Sept 6th Meeting

BULLETIN

DIABLO VALLEY
CHAPTER 107
NAWCC

AUGUST 1991

ISSUE 76

DIABLO VALLEY CHAPTER 107
National Association of Watch and Clock Collectors, Inc

MEETINGS

Chapter: Second Sundays, Even Months, Noon
Evening: First Fridays, Odd Months, 7:30 PM
Board: Second Mondays, Odd Months, 7:30 PM

1991 OFFICERS

President	John Stohr	376-6476
Vice President	Harold Montano	223-7931
Vice President	Bob Wahrer	462-4912
Secretary	Tom Armour	654-3363
Treasurer	Tom Mitch	865-6711
Past President	Steve Fabes	932-5091

DIRECTORS

Glen Armstrong	1990-1991	837-6298
Rick Calicura	1990-1991	228-4992
Shirley Gibson	1990-1991	735-3377
Roy Holman	1991-1992	530-5428
Jack Coulter	1991-1992	254-0746

COMMITTEE CHAIRS

Display	Bob Wahrer	462-4912
Drawing	Harold Montano	223-7931
Library	Sandy Cuthill	686-3144
Mart/S Auction	Ellis Weisker	547-3803
Membership	Steve Fabes	932-5091
Nominating		
Photo	Rick Calicura	228-4992
Program	Harold Montano	223-7931
	Bob Wahrer	462-4912
Refreshments	Bud Ehler	228-5387
	Shirley Gibson	735-3377
Editor	John North	676-9188

Please send material for the bulletin to:
John North
4427 Striped Maple Ct.
Concord, Ca 94521

MEETING INFORMATION

Sunday, August 11, 1991

at

HOME FEDERAL

Tice Valley Road and Rossmoor Parkway
Walnut Creek

Mart Setup 11:30 AM
Mart Begins 12:00 Noon

PROGRAM

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The EAGERLY AWAITED, ONCE A YEAR ONLY

WHITE ELEPHANT AUCTION

Featuring the Inimitable Auctioneers
Bob Prochnow and Wayne De La Roche

Bring your White Elephants
(Horologically Related of Course)
To be auctioned for the Benefit of the Chapter

ALSO
^^^^^^^^^^^^

THE ANNUAL UGLY CLOCK CONTEST
(previous winners not allowed)

AND IN ADDITION
!!!!!!!!!!!!!!!!!!!!!!!!

OUR FAMOUS COOKIE BAKE-OFF

Bring your best home-baked cookies, or those of a friend!

KODAK CAROUSEL SLIDE PROJECTOR

Our new Carousel slide projector worked like a charm at the friday night meeting. THANKS TO HAROLD MONTANO and some of his friends, we now have a new casette player and a rebuilt carousel projector. Out of pocket for the Chapter was only a small repair charge for the carousel. Thanks Harold.

PRESIDENTIAL CITATION

Our Chapter received a NAWCC Presidential Citation at the Denver National. It was brought to us by Frank Specie, who had attended the breakfast where it was awarded. It is an impressive certificate, and I will bring it to the August meeting. I only wish I could tell you why we got it!

John Stohr

CENTERFOLD

This Bulletin has a double first....

The first article in our Bulletin by Richard Tremaine, a retired college professor and new Chapter member.....

The first article prepared as a centerfold so you can post it in your work area for quick use if you wish.

Editor

Richard L. Tremaine
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Lafayette, CA 94549
939-2621

CLOCK EQUATIONS

Most of us do not use mathematics very often so do not even think that mathematics can help. Even if we do, we are a little afraid to derive equations because we are afraid we might not get the right answer. (Believe me, this bothers me too.) I would like to dispell your concern about using mathematics and give you some simple equations that you can use to solve clock problems. These equations also tell you more about how a clock actually works.

The equation for a pendulum is the basic equation for clocks having pendulums. It was probably worked out before they even knew how to make clocks with pendulums, so this equation is not exactly new. All I have done is to modify the basic pendulum equation to fit this part of California and to simplify solving certain problems of the clock repair enthusiast. Although they might look quite different, all the equations given in this article derive directly from the basic equation for a pendulum.

