINISHED 4-14-45

1ST PERIOD 90° F				3RD PERIOD 55° F				5TH PERIOD 72½° F			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
1	+68.73	—	—	13	+70.01	—	—	24	+69.11	—	—
2	+68.89	+0.16	0.01	14	+69.90	-0.11	0.01	25	+69.21	+0.10	0.00
3	+69.03	+0.14	0.03	15	+69.81	-0.09	0.01	26	+69.29	+0.08	0.02
4	+69.21	+0.18	0.01	16	+69.74	-0.07	0.03	27	+69.39	+0.10	0.00
5	+69.40	+0.19	0.02	17	+69.62	-0.12	0.02	28	+69.48	+0.09	0.01
6	+69.57	+0.17	0.00	18	+69.51	-0.11	0.01	29	+69.59	+0.11	0.01
SUM		+0.84	0.07	SUM		-0.50	0.08	SUM		+0.48	0.04
AVERAGE		+0.17	0.01	AVERAGE		-0.10	0.02	AVERAGE		+0.10	0.01

2ND PERIOD 72½° F				4TH PERIOD 55° F				6TH PERIOD 90° F			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
7	+69.80	—	—	18	+69.51	—	—	30	+69.72	—	—
8	+69.91	+0.11	0.01	19	+69.40	-0.11	0.00	31	+69.89	+0.17	0.01
9	+69.98	+0.07	0.03	20	+69.29	-0.11	0.00	32	+70.05	+0.16	0.02
10	+70.07	+0.09	0.01	21	+69.18	-0.11	0.00	33	+70.24	+0.19	0.01
11	+70.18	+0.11	0.01	22	+69.08	-0.10	0.01	34	+70.45	+0.21	0.03
12	+70.28	+0.10	0.00	23	+68.95	-0.13	0.02	35	+70.64	+0.19	0.01
SUM		+0.48	0.06	SUM		-0.56	0.03	SUM		+0.92	0.08
AVERAGE		+0.10	0.01	AVERAGE		-0.11	0.01	AVERAGE		+0.18	0.02

ISOCHRONISM (OPTIONAL)			
DAY	ERROR	RATE	
10	+70.07	—	COMBINE WITH ANY DAY IN PERIODS 2 OR 5 72½° F
12 HR.	+70.12	+0.05	
11	+70.18	+0.11	
DIF. 12 HR. & ½ 24 HR. RATE		0.005	

PASSED ☑
FAILED ☐
APPROVED MEW

PERFORMANCE	ACTUAL	TOLERANCE
REGULATION:- Largest Average Daily Rate Any Period	0.18	1.55
RATING:- Average Deviation Of Rates	0.01	0.50
Largest Dif. Any Two Daily Rates In Same Period	0.21	0.75
TEMPERATURE COMPENSATION:- Dif. Between Average Daily Rates At 90° F (Periods 1 & 6) And 72½° F (Periods 2 & 5)	0.07	0.75
Dif. Between Average Daily Rates At 72½° F (Periods 2 & 5) And 55° F (Periods 3 & 4)	0.22	0.75
Dif. Between Average Daily Rates At 90° F (Periods 1 & 6) And 55° F (Periods 3 & 4)	0.28	1.20
RECOVERY:- Largest Dif. Between Average Rates For Dif. Periods At Same Temp.	0.01	0.70
ISOCHRONISM:- Dif. 12 Hr. And ½ 24 Hr. Rates	0.005	0.50

PRNC-1-24-40-5M

Figure 3. Ship's Chronometer Trial Record for Hamilton No. 6721.

performance of the chronometer, are as follows: *regulation*–the largest mean daily rate for any periods; *temperature compensation*–the difference between the mean daily rate at one test temperature (two periods) and the mean daily rate at another test temperature (two periods); and *recovery*–the largest difference between the mean rate of any two periods at the same temperature. The allowable tolerances as specified by the U.S. Navy for these classifications are Regulation–1.55 seconds per day; temperature compensation–1.20 seconds per day for a difference of 35° F and 0.75 seconds per day for a difference of 17½° F; and recovery–0.70 seconds per day.

In addition to the above criteria, the chronometer performance card lists the mean deviation of rates for all periods and the largest difference between any two daily rates in the same period. For these, the tolerances are 0.50 seconds per day for deviation and 0.75 seconds per day for largest difference. These two factors, just mentioned, are important in determining the excellence of a chronometer. A steady rating chronometer, which is the desired objective, will show

a low figure for mean deviation of rate and for largest difference between two daily rates in the same period. The isochronism check, shown on card, indicates the difference between the 12-hour rate and one-half the 24-hour rate at 72½° F.

When the chronometer was issued to service, a rating certificate accompanied each instrument showing how the chronometer may be expected to rate under average conditions.

In preparing this certification of rate, the method of reading the chronometer error was the same as described in the previous paragraphs except that the rating is done entirely at room temperature of 72½° F, and subsequent to the completion of the performance test. Fifteen consecutive daily rates are taken at this temperature during the period immediately preceding the issuance of the instrument for service. Here again, the daily rates–in this case, 15, are averaged, and the mean rate at room temperature obtained. This rate is an indication of how much the chronometer will gain or lose each day if maintained at this temperature.

The U.S. Navy's performance test for ship's chronometers, was a test for thirty-five (35) consecutive days' duration. The test was conducted in a dust-free room, isolated from shocks and vibrations, with room temperature controlled at 72½° F. The tests at 90° F and 55° F were conducted in thermostatic controlled cabinets. In all cases when a chronometer was changed from one temperature to the next, a settling down period of one day was allowed to permit the instrument to adjust itself to the new temperature.

During the time of the test the daily check of the rate of the chronometers was obtained by comparing the indication of the instrument under test with that of the amplified "time tick" from the Observatory's master clock. This method was used from about 1939 until 1945 when the Naval Observatory purchased two Hamilton electronic comparators. Before 1939, the comparison of daily reading was done on a drum chronograph.

In all instances, except when the electronic comparator was used, the reading was made at the same point on the dial each day; thus, the effect of any error in graduation of the dial or eccentricity of the position of the hand was avoided. Furthermore, the comparison was done at the same time each day, within a few minutes, so the daily rate obtained needed no further correction. The instruments were wound each day just before they were read, so that no isochronal variations would be introduced into the daily reading.

During the very early trials, the daily reading was recorded on a drum chronograph, Figure 4, which also recorded the time through electric seconds contacts of the Observatory's master clock by tapping a telegraph key when the second hand of the chronometer reached the sixty (60) graduation mark on the second's dial.

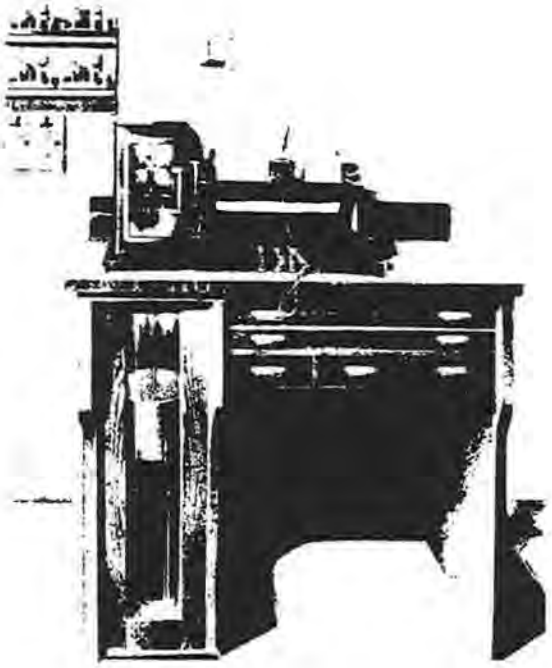


Figure 4. Recording Drum Chronograph.

Figure 5. Marine Chronometer Electronic Comparator made by Hamilton for the U.S. Naval Observatory.

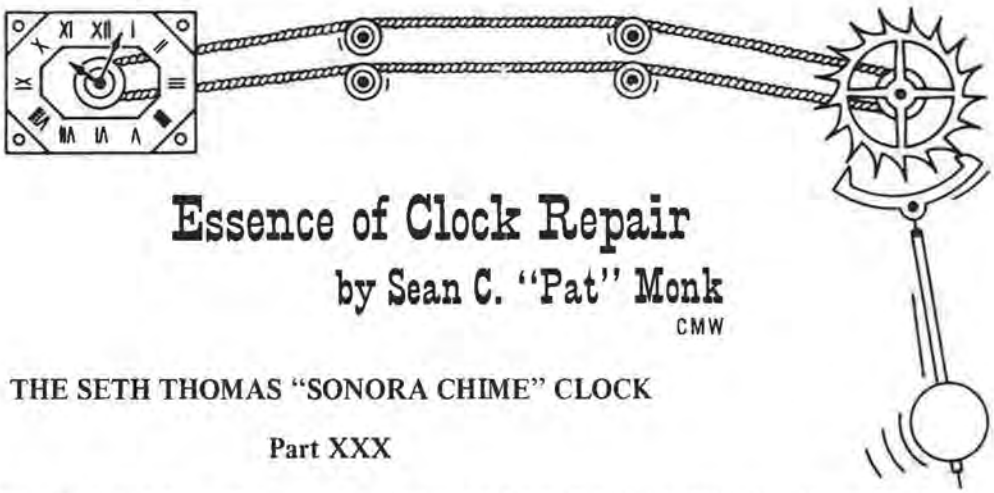
This electric drum recording chronograph consisted of a large cylinder drum which revolved about its axis in exactly one minute, its speed being kept uniform by a governor. A plain sheet of paper is wrapped around the drum and clamped tightly into place. Two pens resting upon it were moved along by a long screw that extended from one end of the drum to the other, thus causing each pen to make a special

line upon the paper. Each pen would be drawn sideways by a magnet, producing a notch in the line, when activated by either the clock or the tester when he depressed a key which sent an electric current through the magnet. The one controlled by the clock makes a notch each second except the 59th second which was omitted to show where the minute begins. The one controlled by the tester makes a notch at the instant when the second hand reached the sixty (60) second mark on the dial. The error was then determined by comparing the chronometer notch with the time notch made by the clock. The time notch is produced when the controls are opened and closed each second by a 59 tooth wheel mounted on the seconds arbor of the master clock pressing a lever sideways, thus making and breaking the circuit.

The Hamilton Marine Chronometer Comparator (Figure 5) was an electronically operated precision timing machine for reading dial errors of ships' chronometers to within a few hundredths of a second. First, the comparator was set to the master clock. Once it had been set, it would continue in synchronism with the master clock, since the comparator operated from a standard frequency current. To check a chronometer, the comparator mechanism was rotated until its hand, a second hand, was visually in synchronism with the chronometer's second hand. Since visual setting was only approximate, an electronic device was used for the fine adjustment. A microphone was placed on the crystal of the chronometer to pick up the second ticks which were amplified by the electronic unit and were then translated into flashing lights on the comparator. Built into the comparator was a device which eliminated the half second tick. Three lights on the comparator indicated to the operator how closely he had matched the hands. When the center light flashed, the operator knew that the hands had been matched to within a few hundredths of a second. If the lights on the right or left hand flashed, this indicated that the comparator's second hand did not coincide. The necessary correction was then made to cause the center light to flash. The amount that the comparator clock had to be rotated to match the second hand of the chronometer was indicated on a calibrated dial which read directly to hundredths of seconds. From the dial error for two consecutive days, the rate could be determined. The operator, working with three assistants—one to record the rates, one to supply the chronometers and one to wind and take them away—could easily time 200 to 250 instruments per hour. Figure 6 shows two chronometer performance Record Cards for the same instrument. On the Hamilton card, the errors were determined by the electronic comparator, while on the Observatory's card, the errors were noted by eye as the observer listened to the master clock "time tick."

By comparison, the actual results of the two methods

(Continued on page 50.)