This article covers such things as determining how long a pendulum should be without taking a clock apart, knowing how far to turn the rating nut to correct for an error, how to adjust a clock fairly accurately in 10 or 15 minutes instead of waiting days, and a few interesting observations on gravity.

The basic clock equation

Whether we like it or not, we have to first get into the basic equation for a pendulum. This equation relates the time for one swing of the pendulum to the length of the pendulum. If a pendulum goes back and forth, this is two swings. The time for one swing is the time between two ticks of the clock. We all know that the longer the pendulum, the slower it swings (more time between ticks), but how much slower? The basic equation for a clock having a pendulum is:

$$t = \pi\sqrt{\frac{L}{g}} \quad \text{Eq. 1} \quad \text{or} \quad L = \left(\frac{t}{\pi}\right)^2 g \quad \text{Eq. 2}$$

Where:
- t = time in seconds for one swing (time between ticks)
- π = 3.141593
- L = length in inches
- g = force of gravity in inches per second squared (in this area, g = 385.8023 in/sec^2)

The above are both the same equation. One form tells you if you have a pendulum of a given length, what the time for one swing will be. The other form tells you if you need a pendulum to have a certain time per swing, how long it should be. These equations look a little formidable but we can simplify them for our own use. All we have to do to simplify them is take advantage of the fact that π is a constant and in the Bay Area, gravity (g) is 385.8023 in/sec^2. If we simply substitute these values into the above equations, they become:

$$t = .1599\sqrt{L} \quad \text{Eq. 3} \quad \text{or} \quad L = 39.09t^2 \quad \text{Eq. 4}$$

Now they do not look nearly so bad and you do not have to find out what gravity is in this area or know what π is to use them.

But what does one do with these equations? Two very useful things that you can do are to (1) determine accurately how long the pendulum in a clock should be without taking the clock apart and (2) determine how far you should move the rating nut on the pendulum to correct a known time error.

Determining length of required pendulum
for any clock

This one is simplicity in itslf. First select the pendulum that you will use and put the rating nut in the middle of the rating nut thread. The pendulum should be as long as possible, as long will fit in the case. (Unless the clock manufacturer made a horrible mistake, he had to design the clock so the pendulum would fit inside the case. On second thought, if he had designed the clock so that the pendulum was too long for the case, you would not have the clock because he could not have sold it. It is a pretty safe bet that the correct pendulum will fit into the clock case.)

Next, set the clock to the correct time and write down the time. Now let the clock run for about one day. At the end of about one day, record the time that the clock reads and record the correct time. The correct length of the pendulum for this clock is:

$$L = L_t \left(\frac{T_i}{T_c}\right)^2 \quad \text{(Eq. 5)}$$

Where:
- L = correct length of the pendulum for this clock in inches
- L_t = original length of the pendulum in inches
- T_i = the elapsed time as indicated by the clock in minutes
- T_c = the correct elapsed time in minutes

For use in this equation, L_t is measured accurately enough by measuring from the pivot point to 2/3rds up on the bob.
Shorten the pendulum by the distance $L_t - L$.

If you are interested in how to get this equation, simply note from equation 4 that the length of the pendulum varies as time squared. If you wanted to increase the time by 10% (1.1 times), you would have to increase the length of the pendulum 1.21 times ($1.1^2 = 1.21$). If the clock is running too slow, then the pendulum is too long, so a shorter pendulum, (shorter by $(T_i/T_c)^2$), is required and visa versa.

(A tip. To determine elapsed time, note that there are 1440 minutes in one day. If you use this number then it is only necessary to add to or subtract from 1440 the difference between now and when you set the clock to get the correct and indicated elapsed times. Also, be careful of backlash and paralax. It is best to start and finish when the minute hand is between 25 and 5 minutes before the hour.)

An interesting side light on this method of determining the length of a pendulum is that it is extremely accurate. In this method, you are using a real pendulum. The classical method assumes a theoretical pendulum. A theoretical pendulum has no air resistance, it swings through a very small arc, there is no weight in the rod supporting the bob, the pivot point is at the point of suspension (not just below it), it does not have an escapement (it doesn't need one; it will swing forever), and it has a frictionless support. Fortunately, real pendulums do not know how bad off they are, so they act almost exactly the way a theoretical pendulum would act.