Essence of Clock Repair

by Sean C. "Pat" Monk
CMW

THE SETH THOMAS "SONORA CHIME" CLOCK

Part XXX

This clock is of the 8-day, hour-strike type. It does not strike at the half hour. According to the stamping on our particular movement, it was made by Seth Thomas, the patent date being September 7, 1880. However, we must assume by the mantel-type wooden case that our clock was made some years later, probably around the turn of the century.

Two separate units comprise the clockworks, the one mounted behind the other. The frontal unit consists of the 8-day striking mechanism. The latter is of the standard Seth Thomas type, but, as mentioned, with no provision for the half hour strike. The rear unit consists of a separate chime mechanism, the latter being arranged to function each quarter hour, through a tripping arrangement between the two units. This shall be described. The chime unit is mounted on the clock's baseboard by two securing screws. Two brass securing plates are mounted at the top of the chime unit, the one securing the chime unit to the case and the other securing the unit to the back plate of the frontal clock unit.

The chime mechanism is powered by an extremely strong mainspring, shown at the top of Figure 1. On the center arbor of the clock movement is a round brass disc, approximately 5/8 inch in diameter. The latter has four brass pins secured to its inside face. At each quarter hour, one of these pins moves against a spring-loaded steel trip wire, the other end of which is shown as lever "a," Figure 2. When this lever

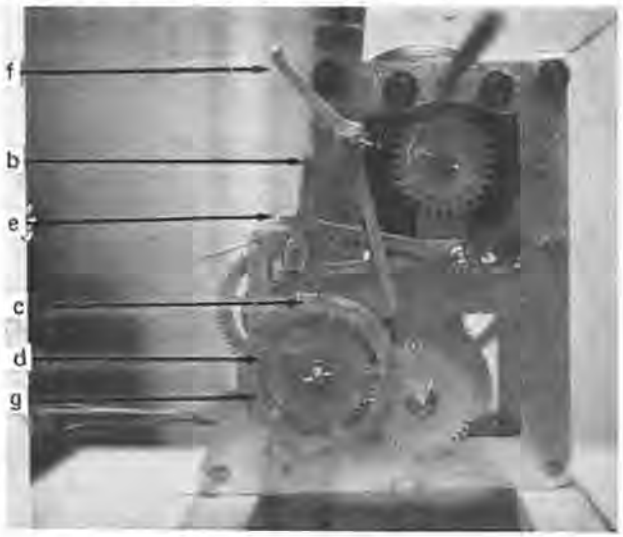


Figure 1.

rises each quarter hour, it raises a steel pin "b" on the chime flirt, Figure 1. This pin is shown as a dot in the figure. After this pin is raised, the chime warning sequence commences. When the steel pin rises, it also allows a brass locking piece "c" to lift from a slot in the chime wheel "d." Figure 1. In addition, at the same time as the steel pin is raised by the lever "a," a brass arm "e" of the chime flirt moves to arrest a fine trip wire on the chime fan arbor.

Up to this point, the chime warning sequence is complete.

The chime sequence now commences. It begins as soon as the lever "a" trip wire falls down under the tension of its helical spring. When this lever falls, the steel pin "b" on the chime flirt also falls, under gravity, clearing the fan

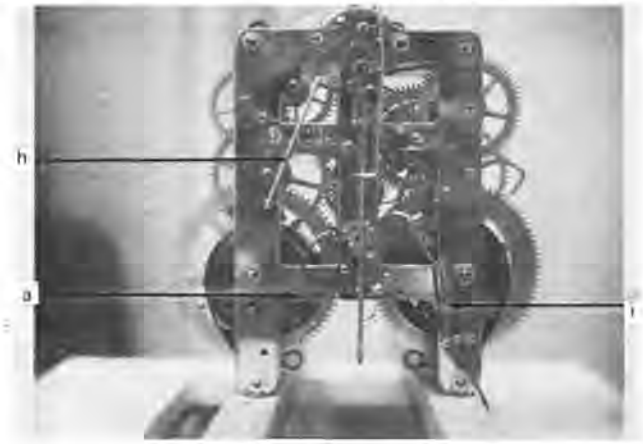


Figure 2.

arrest. The chime now commences. The chime is called "Sonora," its hammers (left, Figure 1) striking upon four round steel banked bells.

The hour strike is performed when the toe of the hour strike lever, or flirt "f" (top left, Figure 1) is pulled to one side at the hour. This is accomplished by the movement of a single steel pin "g" mounted on the face of the chime wheel. As the lever "f" is pushed to one side, the strike warning occurs. At a point in its travel, lever "f" pushes against a steel lever "H," Figure 2, and this is arranged to occur after the last quarter hour chime sequence is completed. At this point, the strike is ready to occur. Also at the point in question, the lever "f" will have cleared the steel pin on the chime wheel and the brass locking piece "c" will fall into a slot in

the chime wheel. When this sequence is completed, the lever "h" returns to its normal position, freeing the hour strike. As the strike occurs, a steel count hook operates against the teeth and recessed slots in the count wheel (right, Figure 2) in the usual manner for American striking clock mechanisms. The hour strike hammer arm "i" operates against one only of the steel bells.

Correction and new information on previous articles. In our article on the English Skeleton Clock, page 21 of the *Horological Times*, November 1977, the barrel hook drawing and the fusee hook drawing are marked in reverse. The hook with the "gaff" on the end is the one which anchors to the barrel.

More information regarding F. Kroeber (ref. our article on the 8-day F. Kroeber Clock, circa 1875, *Horological Times*, October 1977). From Henry Fried, we have the information that Florence Kroeber was a *he*. His son, Alfred, was the dean of American anthropologists. Florence was born in 1840 and had three other children. His business was first in New York City. He was most noted for his novelty clocks: swinging doll clocks, conical pendulum clocks, and animated clocks. He used some Seth Thomas movements, but had numerous patents of his own. □

REGISTERED MAIL FEES SCHEDULED TO INCREASE

The fees for registering mail—a service which provides evidence of mailing and indemnity case of loss or theft—are currently scheduled to rise by as much as 57%, probably starting in the Spring of 1978. Current rate for registering items valued at under $100 is $2.30, which would increase to $3.30 according to the proposal now before the Postal Rate Commission. The increase is a little more moderate for more valuable items, with registration fees for a $10,000 piece going up from $6.20 to $8.50. Unless the Commission acts with unexpected haste, the hike won't become effective until April or May. RJA will be filing a protest to the proposed rate hike with the Postal Rate Commission.

(From the RJA Bulletin.)

escapement module barrel arbor pendulum balance staff quartz crystal verge chimes main wheel ratio hairspring potence push button crystal capacitor crown diode stepping motor fuzee mainspring transistor frequency lathe condenser staking tool capacitor trimmer suspension spring light emitting diode detached lever repeater liquid crystal loupe tweezers attraction friction buff amplitude poise endshake resistor analogue stop works gear lubrication calendar torque

Questions and Answers

by Henry B. Fried

CMW CMC FBHI

SAW TOOTH CLOCK

Q. Let me start by expressing my interest and appreciation for your department every month. I write this inquiry for all the repairmen who have ever worked on a "saw clock." These are manufactured by "Gebruder Allgaier" and marketed in this country under the name of "Selva" among others.

The clock consists of a single train, pin pallet type escapement. It is powered by the weight of the heavy movement housing as gravity pulls it down the rack. The point at which these differ from most pin pallet clocks is in the arrangement of the pallets, fork, and pendulum. As you can see from the enclosed photo the pallets are pressed into a flat disc with a slot at its top. A wire extends down from the pendulum arbor into the slot in the disc. It appears, from the

shape of the escape wheel teeth, to have been designed as a detached escapement. If it is adjusted as such, with the wire from the pendulum arbor in proper engagement in the disc, it runs no better than it does with very deep engagement. (Which is intermittently.) I have taken great care to put them exactly in beat, "equalize the drop," and to insure safe locking, but even after repairing dozens of these, they are all marginal runners, with little overswing. Any insight you can give as to how they should be properly adjusted would be greatly appreciated.

David Arnold
St. Charles, Illinois

A. Thank you for your kind remarks which are appreciated. As to the clock: these are referred to as Sageruhr or as you know, in German, saw(tooth) clocks. They get their name, not from the escapement but rather from the rack upon which the clock descends to provide its own weight to the pinion upon the clock which supplies the power.

As for the escapement, this pinwheel type is a modification of the drum escapement used in the short pendulum Viennese zappler or plate clocks or miniature clocks. I have both in my collection. The span of the pallets, whether they be pins or the recoil type of anchor, is rather short with spanning few teeth. This provides a wide arc to the clock's pendulum and insures that it will run even with the slight disturbances of descending on the rack.

As to adjusting these, I lean towards a rather deep pallet engagement. Recently, I had to make a small potence for the Viennese zappler and I made it so that the depthing could be adjusted. I found the best motion with a deep engagement. As for commercial repairs, I too favor the deep engagement because with the wearing of pivot holes due to excessive weight of the gravity feed movement, wear will result, but with the deeper locking, it will run just that much longer before it finally needs rebushing.

I appreciate your hints and will pass them on to our readers.

Screws

Q. Can you send me and/or give me reference to a list of all the small screws used in clocks and watches, both of American and European origins. I would like all the information on them available as to system of measurement, thread count per length, diameter (however designated), and cross references if such exists and English and/or metric measurements.

Screw sizes have been the greatest item of my disorganization and I would like to have these catalogued and as readily available as jewels or bushings. Do you know of a source where I can obtain these screws individually and NOT in some assortment.

Can you give me the formulae of a non-aqueous clock cleaning solution–preferably ammoniated?

Leon L. Brown, Jr.
Lewisville, Texas

A. The best reference for small screws is in Louis and Samuel Levin's book, Practical Benchwork for Horologists. *There are 9 pages devoted to tables of screw sizes, pitch, etc. These*

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include metric equivalents of drills for tapping, etc., double depth of screw threads, pendant tap sizes, crown taps and sizes, tap drills for watch screw taps for Elgin, the Elgin threads per inch for both right and left threads, the same for Waltham, and a section on thread cutting, both for inches and millimeters.

I believe that Bergeon does sell metric screw assortments or if ordered in quantities, individual sizes. Also, screwplates and screw dies can be had in metric measurements from Bergeon. Their catalog shows individual sizes available by diameter and length but I note nothing less than 1.0 mm in thickness. However, they do show various individual assortments of all types of screws but again, these are assortments. There is very little else available on screws. My own book, Bench Practices for Watch and Clockmakers, *deals with the making of screws, etc., but does not give tables.*

We must beg off on a non-aqueous solution. We just don't know one. Commercially prepared clock cleaning solutions are mostly proprietary things. Ones we have used and know best are the water-based solutions. However, I'll ask around about a non-aqueous formula.

Valjoux 72

Q. I have a 13L Girard perregaux 72 Valjoux chronograph and need help. I hope a technical bulletin is available that you can send me, one showing sequence of reassembly or exploded view. Any help will be gratefully accepted. Many thanks.

Ed Ghidoni
Anna Maria, Florida

A. A detailed step-by-step book on the repair, adjustment and assembly of this calibre is available from the lending library of AWI. The GP72 is a Valjoux Cal. 72 chronograph. This is detailed as explained in volume 21 of the Esembl-O-Graf Chronograph Guide.

Ship's Chronometer

Q. I have a Waltham ship's chronometer in a gimballed box. It is on F day wind with mainspring winding indicator.

It is known that Hamilton made chronometers for the U.S. Navy during WWII. Elgin made trial chronometers, number not known, to obtain a Navy production contract. What about the Waltham chronometer? When did they make them? How many were made? Is it a production run? Or a trial run? Whose design is it? Hamilton?

I would like to know the story about this. I believe prior to WWII, the U.S. did not produce any chronometers—during the war, a crash program by the U.S. Navy was instituted to produce chronometers for our expanded Merchant Marine and U.S. Navy ships. Any reference material on this subject is of interest.