Adjusting a clock

We have all had the experience of adjusting a clock because it is running slow only to have it take off like a house afire and then when we tried to slow it down, it practically stopped. Here is a simple way to determine about how much to move the rating nut to get a clock to make a desired change.

Adjusting a clock to make it run more accurately and determining the correct length of a pendulum are really one and the same thing. The only real difference is that in one case you will probably make a major change in the pendulum length and do not expect the pendulum to be perfect when first installed. In adjusting a clock, you only want to move the bob up or down a very small amount and you now want the change to bring the clock very close to operating correctly, if not right on the correct time. To move the bob a little bit to bring the clock right in, you need to know how far to turn the rating nut to speed up or slow down the clock just enough to make if run one minute per day faster or slower.

This is actually quite easy. First determine the length of the pendulum and the pitch of the rating nut thread. (Length is determined as before. Pitch is the number of turns of the rating nut required to move it one inch. The easiest way to determine pitch is to move the rating nut until the bottom of the nut is exactly 1/2 inch from the end of the thread and then count the number of turns until the bottom of the nut is flush with the end of the thread. This count times two is the pitch.)

To speed up or slow down a clock one minute per day, the equation is:

$$N = .00139\ L\ P \qquad \text{(Eq. 6)}$$

Where: N = Number of turns of the rating nut required to speed up or slow down the clock one minute per day

L = Length of the pendulum in inches
P = Pitch of the rating nut thread in turns per inch

The following are reserved for the perfectionist, but are useful in regulating a tall case clock. If you want to change one minute per week, the equation is:

$$N = .0002\ L\ P$$

To change one second per day, the equation is:

$$N = .00002317\ L\ P$$

For a typical American mantel clock with a 6" pendulum and a pitch of 40, 1/3 of a turn of the nut is about one minute per day.

Length of reauired pendulum using escape wheel

The classic way to determine the length of the required pendulum for a particular clock is to count the number of teeth on the escape wheel and the number of turns the escape wheel makes in one hour. When you do this, what you are really doing is determining the number of swings of the pendulum (the number of ticks) in one hour. Each tooth causes two swings (or ticks), so two times the number of teeth on the escape wheel times the number of turns of the escape wheel in one hour is the number of swings per hour. Knowing this and using equation 4, it is a simple matter to derive the classic equation for the length of a pendulum. The classic equation for this area is:

$$L = \left(\frac{11254}{T\ R}\right)^2 \qquad \text{Eq. 7}$$

Where: L = Length of the pendulum in inches
T = Number of teeth on the escape wheel
R - Number of turns of the escape wheel in one hour

If you look this equation up, you will probably get a very slightly different equation. The "book" equation is:

$$L = \left(\frac{11250}{T\ R}\right)^2$$

The reason for the difference is that the "book" equation was probably worked out in an area south of here where gravity is slightly less than it is here, so they have to use a slightly shorter pendulum than we do to get the same time per swing. However, either is more accurate than you can measure the length of the pendulum anyway.

Adjusting a clock in a hurry

If you want to adjust a clock in a hurry, no way is watching the hands move going to work; you need a much faster way of determining whether the clock is running too fast or too slow. You can do this if you know how fast the pendulum should swing.

As pointed out before, two times the number of teeth on the escape wheel times the number of turns it makes per hour is the number of swings the pendulum should make in one hour. If you know how many swings it should make in one hour, then real quick, you can figure out how many swings it should make in one minute. The number of swings the pendulum should make in one minute is:

$$\text{swings per minute} = \frac{T R}{30} \qquad \text{Eq. 8}$$

If you simply count the number of swings for one minute, you can tell whether the clock is running too fast or too slow. To adjust a clock accurately, it will take more than one minute because you need an accuracy of one part in about 1500 to get an accuracy of one minute per day. If you have a stop watch, you can count the swings for two or three minutes stopping on an exact swing. Divide the swing count by the time in minutes to see if the clock is running too fast or too slow. If the clock has a relatively short pendulum, it is easier to count the swings in one direction only then multiply this count by two to get the number of swings. (More than two or three minutes would be required to set it very accurately, but this will get you pretty close.)