A.W. DePrisco
Cleveland, Ohio

A. The Waltham ship's chronometer was a bit different from those made by Hamilton and Elgin.

The Waltham boxed watches were actually very well made eight-day movements, highly jeweled with an up-and-down indicator. Literally thousands were made from the first eight-day model; a fifteen jewel is listed as being number 18124001 and two runs of these were made consecutively then to number 18125000, an open-faced model and the date is 1910. Many thousands were made later as auto clocks, deck clocks, etc. The first with winding indicator, 15 jewel was in the same year (1910) with 2000 of these, and another 1500 made two years later, followed by others without the winding indicator, using but seven jewels. Some seven jewels also used the winding indicator. The first labeled as "chronometer" also had 15 jewels with winding indicator and was made in 1914 with a run of 1000. In 1926, the 8-day model was changed a bit and was used much in traveling clocks, but from outward appearances was similar to the earlier models. The last marked "chronometer" was a 15 jewel, also an 8-day (1926 model), numbered 28924500, one of 500 such clocks. The first 8-day CDIA 8-day clocks were produced in September, about the 25th, in 1941. The last altogether was made in 1953 as a special aircraft. The last of the 37 size 8-day models was made in 1942, number 31894000. All after that were 22 size clocks.

These were lever watches and again not detent escapement models as were Hamilton and Elgin. Elgin made about 200, but I understand, these were never used by the Navy. Manuals for the Hamilton chronometer repair are available from the AWI library. None exists for Elgin. I do not have the figures for Hamilton's production which was considerable. The series on the ship's chronometer which is being presented in Horological Times *by Marvin Whitney will also answer other questions on this topic.*

Burwood

Q. I am in need of some information which I hope you can provide. I have a battery-operated clock for the wall, made of plastic, with a perpetual calendar on it. The name Burwood is the only identification. It is made in the USA.

Can you supply the name and address of the manufacturer so that I can contact him concerning the purchase of several of them?

Norm Hempel
Mesa, Arizona

Q. For your Burwood parts, try Burwood Prod. Co., 6601 N. Lincoln Avenue, Chicago, Illinois 60645, or the same company at 41 Madison Avenue, 8th Fl., New York, New York 10036.

McClintock Clock

Q. I just received the November issue of *Horological Times* and was extremely interested in the article about a McClintock clock and chimes by Mr. Hagans. I was just recently approached by a salvage firm to restore a clock they had removed from an old bank building. It was a 4-dial O.B. McClintock with chimes. I had never seen one before and was at a complete loss as to how it worked. Of course, it did not take me long to figure that what I was viewing was a slave unit with stepping motors to drive the hands and electromagnetic solenoids to operate the chime hammers. I asked to see the master clock and was advised if there had been one, it must

have gone down with the building. That is where my trouble really started, as they still wanted it "fixed," and as they put it, "can't you rig up something?".

The wiring diagram on page 24 of the *Horological Times* did not come out very well and I am unable to read any of the printed material. Could you please supply me with a readable copy of this diagram along with any other technical information available regarding this clock, such as the voltage used for the solenoids and stepping motors? What type of mechanism impulsed the slave unit and how did it work? The photos of the master clock were at such an angle that I cannot determine how the lower section might operate.

The biggest question I have, since I doubt a replacement master clock unit could ever be located, is whether any of your staff would have any idea what could be used as a substitute. Any and all information will be greatly appreciated.

Herbert J. Horn
Danville, Arkansas

A. Yes, you no doubt have a McClintock 4-dial slave clock and chimes, which is easily understood. The master clock and chimes operated on dry batteries, 12 and 24 v DC. I installed a step-down transformer in order to eliminate batteries and, of course, if current is interrupted, the clock will stop, but for display only, we are not using the alarm system.

As to the wiring layout, this is all on back of the clock case. True, the drawing is poor, but it is old and hard to reproduce without redrawing entirely.

It is remotely possible that you could acquire a master clock from Mr. Charles M. Stevenson, President, General Bank Equipment Co., 5601 Newland Way, Arvada, CO 80002. His company has serviced many of such alarm and time systems. I suggest you write to him and explain your needs. He is a very cooperative person and his company services many banks and large businesses.

He might even be able to tell you how to adapt a chiming setup by use of electronics.

Please bear in mind that Mr. Stevenson is in business

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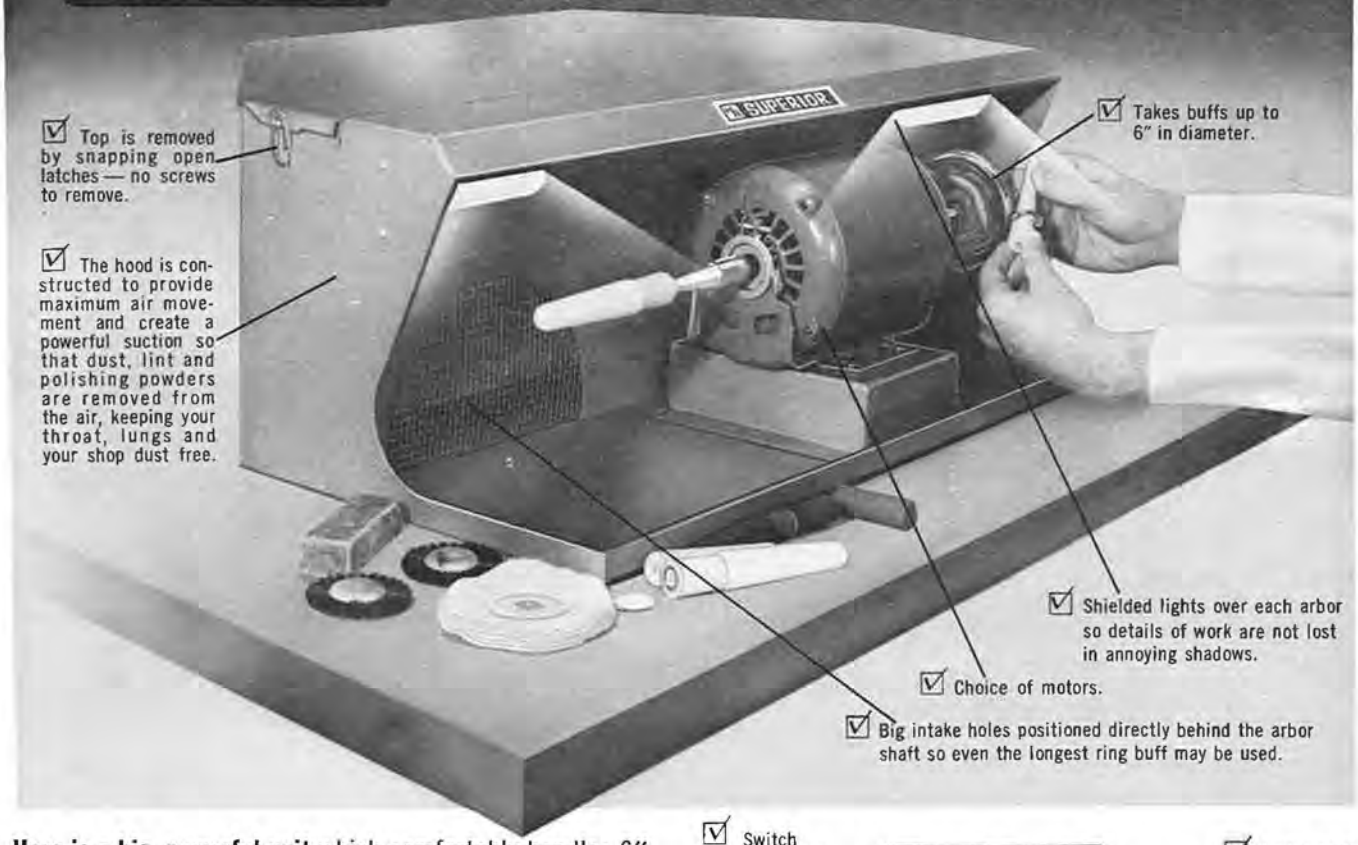

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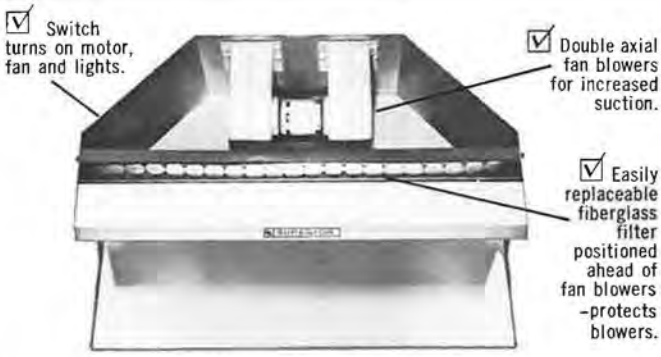

Inside View of Dust Collector

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and you must expect to compensate him and his staff for time given you, so ask for an estimate before proceeding.
(Answer provided by Orville R. Hagans).

Rabbi?

Q. Enclosed are two photos of an improved version of a "Rabbi" that I thought I would like to share with you. It has

always bothered me that the relationship of the triangle would change as the unit was tilted into a larger pivot hole. By having a depth adjustment on the main leg, you can maintain exact centers no matter what the pivot hole sizes. This

"Rabbi" was made with available materials, and therefore somewhat crude, but when I have need for it, it does the job well.

Fred Bausch
San Carlos, California

A. Many thanks for the photos. I like your idea; of course best that you call it a rabbi–I've heard it called a "preacher" so often–it's about time they spread the assignments around.

The idea of the adjustable leg is good since at times one spot may be in a depressed area or lower level.

Turnabout about Finials

Q. Regarding the question from R. Evola of Flushing on page 39 of the November issue of *Horological Times.* Wood finials are something I use very often, so here is some information.

The Antique Nook, 6226 Waterloo Road, Atwater, Ohio 42201, has a fine assortment. They also make custom finials to order. Also, R & M Imports, 109 W. Orchard Street, Itasca, Illinois 60143, makes a good line of finials. Hope this helps.

Leonard J. Schiff, M.D.
Plattsburgh, New York

A. Thanks for the information. I know that many of our readers will enjoy learning about this availability.

Mainspring Manufacturer

Q. I have a Simplex Time Clock (a Seth Thomas movement) which, after overhaul, stops periodically. It went through a fire in our shop a while ago, and sustained some rust. I'd like to replace the mainsprings, but can't obtain them from my supplier. I remember reading somewhere that there is a firm which makes springs, but I can't find them in my literature. Can you help?

I am also rebuilding a Black Forest cuckoo for a customer. It has wooden plates (at some time bushed with brass bushings). I'm curious about how late wooden plates were used so that I can approximate the age of the clock. My customer would appreciate some idea of how old it might be.

Finally, I want to thank you for your responses of the past. It's good to have someone to turn to when we get in a bind.

Phil Strayer
Boulder Creek, California

A. I have made some inquiries for you and was told that mainsprings may be had by simply sending the sample, the dimensions, or the dimensions of the mainspring barrel's insides to Sam Greenglass of J.A. Poltock Co., Inc., 87 Nassau Street, New York, New York 10038.

Black Forest (German) cuckoo clocks with wooden plates were made up to about the middle of the last century. Many also had fusee arrangements within these wooden plates. These, too, would date from the 1820 to 1850 period. Hope this helps, and thank you for your kind words. □

SCHOLASTICALLY SPEAKING

by Gerald G. Jaeger CMW

Chairman, Research and Education Council

1978 looks like a banner year for the Research and Education Council of AWI. Even though the snow is flying and the winds are blowing in the northern climes, plans are being made for a program that will insure maximum participation of our member schools in the annual workshops held in conjunction with the REC Annual Meeting.

The dates, even though tentative at this writing, will be firm at the time of publication. This article is appearing in the March edition of *Horological Times* even though being written in January. The dates for REC are June 19, 20, 21, 22, 1978.

The minutes of the 1977 meeting are in the hands of all instructors who attended the meeting. The makeup of the business meeting and all programs and presentations will be handled via direct mail contact with those being called on to participate. Here I refer to the programs and presentations being conducted using the expertise from within our organization. Contacts have been made and commitments secured from both Watchmakers of Switzerland Information Center through Mr. Jean Pierre Savary, President, and Zantech Inc., through Mr. Louis A. Zanoni, President.

WOSIC will conduct a one-day seminar-type meeting. We will have an update of the new Swiss Calibres, along with presentations which will lead to upgrading classroom instruction. Mr. Jean Pierre Savary, Mr. Francois Giradet, and Mr. Jacques Reymond, all representing WOSIC, will conduct this seminar.

Mr. Louis Zanoni of Zantech will conduct a two-day, hands-on workshop on the repair of solid state watches. Mr. Zanoni will set up work stations which will be supplied with the latest in diagnostic equipment. The instructors will go through Mr. Zanoni's well planned and arranged program on the repair of the solid state watches. The workshop will consist of Phase 1, review of the structure and components of both the LED and LCD modules; Phase 2, methods to test and determine which components have failed; Phase 3, methods to make repairs, which include soldering and desoldering of quartz crystals, switch contacts, etc., and methods of repairing broken wire bonds with conductive silver epoxy; and Phase 4, repair of your problem watches and modules. (Bring along any faulty LED or LCD watches.) I will be in touch with all schools via the mail with complete details on the needed equipment to complete this course.

With this brief description, you can see that we again will have the type of instruction that is transferable to the classroom—this is the mission of REC. I have visited Mr. Zanoni's laboratory and observed his equipment along with demonstrations of his procedure and technique. I can assure you that this will be one fine, instructional program. Mr. George Schlehr, our colleague from Mountain View College of Dallas, recently attended Mr. Zanoni's complete course. George indicated to me that it is an outstanding course and we are indeed fortunate to have both WOSIC and Zantech represented on our program. He said, pardon the pun, "it is extremely timely."

You will recall that much literature and many technical bulletins were distributed by WOSIC at last year's REC meeting. I would suggest you review them all prior to this year's update program. Mr. Zanoni's articles which have been published in *Horological Times* should also be reviewed prior to the REC workshop.

Again, let me remind you to make plans to be in attendance at the 1978 REC meeting in Cincinnati.

Tempus fugit! □

PARIS TEXAS COLLEGE RECEIVES GRANT FOR GEMOLOGY PROGRAM

For a pilot research project in professional gemology, the Texas Education Agency has awarded a grant of $132,335 to Paris Texas College, announces Louis B. Williams, president of the college.

"We are extremely excited over this new program and over the fact that the Texas Education Agency and the State Board of Education have recognized the importance of this training for the national jewelry industry," Williams stated. "The program for training gemologists will give added dimension to the jewelry technology and horology program at the college," he added.

Under the direction of Orlando Paddock, a nationally recognized authority in gemology, the first class started on January 9 with the maximum of 20 students enrolled. Assisting Paddock as an instructor is Malcolm D. Heuser, a 1973 graduate of the Gemological Institute of America.

The next class to begin in September is filled to capacity, and the third class, set for January of 1979, is filling fast. Classes will be scheduled on a continual basis, and inquiries may be made to Paul Clayton, chairman of the Division of

Horology, Jewelry Technology and Gemology, Paris Texas College, Paris, Texas 75460.

The pilot project in vocational gemology will prepare graduates for accurate identification, grading, appraisal of gemstones, for use and care of laboratory instruments, for successful merchandising and ethical trade practices, and for craftsmanship in the execution of benchwork.

Barry and Joellyn Laughlin of New Bethlehem, Pennsylvania (seated and standing left), one of two married couples enrolled in the new gemology pilot program at Paris Texas College, receive instruction in gem identification from program instructors, Malcolm Heuser (standing right) and Orlando Paddock. Mr. and Mrs. Laughlin plan to complete the gemology program and then enroll in PTC's jewelry technology program.

Jewelry industry representatives have estimated that fewer than one of 10 independent jewelers have sufficient gemological skills for the proper evaluation of gemstone quality, Paddock explained. Only one proprietary, scientifically-oriented gemology certification program exists, and the national jewelry industry needs other sources for gemological training and development of a business-oriented curriculum in gem evaluation to facilitate intelligent buying and selling.

Dissemination of the results of the project will be conducted, and other institutions and organizations in the nation will have the benefit of this piloting research on which to base similar programs.

In the course, each student has his own station, equipped with microscope, polariscope, refractometer, and dichroscope. Students will use "Gemformation," a primer of precious gems written by Paddock himself, and "Gem Identification" by Richard Liddicoat. Classes will be held for thirteen weeks, six hours per day, five days per week, in the Applied Sciences Center on campus.

Paddock, director and instructor of the project, is a longtime member of the American Gem Society and a 1941 graduate of the Gemological Institute of America. He has more than 35 years experience in independent jewelry management with more than 20 years of that experience related to the precious gem departments of Tilden-Thurber Corp., Providence, Rhode Island; Mermod, Jaccard and King, St. Louis, Missouri; and Everts Jewelers, Dallas, Texas.

A monthly columnist for *Independent Jeweler* magazine, Paddock has taught gemology for the Dallas Health and Science Museum and for the Gemologist Institute of America tutorial groups. He has served as consultant to Paris Junior College in the development of the gemology short courses from which the pilot project evolved.

Heuser, who will assist Paddock as instructor, attended Paris Texas College, the Colorado School of Mines, the University of California at Santa Barbara, and Eastern New Mexico University, in addition to being a graduate in residence of the Gemological Institute of America. A graduate of the Jewelry Technology Program at PTC, he returned to join the faculty of that program in 1974. Prior to that, he was co-owner of the Central Gemological Laboratory in Oklahoma City, Oklahoma. □

AFFILIATE CHAPTER COLUMN

by Willard Blakley CMW

My report to you in this month's issue will be very short, as we have a report from one of our Affiliate Chapters. AWI has given us this space in the *Horological Times,* at our request, so let's take full advantage of it. Our Affiliate Chapter meeting will be here before we know it. If your Chapter has not yet selected a Delegate for this year's meeting, I urge you to do this within the next month. It has been decided that we will try sending in the Affiliate Chapter Reports early this year. The selection of a Delegate is necessary now so that I may have the Affiliate Chapter Reports by April 15. It is really to our advantage to get these reports out early so that we can have a more meaningful Affiliate Chapter meeting.

The membership of the Bay Area Watchmakers Guild of San Francisco, California, wishes to express their thanks to the AWI Officers and staff for the many services they have provided during the establishment of our guild as an affiliate chapter.

The monthly column for chapter news is an excellent conduit for the exchange of information and ideas that will be useful to each and every member of the association. I am sure that each Guild, regardless of geographical or age considerations, recognizes the need for member-oriented continuing educational programs.

At the 1977 convention, chapter delegates asked for space in each issue of the *Horological Times.* This has been provided. They asked for frequent listings of AWI programs available to affiliate chapters. This request has been incorporated. Requests for membership forms to be included in the *Times* were made. Space for these forms has been provided.

The Officers and Directors of AWI have shown that they are responsive and will act without delay to any and all reasonable requests from the membership.

As a delegate and area rep, I feel that they should know what results have been obtained by having granted these requests. I have brought to the attention of the board the importance of naming a delegate soon for this year's convention as well as instructing the delegate in the needed information to prepare a report for a deadline of April 15, 1978. I feel your suggestion has much merit and will produce much better results than did last year's efforts.

The Bay Area Watchmakers Guild has used the Chapter column and News section of the *Times* in four of the last six issues with write-ups of guild functions. These have been "high-lighted" with felt tip markers and the issues passed on to nonmembers of the industry. This will show nonmembers what benefits could be theirs if they joined the AWI and the local Guild. Several membership forms from these issues have been sent in as a result of this action.

Better use of the film, tape, and technical library materials has been due to the more frequent listings of these services. Thanks for the opportunity to express the views of our local group. Keep up the good work.

W. K. Owen
Chairman, Area Rep. BAWG

FLORIDA

A General Guild meeting of the Suncoast Watchmakers Guild was held in November. The technical presentation was a 1-hour program on bench tips by the AWI. The technical

Immediate Past President Dorothy Aderman welcomes Kenneth Heitz to the presidency of the Florida State Watchmakers Association.

(Continued on page 46.)

WE SALUTE
THESE NEW MEMBERS!

ANDRASSI, Donald–Chicago, IL
ANGEL, Del–Harrisonville, MO
ATKINSON, William–Marion, IN
BAKSHI, Vinod K.–Toronto, Ontario
BARNHOUSE, Steve–Eldon, MO
BLANQUART, Gary–Belleville, IL
CAPPER, Arthur G.–Iola, KS
COLLINS, Donald E.–Findlay, OH
CONTRERAS, Eduardo–Clifton, NJ
CRANE, Charles R.–Roswell, NM
DAILEY, John H.–N. Plainfield, NJ
DARR, Donald M.–Berthalto, IL
DAVOLT, L.G.–Grand Island, NE
DeSANTO, Jack–Medford, MA
DIVERS, Robert E.–Roanoke, VA
DUDLEY, Charles G.K.–Sanger, CA
DUNCAN, Charles A.–Edmonds, WA
ESKEW, Ormand W.–Fremont, CA
FARINO, Barry–Woburn, MA
FAUSER, Beverly–Pinedale, CA
FIELDS, Walter R.–E. Fultonham, OH
FONTES, James G.–Maynard, MA
GAAB, Richard–Spokane, WA
GERMANO, Frank V.–Akron, OH
GRAHAM, Robert E.–Dallas, TX
GRAJEDA, Jose–Los Angeles, CA
GREEN, Donald O.–San Jose, CA
HALBROOK, Max B.–Portland, OR
HERNANDEZ, Mac P.–San Antonio, TX
KIRSHENBAUM, Selwyn–Cranston, RI
KNIFE, Brian W.–Mountain Home, ID
KOESTER, Maureen–Quincy, IL
LUTCHE, Lou–Fair Oaks, CA
MALO, Richard L.–St. Petersburg, FL
MARTIN, David S.–Lexington, NC
MARTIN, J.–Orangeburg, SC
MEGGERS, William F., Jr.–Ridgecrest, CA
MENARD, David B.–Whitman, MA
MIELENZ, Richard W.–Port Orchard, WA
MILLER, Louis–Seal Beach, CA
MOJICA, Dogaberto–Trenton, NJ
MONTGOMERY, George M.–Louisville, KY
NIELSEN, Dennis M.–Luck, WI
PARM, York L.–Ayer, MA
PETERS, Donald B.–Allentown, PA
POLLOCK, Harold F.–Dubuque, IA
REBMANN, Edy–St. Croix, VI
RESLER, Alven–Edmonton, Alberta
ROGERS, A.–Manhasset, NY
ROTHSTEIN, Herman B.–New York, NY
SACCHETTI, Candida–Scranton, PA
SAUERHAMMER, L.–Linthicum Heights, MD
SCOTT, E.C.–Louisville, KY
STOKES, Randall W.–Hartsville, SC
SWARTOUT, Hugh–Mobile, AL
THOMAS, Paul J.–Louisville, KY
TOLSON, Norman–Worcester, MA
TUCKER, James–Owensboro, KY
UMBERGER, Richard W.–Yakima, WA
WANGERIN, Timothy P.–Kensington, KS
WEBB, Martha E.–Urbana, IL
WEHLING, Nancy–Champaign, IL
WHITMER, Bernie D., Jr.–Central City, KY
WILES, Chris–Lexington, NC
WINNER, Virgil C.–Dayton, OH

DR. UNWALLA TO SPEAK

Dr. Darab B. Unwalla, Professor of Management and Marketing and Director of Executive MBA Programs, Graduate School for Business and Public Administration, Florida Atlantic University, will work on two panels at the WMJDA Annual Convention in Boca Raton, Florida. The convention is being held March 28–April 1.