Now that you know whether the clock is running too fast or too slow and how much, you still have a problem and that is how far should you move the rating nut. The number of turns of the rating nut needed to correct the rate at which the pendulum swings is simply:

$$N = \left(\frac{S_a}{S_c}\right)^2 L P \qquad \text{Eq. 9}$$

Where:

N = Number of turns of the rating nut
S_a = actual number of swings in one minute (or 5 min)
S_c = correct number of swings in one minute (or 5 min)
L = length of the pendulum in inches
P = pitch of thread in turns per inch

If this equation looks similar to equations 5 and 6, it should; all three are the same equation. The number of swings per minute (or per 5 min) shows exactly what the indicated elapsed time would be if you ran the clock for one day. The only difference is that in one case the hands of the clock "counted" the number for swings for you and in this case you counted them. (A six inch pendulum in a mantel clock swings 220,592 times in one day so there is an obvious advantage to letting the hands do the counting for you.)

Determining the actual length of any pendulum

I have two pendulums, one of which is physically two inches shorter than the other yet both have exactly the same length as pendulums. If you have an oddly shaped pendulum such as the pendulum in some Morbier clocks, or one with a temperature compensating support, you probably should use the following method for determining the length of a pendulum.

To determine very closely the length of any pendulum, support the pendulum so it can swing freely at the point where it will be supported in a clock. At zero time, start counting the swings. Count the swings as long as you can and note the time when you stopped counting. The equation for the length of any pendulum is:

$$L = 39.09 \left(\frac{60 M}{N} \right)^2 \qquad \text{Eq. } 10$$

Where: L = Length of the pendulum in inches
M = Counting time in minutes
N = Number of swings

The accuracy of this measurement is dependant on the count; the more the merrier. If you mount the pendulum in a clock, this method of measuring the length of a pendulum is very accurate because the effect of all the factors that cause a pendulum to deviate from a theorectical pendulum are included in the count. This will give the correct length of any pendulum regardless of its shape.

A few interesting facts about gravity

Everyone has heard that gravity varies on the surface of the earth and we often hear that astronauts orbiting the earth in space are in zero gravity. (Actually, this is not true. In a space vehicle orbiting the earth every 90 or so minutes, centrifigual force, which is throwing them out, equals the force of gravity, which is pulling them toward earth. Therefore, the net effect is the same as if they were in fact in zero gravity. They are weightless but they are not in zero gravity. If they were to stop orbiting the earth, there would be no centrifigual force so they would fall to earth. Even at 4000 miles above the earth, gravity is still 1/2 what it is on the surface of the earth.) Gravity is greatest at the poles (you are closer to the center of the earth — 13 1/2 miles closer) than it is at the equator.

As equation 1 shows, for a clock to run accurately at different places on the earth, the length of the pendulum must be increased or decreased as gravity increases and decreases. If you did not change the length of a pendulum, a clock that runs perfectly here would run 4 1/2 minutes per day slow at the equator and nine minutes per day fast at the north pole. If you ever manage to take a clock to the moon, be prepared to shorten the pendulum to 1/6th of its length on earth to get it to operate correctly on the moon. If you don't do this one moon hour will be about 2 1/2 earth hours.

If you ever want to know gravity anywhere, the federal government has a department which will tell you exactly (and I do mean exactly) the value of gravity anywhere and they take credit cards ($5.00). But before you call, look up your exact lattitude and longitude to the nearest minute and your elevation, preferably in meters (and have your credit card handy). Your clock will run slower on the top of Mt. Diablo than it does in your home (all of 3/4ths of a second per day slower) so the government really does need to know elevation so they can give you the exact value of gravity. Shortly after giving the government the necessary information, you will receive a computer printout giving you the value of gravity at the location of interest to you. (You might ask them for the "acceleration due to gravity" which is the correct term for gravity so they will think you really do know what you are asking for.)