On Thursday, March 30, there will be a panel discussion on "Management Controls for Small Business." On Saturday, an exciting panel will be presented on "Perpetuation of Business."

Dr. Unwalla is unusually well qualified to help small business people work on their management concerns and is doing some first-hand research with some of the members of WMJDA.

(Continued from page 44)

program for the December meeting was "Watch Repair Problems–Practical Solutions and Answers," conducted by Florida's Technical Program Director, Mr. Harry Warshaw.

NORTH CAROLINA

The NCWA Board of Directors met on January 29 for a regularly scheduled meeting of the Board.

ARIZONA

The Arizona Watchmakers Guild met January 17. At the meeting, Norman Levine spoke on the latest in equipment and technical procedures of Portescap.

NEW JERSEY

The Watchmakers' Association of New Jersey, which meets on the second Tuesday each month, began the new year by using its January meeting to plan programs for 1978.

In February, new products and developments of L&R Mfg. Co. were demonstrated by Tom Lang. The latest products being offered by Portescap U.S. will be demonstrated at the April meeting by Don DeWolf, a long-time Jersey member.

OHIO

The Central Ohio Guild held an organizational meeting at the home of Jim Broughton in December. Elected were Jack St. Cyr, Chairman; Vincent Manion, program chairman; and Howard Opp, secretary-treasurer.

During their meeting in February they studied the LED watch at Don Foltz's Jewelry Store.

The Watchmakers Association of Ohio held a seminar on January 15 in Middletown. Mr. Gerald Jaeger instructed on the New Caliber Swiss Quartz Watch. On the 14th, Jerry Wilson lined up two programs from AWI entitled, "Those Short Pesky Cannon Pinions," and "One Step to Profit."

Jim Broughton is coordinating a trip to Las Vegas for April 20–April 23, and also a Cumberland Lake Boat Trip from August 7 through 11 for the Guild.

ILLINOIS

At the Central Illinois Watchmakers Association meeting on January 19, Wes Door presented a slide presentation entitled, "Production Methods in Watch Repair." New CIWA officers for 1978 include Bernard Smith, Earl Lipp, and Delmar Hancock.

CALIFORNIA

An Evening with Ray-O-Vac was held on January 31 by the Horological Association of California. Led by Mr. Ritchie, Mr. Bockstahler, and Mr. Friesen of Ray-O-Vac, HAC presented an outstanding slide presentation showing the projected growth of the watch and watch battery market.

Recently, members of the Bay Area Watchmakers donated money to a member who had injured his right hand in an accident. Furthermore, the members volunteered to do his bench work until his recovery. New officers for the Guild are President–Harold W. Fryday; 1st Vice Pres.–Burnett Cornwell; 2nd Vice Pres.–Larry Baker; Secretary–Walter R. Hain; and Treasurer–Ed H. Mankinen. Directors include Robert M. Dearmin, George Pain, Fred McIntyre, Don Crosby, Lewis Hitchcock, and Richard Decker.

NEW YORK

Mr. Thomas J. Lange of L&R was the guest speaker at the January 9 meeting of the Horological Society of New York. The theme of his presentation of "Work Smarter Not Harder." A full line of new products from L&R was displayed and demonstrated by Mr. Lange. A question and answer period followed the presentation.

MASSACHUSETTS

M. Martin Sarill was recently elected to the Board of Directors of the Massachusetts Watchmakers Association. At a recent meeting, Al Carucci gave his final report on Ladies Night held at the Saugus Chateau de Ville.

President Charles J. Glavin congratulating M. Martin Sarill, our newest member of the Board of Directors.

The AWI Charter was given to President Charles J. Glavin, with the suggestion that it be given to each succeeding President. Also at the meeting, Mr. Gleason discussed burglar alarm systems from the Sentry Electronic Systems.

SOUTH CAROLINA

The South Carolina Watchmakers Association will hold its seventh annual convention on April 8 and 9 at the Holiday Inn, 630 Assembly Street, Columbia. For further information, contact South Carolina Watchmakers Association, P.O. Box 3028, Charleston, 29407.

PENNSYLVANIA

On January 19 the Watchmakers Association of Pennsylvania held a program on "How to Clean Low Priced Watches at a Profit." The featured speaker was Al Rodibaugh from Western Pennsylvania Horological Institute. Mr. Rodibaugh has developed his own lubricant solution and method for cleaning watches at a fraction of the time of conventional methods. At the meeting, he demonstrated the solution's effectiveness and benefits. ▢

BENCH TIPS

We wish to thank the following watchmakers for sending us this month's Bench Tips, and hope they will save you some time and worry if confronted with these problems.

Tip 1 is from Allan D. Simmons, ARJ Jewelry Company, 509 Colorado Avenue, Pueblo, Colorado 81004. Tips 2, 3, 4, and 5 are from the November 1977 News Bulletin, "Through the Loupe," School of Horology, Quincy, Illinois, and smuggled to the Bench Committee by our good Editor, Hal Herman.

Although we don't completely agree that some of the tips published are the most practical way to cope with a problem, they will undoubtedly cause local debate among the *Horological Times'* readers. We will continue to publish the source of the bench tips and will be glad to print any rebuttal or improvement to the tip we receive—provided it is signed and includes the reader's address.

Fellow watchmakers, we thank you again for taking the time to send us your Bench Tips. Keep them coming and we will print them!

How about all the Guilds and State Editors of news letters putting us on your mailing list so we can print your tips—nationally? The mailing address is Jingle Joe Crooks, 265 North Main Street, Mooresville, North Carolina 28115.

Tip 1: Watchmakers who do any work on antique pocket watches might be interested in the following.

When using an ultrasonic machine to clean cases, many people use a plain ammonia and water solution. Gold-filled (and other non-karat gold material) cases sometimes become plated a purplish blue. It is not always feasible to again buff these clean with rouge.

For filled and other non-karat material, using "lemon scented" rather than straight ammonia will avoid the problem. (I believe it is a brass/ammonia reaction that the lemon scenting avoids, though the specific reasons are unimportant.)

Tip 2: To whiten silver watch dials, lay face up on a flat piece of charcoal. Apply a gentle heat over the whole dial with a blowpipe, so as to heat without warping. Then pickle and rinse. (Editor's note: why not then spray with clear lacquer or clear plastic to prevent tarnishing?)

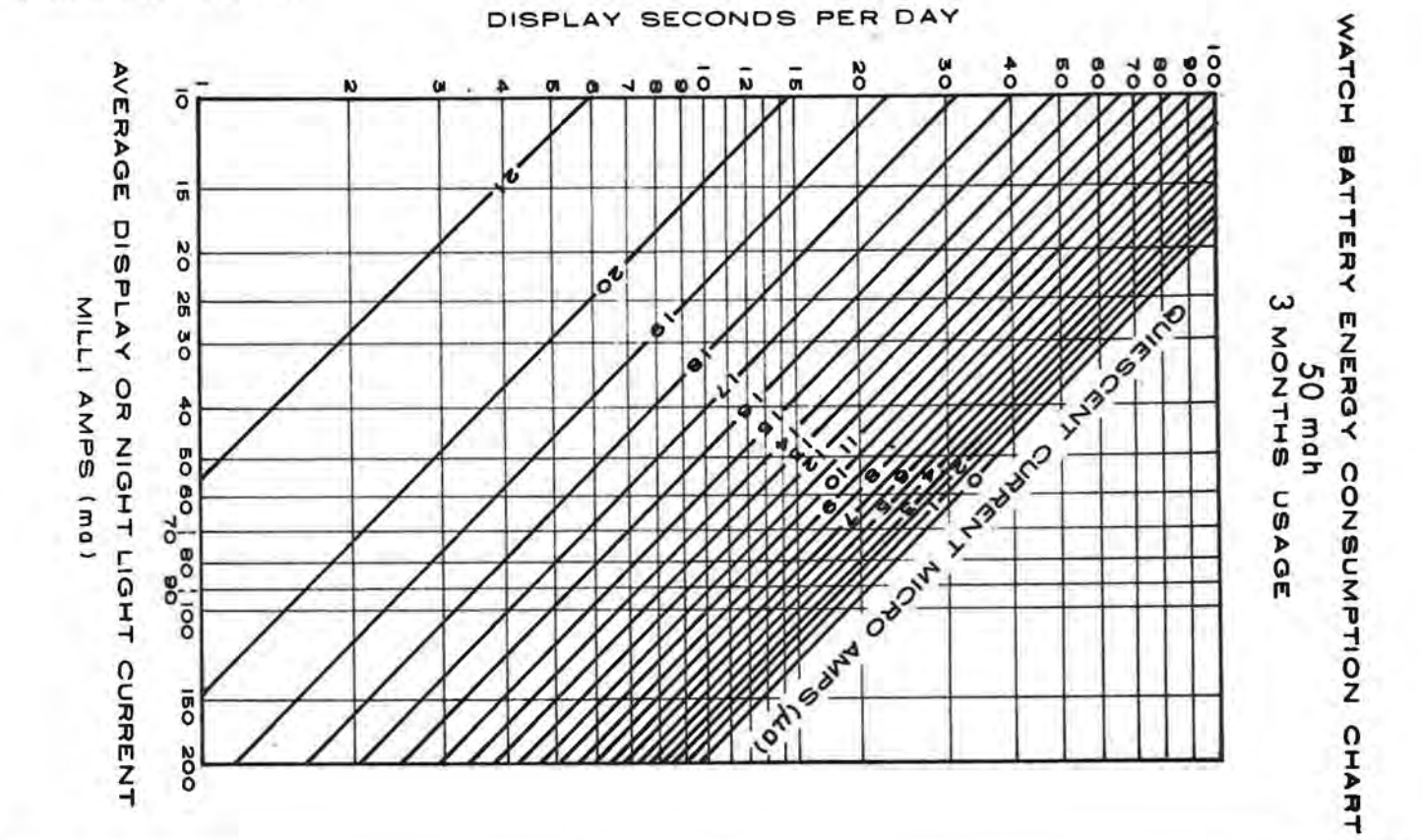
Tip 3: To reblack clock hands, use asphaltum varnish. One coat will make old, rusty hands look like new.