The classic one second pendulum is generally thought to be one meter (39.37 inches) long. In this area, to get a one second pendulum, the length must be 39.09 inches. To use a true one meter long pendulum to get a one second swing, you would have to be where gravity is 388.57 inches per second squared. This isn't far from the north pole where gravity is approximately 390.6 inches per second squared.

In closing, I hope that these comments have been of interest. If any of you have any questions or a problem that you think might be solved if you knew the equation to use, please ask me. These equations might look complicated or mysterious, but as I said before, they are all simply variations of the basic equation for a pendulum which some long forgotten astronomer worked out long ago. Your comments and questions would be appreciated.

I wish to thank the following who have reviewed this. Their comments helped make this more intelligible and, I hope, more useful.

Roy Holman
Shirley Gibson
Marianne Duncan

DIABLO VALLEY

CHAPTER 107

NAWCC

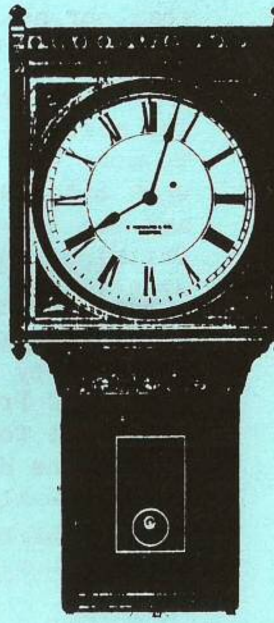
PRESIDENT'S MESSAGE

Past the halfway point; time to think about next year. Did you ever think what would happen to the Chapter without officers or committee members? It's as bad as having a Chapter meeting and no one shows up. Need your help for next year so say you will help and we can fill the good jobs early.

Turnout for the Friday July 12th meeting was 18. We were treated to an excellent presentation by Ellis Weisker on his recent trip to the Willard House in Grafton, Mass., and also saw a Dorothy Glenk slide presentation on "Architecture in Horology". Fortuitously, the two presentations complimented each other and made for a wonderful evening.

Now that everyone is back from Denver, lets have a good turnout for our August 11th meeting. It will be our annual White Elephant Auction and the Ugly Clock Contest. And we'll have the Cookie Bakeoff, so bring in those wonderful cookies you or a friend bake!

See you at the meeting......



The Denver NAWCC National

By Phil Russell

Sarah and I thought you might be interested in a short review of the Denver National meeting in June. There were 2824 members registered, and there were 830 Mart tables at the Denver Holiday Inn.

There were 13 general programs as follows: Horological Art; Auctions and the Market; Dial and Reverse Painting; Engraving and Reverse Painting; Watch mnfring at Waltham; Evolution in Time; Identifying and Appraising Clocks; 1872 Waltham Seminar; A Ramble Thru English Watchmaking; Making a Skeleton Clock; Gold Case Making and Gold Soldering; Morbier Clocks. Sarah and I went to all the programs-and were especially pleased with our member Dorothy Glenk Waldrip program on 'Architecture and the Empire Clock.

The Mart certainly had alot of variety of clocks and watches , parts, books etal. We may have missed something (we usually do) or not up to date on pricing-but saw no low priced sleepers, nor, as mentioned, not much to buy for resale. Black Mantles started around $150, Adamantines over $200, Kitchens over $225 etc,etc. Many sellers we talked to were not pleased with sales, but probably typical.