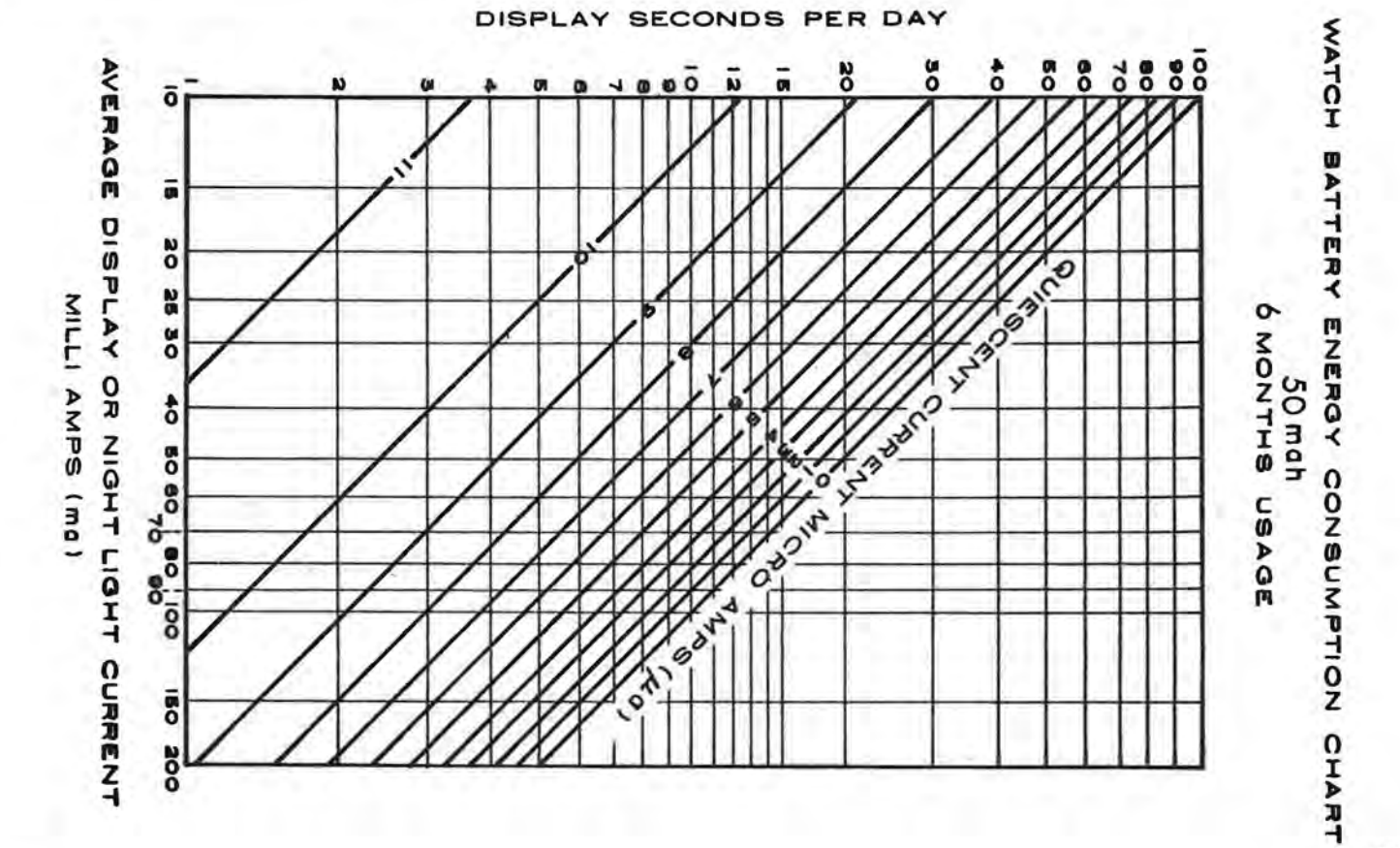
Tip 4: To cut glass round or oval without a cutter, scratch glass around the shape desired with the corner of a file. Then bend a piece of wire the same shape. Heat it red hot and lay it on the scratch. Sink the glass into cold water. It rarely fails to break perfectly true.

Tip 5: To remove marks from gilt clocks, use cyanide potassium (¼ oz.) and water (½ pt.). Clean marks with solution. Scratch brush, and clean with hot water. ▢

HOW LONG WILL A WATCH BATTERY LAST

(Continued from page 14)





□

INSIDE THE CLOCK SHOP

(Continued from page 24)

on the exit pallet and draw on the entry pallet, either a 1/8 inch or a 3/16 inch length of drill rod clamped in a vise will usually be about right in diameter. When the entry pallet shows recoil, as in the upper example in Figure 5, its curvature must be flattened out somewhat. This is done by placing the

Figure 5.

pallet over a length of larger diameter drill rod, about ¼ inch, and tapping with the hammer back a little from the let-off edge.

The bending in both of these cases should take place only toward the let-off edges of the pallets, since that's where the slide takes place. Just a very slight bend is all that's necessary. Test in the movement to see whether recoil or draw has been removed, or very nearly so.

Of course, curving the pallets slightly inward will have the effect of closing the pallets, and they will have to be opened again by bending at the midsection, as described for ordinary adjustments. The center distance may have to be adjusted also.

And when all is adjusted, the pallet pads must be rehardened, tempered to a straw color, and polished.

A lot of trouble for little gain? Perhaps. But I can think of no better way to build a reputation with a customer whose clock has never before kept time.

Next month the shop opens with a new medium—the repair of wooden movement clocks. □

BOOK REVIEW

Evolution of Clockwork, by J. Drummon Robertson. Arlington (Virginia), Arlington Book Co., 1931, reprinted in 1972. 358 pp. $8.95.

For a long time, copies of this scholarly standard work were unavailable and used copies were bringing as high as $100.00. Now this book has been reprinted at a modest price in facsimile reproduction on heavy, light-buff paper compared to the glossy stock of the original. This book's position among the standards of horological literature is due to its scholarly approach to the origins of clockwork, the unbiased presentation of facts concerning the discovery of the pendulum, various escapements, the determination of longitude, the balance spring, and its tracing of the history of famous old clocks.

Yet, this book is prized by many more for its section on Japanese clocks and timetelling, in which it is considered the standard reference. This volume tell the history of Japanese clocks, the complicated methods of simply telling time of day, and examples. As such it is indeed one of the best, if not the best. While Mody's rare volume on Japanese clocks has been reprinted, this book by Robertson explains the ancient methods of telling time in Japan, as well as the nineteenth century evolution into European timetelling methods and the explanation of the many characters found on Japanese clocks.

Illustrated and described in this Japanese section are temple clocks, lantern clocks, table and bracket clocks, stick or "pillar" clocks, drum clocks, rack and pinion gravity clocks, sword clocks, clockwatches, paperweight clocks, fancy clocks, and others.

A third section has 41 pages devoted to a bibliography of over 600 books on timepieces and timetelling, dating from the early 1600's to the twentieth century. This book should have been in every collector's library and at this reprint price it is now affordable.

Reviewed by Henry B. Fried

THE SHIP'S CHRONOMETER

(Continued from page 33)

MAKER Hamilton

SERIAL NO. 16

CONTRACT 85310

CALL NO.

SHIP'S CHRONOMETER TRIAL RECORD

PRNC-NObsy-109

RUNNING TIME 55 +

TRIAL STARTED 7-12-42

TRIAL FINISHED 8-15-42

1ST PERIOD 90° F				3RD PERIOD 55° F				5TH PERIOD 72½° F			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
1	+59.00	—	—	13	+56.00	—	—	24	+65.00	—	—
2	+56.00	-1.00	0.10	14	+57.00	+1.00	0.30	25	+65.00	0.00	0.20
3	+57.00	-1.00	0.10	15	+57.50	+0.50	0.20	26	+65.50	+0.50	0.30
4	+55.50	-1.50	0.40	16	+59.00	+0.50	0.20	27	+66.00	+0.50	0.30
5	+54.50	-1.00	0.10	17	+59.00	+1.00	0.30	28	+66.00	0.00	0.20
6	+53.50	-1.00	0.10	18	+59.50	+0.50	0.20	29	+66.00	0.00	0.20
SUM		-5.50	0.80	SUM		+3.50	1.20	SUM		+1.00	1.20
AVERAGE		-1.10	0.16	AVERAGE		+0.70	0.24	AVERAGE		+0.20	0.24

2ND PERIOD 72½° F				4TH PERIOD 55° F				6TH PERIOD 90° F			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
7	+54.00	—	—	18	+59.50	—	—	30	+65.00	—	—
8	+54.00	0.00	0.10	19	+60.50	+1.00	0.00	31	+64.50	-0.50	0.10
9	+54.00	0.00	0.10	20	+61.50	+1.00	0.00	32	+63.50	-1.00	0.40
10	+54.00	0.00	0.10	21	+62.50	+1.00	0.00	33	+63.00	-0.50	0.10
11	+54.50	+0.50	0.40	22	+63.00	+0.50	0.50	34	+62.50	-0.50	0.10
12	+54.50	0.00	0.10	23	+64.50	+1.50	0.50	35	+62.00	-0.50	0.10
SUM		+0.50	0.80	SUM		+5.00	1.00	SUM		-3.00	0.80
AVERAGE		+0.10	0.16	AVERAGE		+1.00	0.20	AVERAGE		-0.60	0.16

ISOCHRONISM (OPTIONAL)			
DAY	ERROR	RATE	
10	+54.00	—	COMBINE WITH ANY DAY IN PERIODS 2 OR 5 72½° F
12 HR	+54.00	0.00	
11	+54.50	+0.50	
DIF. 12 HR. & ½ 24 HR. RATE		0.25	

PASSED ☐

FAILED ☐

APPROVED

PERFORMANCE	ACTUAL	TOLERANCE
REGULATION:— Largest Average Daily Rate Any Period	1.10	1.55
RATING:— Average Deviation of Rates	0.19	0.50
Largest Dif. Any Two Daily Rates In Same Period	1.50	0.75
TEMPERATURE COMPENSATION:— Dif. Between Average Daily Rates At 90° F (Periods 1 & 6) And 72½° F (Periods 2 & 5)	1.00	0.75
Dif. Between Average Daily Rates At 72½° F (Periods 2 & 5) And 55° F (Periods 3 & 4)	0.70	0.75
Dif. Between Average Daily Rates At 90° F (Periods 1 & 6) And 55° F (Periods 3 & 4)	1.70	1.20
RECOVERY:— Largest Dif. Between Average Rates For Dif. Periods At Same Temp.	0.85	0.70
ISOCHRONISM:— Dif. 12 Hr. And ½ 24 Hr. Rates	0.25	0.50

PRNC-1-34-49-5M

MARINE CHRONOMETER PERFORMANCE TEST

Copy

CHRONOMETER NUMBER: 16

TIMING SPECIFICATIONS: 18C 7d

INSPECTOR: F.M.M.

TEST COMPLETED: JULY 6, 1942

TESTED FOR: U.S. NAVAL OBSERVATORY

TEST STARTED: (0 DAY) JUNE 1, 1942

CHRONOMETER DELIVERED: JULY 7, 1942

PERIOD I 90° F.				PERIOD III 55° F.				PERIOD V 72½ F.			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
1	+59.53	—	—	13	+54.98	—	—	24	+64.75	—	—
2	+58.46	-01.07	.05	14	+55.57	+00.59	.18	25	+65.02	+00.27	.07
3	+57.35	-01.11	.01	15	+56.20	+00.63	.14	26	+65.13	+00.11	.09
4	+56.36	-00.99	.13	16	+57.07	+00.87	.10	27	+65.21	+00.08	.12
5	+55.22	-01.14	.02	17	+57.81	+00.74	.03	28	+65.49	+00.28	.08
6	+53.95	-01.27	.15	18	+58.83	+01.02	.25	29	+65.74	+00.25	.05
SUM		-05.58	.36	SUM		+03.85	.70	SUM		+00.99	.41
MEAN		-01.12	.07	MEAN		+00.77	.14	MEAN		+00.20	.08

PERIOD II 72½° F.				PERIOD IV 55° F.				PERIOD VI 90° F.			
DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.	DAY	ERROR	RATE	DEV.
7	+53.81	—	—	18	+58.83	—	—	30	+65.11	—	—
8	+53.86	+00.05	.04	19	+59.99	+01.16	.05	31	+64.62	-00.49	.09
9	+53.86	+00.00	.09	20	+61.24	+01.25	.14	32	+64.12	-00.50	.08
10	+53.92	+00.06	.03	21	+62.40	+01.16	.05	33	+63.50	-00.62	.04
11	+54.08	+00.16	.08	22	+63.39	+00.99	.13	34	+62.88	-00.62	.04
12	+54.24	+00.16	.08	23	+64.36	+00.98	.13	35	+62.20	-00.68	.10
SUM		+00.43	.30	SUM		+05.53	.70	SUM		-02.91	.35
MEAN		+00.09	.06	MEAN		+01.11	.10	MEAN		-00.58	.07

ISOCHRONISM		
DAY	ERROR	RATE
10	+53.92	—
12 HR.	+53.96	+00.04
11	+54.08	+00.16
DIF. 12 HR & ½ 24 HR. RATE		00.04

COMBINE WITH ANY DAY IN PERIODS II OR V 72½° F.