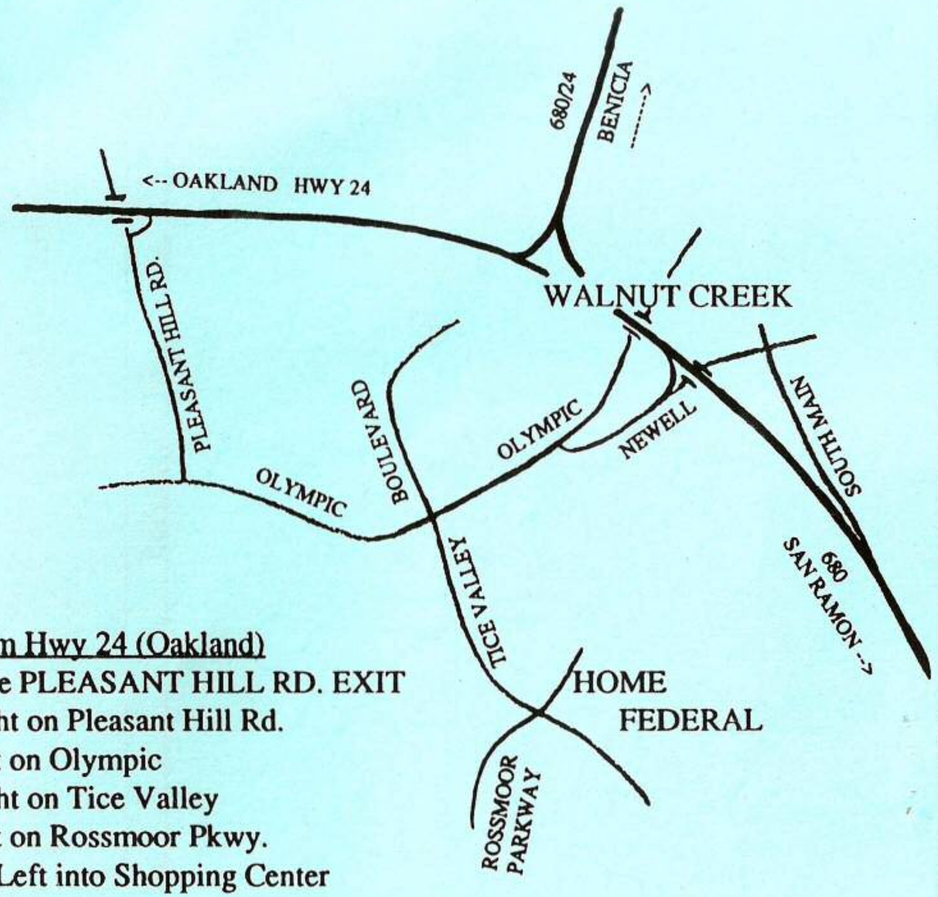
At the Craft competition we were pleased to see that our member Rob MacIver had won 2nd place for his wooden ball clock. It'll be a winner next time.

There was the normal foul-up in transportation to the across town BBQ site-both to and from. Seems 2 buses to move 400 plus people about 20 miles didn't quite work out. Motel locations other than the Holiday Inn and the run-down independent Budget Inn-were not good. Certainly not in walking distance and the shuttle was erratic.

The new and old NAWCC officers were rather conspicious by their absence at the MART (too many meetings?) The NAWCC Promotional booth was nice-met Amy Smith, Editor; Pat Tomes, museum curator, Eileen B. Doudna; also met Arlene Bizlewicz-Membership; and Georgia Barnes, ways & Means.--Also met Tran Duy Ly-Editor Ansonia, S.T. etal

I was very pleased to get a Certificate of Appreciation from NAWCC for my contributions to NAWCC.

DIRECTIONS TO CHAPTER MEETINGS



From Hwy 24 (Oakland)
Take PLEASANT HILL RD. EXIT
Right on Pleasant Hill Rd.
Left on Olympic
Right on Tice Valley
Left on Rossmoor Pkwy.
1st Left into Shopping Center

From Hwy. 680 (San Ramon)
Take SOUTH MAIN EXIT
Left On Newell
Left on Olympic
Left on Tice Valley
Left on Rossmoor Pkwy.
1st Left into Shopping Center

From Hwy 680/24 (Benicia)
Go South on 680 in Walnut Ck.
Take NEWELL EXIT
Right on Newell
Left on Olympic
Left on Tice Valley
Left on Rossmoor Pkwy.
1st Left into Shopping Center

Home Federal is between American Bank & Trust and First Interstate Bank. Meeting Room is at rear.

Annual Chapter Membership $15.00

Guests are most welcome, but due to our tax exempt status, only NAWCC members can participate in the MART.