PASSED ☐

FAILED ☐

APPROVED

PERFORMANCE	ACTUAL	TOLERANCE
REGULATION:— LARGEST MEAN DAILY RATE ANY PERIOD	1.12	1.55
RATING:— MEAN DEVIATION OF RATES	0.09	
LARGEST DIF. ANY TWO DAILY RATES IN SAME PERIOD	0.43	
TEMPERATURE COMPENSATION:— DIF. BETWEEN MEAN DAILY RATES AT 90° F. (PERIODS I & VI) AND 72½° F. (PERIODS II & V)	1.00	
DIF. BETWEEN MEAN DAILY RATES AT 72½° F. (PERIODS II & V) AND 55° F. (PERIODS III & IV)	0.79	
DIF. BETWEEN MEAN DAILY RATES AT 90° F. (PERIODS I & VI) AND 55° F. (PERIODS III & IV)	1.79	1.20
RECOVERY:— LARGEST DIF. BETWEEN MEAN RATES FOR DIFFERENT PERIODS AT SAME TEMP.	0.54	0.70
ISOCHRONISM:— DIF. 12 HR AND ½ 24 HR. RATES	0.04	

NOTE: ALL OBSERVATIONS IN SECONDS: ALL RATES IN SECONDS PER DAY PLUS (+) RATE = GAINING MINUS (—) RATE = LOSING P. O. No. 46292

TESTING LABORATORIES HAMILTON WATCH COMPANY LANCASTER, PENNSYLVANIA, U. S. A.

Figure 6.

are very similar except one. The greatest difference is in the "Largest Difference any Two Daily Rates in Same Period," Hamilton's 0.43 vs the Observatory's 1.50. The Hamilton figure of 0.43 is more representative of the actual error. For when you read by eye, you can only observe seconds and half-seconds, while with the electronic comparator, you are not only following the moving second hand, but the comparator is also picking up the tick of the chronometer. Hence, when the operator synchronizes the two, a more accurate reading is obtained.

Now the chronometer may actually have an error, on a given day, of more or less than a half-second, but the eye is unable to detect it, where the comparator would. For instance, the chronometer may show an error of 0.75 seconds, but since the eye is unable to read other than seconds and half seconds, the observer may read the error as either 0.50 or 1.00 seconds. Since the results of the other performance errors are computed from the mean rather than from the actual observed error as is the case of the "Largest Difference any Two Daily Rates in Same Period," the human error (eye) is not as apparent nor is it as significant as it is in the latter.

Next month's article will discuss production cost figures, National Bureau of Standards, Neuchatel Observatory, and a comparative study between tolerance set by Neuchatel and the U.S. Naval Observatory. □

WILBUR R. CURETON WMJDA MAN OF THE YEAR

Wilbur R. Cureton, President of the Newall Mfg. Co., Chicago, Illinois, will be honored this year at the Watch Material and Jewelry Distributors Association Man of the Year Luncheon. The award luncheon will take place at the Boca Raton Hotel in Boca Raton, Florida on Friday, March 31, 1978. The Man of the Year Award was established to pay tribute to leaders in the industry. This year, for the first time, the luncheon is being held in conjunction with the WMJDA Annual Convention, March 28–April 1.

Cureton, born and raised in the Chicago area, graduated from the University of Illinois with a degree in Business Administration in 1937. He went to work for the Newall Mfg. Co. and in 1943 was drafted into the Army. After 2½ years enlisted service, he received a commission as 2nd Lt. Cureton participated in the Active Army Reserve for 21 years and retired with the rank of Lt. Colonel.


Wilbur R. Cureton

Cureton continued his association with the Newall Mfg. Co. and in 1949 became the Secretary. Since 1958, he has held the position as President of the company.

The Newall Mfg. Co. was an early leader in the industry, making a significant contribution with their fingerprint system, which was a forerunner of the technique used today.

Cureton's family consists of his wife, Frances; two children, and three grandchildren.

Tickets for the luncheon may be obtained from WMJDA, 435 North Michigan Avenue, Chicago, Illinois 60611, Phone (312) 644-0828.

Classified

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HOROLOGICAL TIMES; P. O. Box 11011; Cincinnati, Ohio 45211; (513) 661-3838

THE TRADESMAN

Digital Watch Repair. Specialists in digital watch repair for the trade. Eight years of experience in digital watch design and service. Zantech, Inc., 13 Greentree Rd., Trenton, N.J. 08619 (609) 586-5088.

Clock repair material and tools. Manufacture of clock springs, dials, escape wheels, verge kits, weights, all types of brass and steel stock and custom made parts. Catalog postpaid $1.00. Tani Engineering, Box 338, Atwater, Ohio 44201.

Wheels, pinions, barrels or whatever, repaired or made new, Repivot arbors. On all watch parts, inquire first. Ken-Way Inc., 311 Chestnut St., Addison, Illinois 60101.

Pearl and Bead Restringing. All types. Fast service. Jean A. Gruenig, P.O. Box 12007, Columbus, Ohio 43212.

Johnnies Watch Repair specialized in Accutrons since 1962. CAT No. 2284. One week service. Box 3842 GS, Springfield, Missouri 65804. (417) 744-2082.

FOR SALE

Clockmakers' Buying Guide. New 80-page Second Edition lists over 1000 spare parts and repair services available from over 400 suppliers. $5 postpaid. 30-day satisfaction or refund. Box 171-T, Bronxville, NY 10708.

Brass for barrels, barrel wheels or large blanks. Will cut brass rod to your length from 3/32 dia. to 2½ in. dia. Small orders welcomed. SASE for price list. Ken-Way Inc., 311 Chestnut St., Addison, Illinois 60101.

Unimat 3, Maximat, Emcomat, Sherline Lathes. Precision tools, English or Metric. Aluminum, brass, steel, all shapes. Small screws, taps, drills, saws, collets. 78 page catalog $1.00. Campbell Tools, 1424 Barclay Road, Springfield, Ohio 45505.

Jewelry and Gift Store. Gross $100,000. Excellent watch and jewelry repair. Retiring after 28 years. Stock and fixtures approximately $75,000. Glasow's Jewelry, 507 Third St., Livingston, Ca. 95334.

DIAMONDS–DIRECT FROM CUTTER. Guaranteed highest quality, lowest prices. Send for price list. FL DIAMOND COMPANY, 800 17th Avenue West, Bradenton, FL 33505.

Identification and Price Guide books on clocks and watches. Send large SASE for brochures. Roy Ehrhardt, P.O. Box 9808, Kansas City, MO 64134.

Exciting New 1978 Illustrated 40-Page Clock and Watch Book Catalogue! Contains 300 different titles. Do your own repairs; identify and price your collection. Send $1.00, refundable with purchase, plus bonus! Guaranteed. American Reprints Co. 38, Ironton, Mo. 63650.

ESSEMBL–O–GRAPH LIBRARY in 28 volumes, Pittsburgh, 1955. Chronograph repairing is made easy by Step-by-Step procedure. Each small step of removing and replacing each part and making adjustments is clearly illustrated. No concentrated study is necessary. Write EOG, PO Box 11011, Cincinnati, Ohio 45211.

HELP WANTED

Jeweler–Excellent Opportunity for the Right Person. Must be good craftsman with ability to make-up jewelry and set precious and semi-precious stones, as well as soldering charms and sizing rings. This position requires management ability and offers excellent salary and commission with the opportunity to buy into the business, paid vacation, holidays, sick leave, and group hospitalization. Will help with relocation expenses to Northern Virginia. Send resume: John D. Barlow, Springfield Jewelers, 6611 Springfield Mall, Springfield, Va. 22150.

HOROLOGIST: ENGINEERS–TECHNICIANS –Need persons trained as a horologist to work in product engineering center designing small mechanisms for America's largest manufacturer of battery movements and auto clocks. Ability to invent or innovate essential. Reply in confidence to Harold Anderson, General Time Corporation, P.O. Box 338, Davidson, N.C. 28036.

Watch Repair Department Manager
We have excellent openings for watchmakers who have experience in repairs and estimating and customer contact. Our departments are in the best department stores. Good salary/commission and working conditions. Please send resume and geographic preference to Horological Times, Dept. H-302, P.O. Box 11011, Cincinnati, Ohio 45211. All replies confidential.

Watchmaker or recent graduate needed. All tools and latest equipment furnished. Good working conditions and incentive. Bert Scism Jeweler, 2009 Golfway Drive, St. Charles, Missouri 63301. (314) 723-8180.

Watchmaker for fine Guild Store located in heart of recreation country. Excellent opportunity for right person. Call Freemans 802-773-2792 or write 76 Merchants Row, Rutland, Vt. 05701.

Jewelry craftsman with exceptional talents needed for fine quality AGS store. Custom design experience preferred. Fine working conditions in modern shop. Willing to lease department or guaranteed salary available. Contact W.T. Flora Gems, Decatur, IL, by calling 217/429-4111.

SITUATIONS WANTED

Watchmaker–20 years experience–CAT Certified–AWI member–Central, Kentucky. Write Horological Times, Dept. S301, PO Box 11011, Cincinnati, Ohio 45211.

Joseph Bulova student desires position in watchmaking. Lathe and electronics experience. Write Nicholas Rizzi, 31-15 84th St., Jackson Heights, Queens, New York 11370. (212) 478-9443.

WANTED TO BUY

23 Jewel Pocket Watches wanted for my collection. Send movement serial number, description, and price. Roy Ehrhardt, P.O. Box 9808, Kansas City, MO 64134.

Wanted: American or foreign high grade pocket watches or movements. Will buy individually or in quantity. Describe condition and price. Dick Ziebell, P.O. Box 427, Ipswich, Mass. 01938.

Clock and watch books, clock & watch mfgrs. catalogs, wholesale jewelers' catalogs, books about violins or violin makers, wholesale music catalogs, and other related paper material. Roy Ehrhardt, P.O. Box 9808, Kansas City, MO 64134.

MISCELLANEOUS

Digital Watch Service Training. Zantech, Inc. offers training and instruments for servicing all types of digital watches. Course includes diagnosis of watch malfunctions and repair methods, including techniques in wire bond repairs using silver epoxy. Louis A. Zanoni, Zantech, Inc., 13 Greentree Rd., Trenton, N.J. 08619 (609) 586-5088.

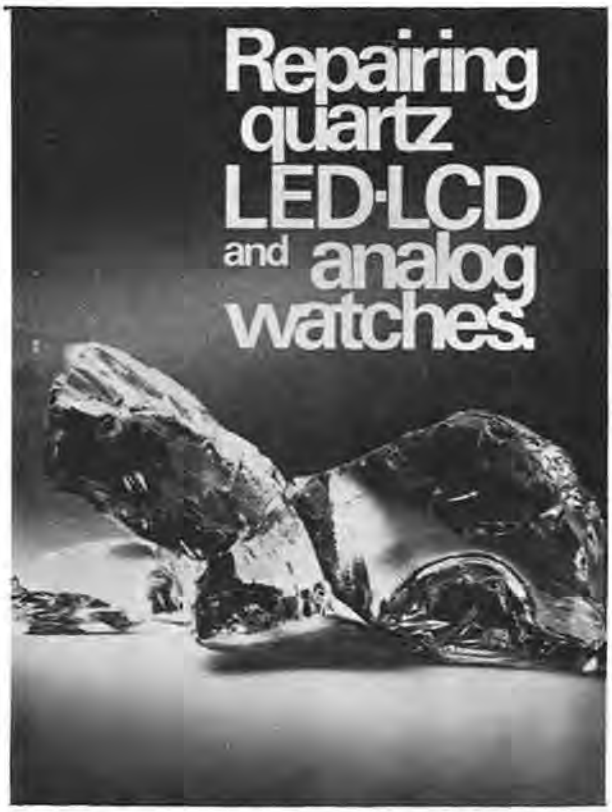
NEW PRODUCTS

REPAIRING QUARTZ LED, LCD, AND ANALOG WATCHES

Eagerly awaited for several months, this new book has just been published. *Repairing Quartz LED, LCD, and Analog Watches* is an indispensable work of reference for the modern watchmaker.

Millions of quartz watches with LED, LCD, or analog display are now sold all over the world. And it is up to the watchmaker to provide after-sales service.

This is the first book that enables him to cope efficiently with all the problems involved in the after-sales



service of quartz watches. It is divided into four main chapters. LED electronic watches, LCD electronic watches, electronic watches with analog display, and testing instruments.

The book provides detailed analysis and expert advice on repairing the main calibres and modules currently employed. It comprises 180 illustrated pages and 300 diagrams, tables, and photographs.

It is published in French, German, English, and Spanish by Scriptar SA, P.O. Box 870 Gare, CH-1001 Lausanne.

FLOW-THROUGH QUARTZ

This lady's Bulova Accutron quartz fashion watch features a white-gold-toned bezel with elegant matching flow-through bracelet and an easy-to-read blue dial with applied silver-tone and white-painted hands and markers. A single aspirin-sized Bulova 247 power cell, retailing for $2.25, assures continuous operation for at least 12 months. In-use accuracy is adjusted at the factory to plus-or-minus 60 seconds a year. Suggested retail is $175. Additional information is available from National Sales Manager, Bulova Watch Company, Inc., Bulova Park, Flushing, New York 11370, (212) 335-6000. □

Calendar

MARCH

4-7—Michigan Gift Show; Lansing, Michigan

5—AWI One Day Digital Watch Repair Training Class; Holiday Inn; Bordentown, New Jersey.

5—AWI ESA LCD & Analog Bench Course; Jerry Jaeger, Instructor; Okmulgee, Oklahoma

5—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Cincinnati, Ohio

5—AWI Introduction to Solid State Repair; Robert Nelson, Instructor; Chicago, Illinois

5—AWI Introduction to Solid State Repair Course; Gene Kelton, Instructor; Gem State Watchmakers Seminar; Berley, Idaho

5-7—Orlando Gift and Decorative Accessories Show; Convention Center/Sheraton Twin Towers Hotel; Orlando, Florida.

5-8—Denver Gift and Jewelry Show; Denver, Colorado

8-19—Trade Fair of the Americas; Expo/Center; Miami, Florida.

11—AWI Citizen LCD Bench Course; Jim Broughton, Instructor; San Diego, California

11-12—Wisconsin Jewelers Association; Mid America Jewelry Show; Princess Olympia; Oconomowoc, Wisconsin

11-12—Missouri Jewelers and Watchmakers Association Convention; Springfield, Missouri

12—AWI Citizen LCD Bench Course; Jim Broughton, Instructor; Phoenix, Arizona

12—AWI Introduction to Solid State Repair Course; Robert Nelson, Instructor; Philadelphia, Pennsylvania

12—Watchmakers Association of Ohio; Diamond Appraisal and Colored Stones; Mansfield, Ohio

12-13—Georgia Retail Jewelers Association; Annual Convention; Century Center Motor Hotel; Atlanta, Georgia

12-13—NBS Seminar; Atlanta Hilton Hotel; Atlanta, Georgia

12-14—Manufacturing Jewelers and Silversmiths of America; Supplier and Equipment Exposition; New York Hilton Hotel; New York, New York

12-15—Southeastern Variety Merchandise Show; Georgia World Congress Center; Atlanta, Georgia.

12-15—Ohio State Gift Show; Columbus, Ohio

12-15—Philadelphia Gift and Jewelry Show; Holiday Inn; Phildelphia, Pennsylvania.

13—AWI Citizen LCD Bench Course; Jim Broughton, Instructor; Albuquerque, New Mexico

14—Watchmakers' Association of New Jersey; regular meeting; Howard Johnson Restaurant; Clark, New Jersey

18—Manufacturing Jewelers and Silversmiths of America; 75th Annual Boston banquet; Sheraton-Boston Hotel; Boston, Massachusetts

18-19—Michigan Jewelers Association Convention and Trade Show; Hyatt Regency Hotel; Dearborn, Michigan

19—AWI One Day Digital Watch Repair Training Class; Holiday Inn; Bordentown, New Jersey

19—AWI ESA LCD and Analog Bench Course; Jerry Jaeger, Instructor; Wichita, Kansas

19—AWI ESA 9157-58 and ESA 9200 Bench Course; Howard Opp, Instructor; Denver, Colorado

19—AWI Citizen LCD Bench Course; Jim Broughton, Instructor; Goldsboro, North Carolina

19—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Mobile, Alabama

19—AWI Seiko Quartz Bench Course; Les Smith, Instructor; Washington, D.C.

19-21—Kentucky Gift Show; Louisville, Kentucky

19-23—Boston Gift Show; John B. Hynes; Veterans Auditorium and Sheraton-Boston Hotel; Boston, Massachusetts

21—Massachusetts Watchmakers Association; regular meeting; Cambridge, Massachusetts

28-April 1—Annual Convention; Watch Material and Jewelry Distributors Association; Boca Raton Hotel; Boca Raton, Florida.

29-31—Manufacturing Jewelers and Silversmiths of America; Suppliers and Equipment Exposition; New York Hilton; New York, New York

31-April 2—Texas Jewelers Association/Texas Watchmakers Association Annual Convention; Kahler Green Oaks Inn; Fort Worth, Texas

APRIL

1-2—MNWRJA Convention, Trade Show and Workshop, Northern Hotel; Billings, Montana

2—AWI Citizen Quartz LCD Bench Course; Jim Broughton, Instructor; Charlotte, North Carolina

2—AWI Introduction to Solid State Repairs Course; Robert Nelson, Instructor; Baltimore, Maryland

2—AWI Seiko Quartz Bench Course; Les Smith, Instructor; Boise, Idaho

2-3—Annual Convention; Alabama RJA; Mountainbrook Sheraton Hotel; Birmingham, Alabama

7—Sunshine Watchmakers Guild; regular meeting

7-11—AGS Conclave; The Fairmont; San Francisco, California

8-9—South Carolina Watchmakers Association; 7th Annual Convention; Holiday Inn; Columbia, South Carolina

9—AWI ESA 9157-58, ESA 9200 Bench Course; Howard Opp, Instructor; Little Rock, Arkansas

9—AWI ESA 9181 Bench Course; Bill Bieberman, Instructor; Salt Lake City, Utah

9—AWI Seiko Quartz Bench Course; Les Smith, Instructor; New York, New York

11-18—United Jewelry Show; Manufacturing Jewelers and Silversmiths of America; Holiday Inn; Providence, Rhode Island

14-16—Wisconsin Licensed Watchmakers Association Annual Convention; AWI ESA LCD and Analog Bench Course; Jerry Jaeger, Instructor; Holiday Inn; Fon du Lac, Wisconsin

15-16—Michigan Watchmaker's Guild 1978 Guild Convention; AWI Citizen Quartz LCD Bench Course; Jim Broughton, Instructor; Doherty Hotel; Clare, Michigan

15-16—Oklahoma RJA Spring Seminar; Lincoln Plaza Forum; Oklahoma City, Oklahoma

15-24—European Watch, Clock, and Jewelry Fair; Basel, Switzerland

16—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Los Angeles, California

17—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Los Angeles, California

19—AWI European Tour; departs from JFK International Airport; arrives in Zurich, Switzerland

19-27—Hanover Fair; The Fairgrounds; Hanover, W. Germany

20-23—Watchmakers Association of Ohio; Las Vegas Trip; leave from Columbus

21-23—Annual Convention; Louisiana RJA; Baton Rouge Hilton Hotel; Baton Rouge, Louisiana

23—Iowa Retail Jewelers Association/Horological Association of Iowa Spring Seminar; Hilton Inn; Des Moines; Iowa

23—AWI ESA 9181 Bench Course; Bill Bierberman, Instructor; Memphis, Tennessee

27-30—Scandinavian Gold and Silver Fair; Bella Center; Copenhagen, Denmark

30—AWI ESA 9157-58, ESA 9200 Bench Course; Howard Opp, Instructor; Atlanta, Georgia

30—AWI ESA 9362 and ETA 940111 and 942711 LCD Bench Course; Jerry Jaeger, Instructor; Portland, Oregon

30—AWI Citizen Quartz LCD Bench Course; Jim Broughton, Instructor; Birmingham, Alabama

30—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Richmond, Virginia

30—AWI Seiko Quartz Bench Course; Les Smith, Instructor; Minneapolis, Minnesota

30-May 2—Orlando Gift and Jewelry Show; Tupperware Convention Center; Orlando, Florida

30-May 2—North Carolina and Virginia RJA Convention; Winston-Salem, North Carolina

30-May 3—Atlanta Jewelry and Fashion Accessories Show; Atlanta, Georgia

Calender

MAY

5-7—Florida Jewelers Association Annual Convention; Sarasota Hyatt House; Sarasota, Florida

7—New Jersey RJA Banquet; Orange, New Jersey

7—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Findlay, Ohio

7—AWI ESA 9362 and ETA 940111 and ESA 942711 Bench Course; Jerry Jaeger, Instructor; Boston, Massachusetts

14—AWI Seiko Quartz Bench Course; Les Smith, Instructor; Chicago, Illinois

21—AWI Bulova SMQ Bench Course; Calvin Sustachek, Instructor; Denver, Colorado

28—AWI ESA 9362 and ETA 940111 and ESA 942711 Bench Course; Jerry Jaeger, Instructor; Rochester, New York

JUNE

18-20—Birmingham Gift and Jewelry Show; Civic Center; Birmingham, Alabama

JULY

9-12—SJTA Souther Jewelry and Gift Fall Show; Hyatt Regency Hotel; Atlanta, Georgia

15-17—Great Lakes Jewelry Exposition; Chicago, Illinois

22-26—Retail Jewelers of America Fall International Jewelry Trade Fair and Convention; Americana and New York Hilton Hotels; New York, New York

23-27—Atlanta National Gift Show; Georgia World Congress Center and Merchandise Mart; Atlanta, Georgia

ADVERTISERS INDEX

Introducing The Incredible Portescap Vibrograf M-80 Digital Quartz Analyzer!

"THE ULTIMATE TIMER FOR TESTING ELECTRONIC AND ELECTRIC WATCHES."

The Vibrograf M-80 is an excellent investment. Its technology is so far advanced that it is at the outer limits of the state of the art of testing watches today.

Its accuracy is many times greater than that of the most sophisticated quartz watches now being made. (M-80 crystal standard oscillates over 8 million times per second to give the M-80 astonishing accuracy.)

Yet its push button efficiency and easily readable display screen make it amazingly simple for you or any of your personnel to operate.

sec/day

IT'S THIS EASY!

Press the matching button on the "M-80" for the type of watch or clock to be measured. Position the watch on the unique microphone holder. Check the display screen to determine the plus or minus rate in seconds per day. The "M-80" is capable of measuring errors as small as 1/100th (.01) of a second per day for all quartz watches.

TESTS ALL KNOWN FREQUENCIES OF WATCHES.

Measures the accuracy of quartz base movements employing digital LED or LCD displays, with analog stepper motor (SMQ) or tuning fork. Tests the accuracy of all tuning fork and conventional balance wheel watches as well.

UNIQUE MICROPHONE HOLDER ELIMINATES SPECIAL PROBES AND ATTACHMENTS.

The Vibrograf "M-80" microphone incorporates capacitive coupling capability for picking up radio signals of quartz crystals. Its inductive coupling capability will monitor the magnetic field produced by the indexing of stepper motors in analog and tuning fork watches. And its acoustic crystal will pick up conventional balance wheel movements.

INTEGRATED SOLID STATE CIRCUITS.

They insure long, trouble-free life, ease and accuracy of operation.

TEMPERATURE COMPENSATED COMPONENTS.

Maintains the Vibrograf "M-80" quartz crystal at precise frequency. The quartz crystal is 8.64 MHZ with a degree of accuracy of $1x10^{-7}$.

A SMALL UNIT FOR A BIG JOB!

The easy-to-care-for Vibrograf "M-80" is conveniently compact. The all-metal cabinet measures only 9½" wide, 4" high, 8½" deep. And for viewing ease, there's a built-in tilt stand.

AN EXCELLENT INVESTMENT!

The "M-80" technology is so far advanced that it will prove to be the only quartz timing machine you'll ever need. Two year guarantee.

Portescap U.S.

VIBROGRAF MACHINE DIVISION

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