THE JADE CLOCK

A Project Constructed by Members of the San Francisco Gem & Mineral Society

THE STORY OF
THE JADE CLOCK

By

Helen Stiles Chenoweth and Ted Bhend

The following members planned and carried out the construction of the Jade Clock:

THEODORE H. BHEND
GEORGE RANDOLPH
HENRY H. REINECKE

aided by the following (listed alphabetically)

MORTON J. BACHRACH
PAUL R. BAER
CHARLES E. BISHOP
LEON BURTON
AMBROSE CANZIANI
HELEN S. CHENOWETH
ALDEN CLARK
FRANK CURTIS
CYRUS K. DAM
HUB DAFOE
RALPH DOTTER
MEL DREFKE
J. G. ENNES
WALTER R. EYESTONE
SYDNEY FISHER
E. F. (AL) GRAPES
ROBERT N. HARDENBROOK
VIRGINIA HERING
WALTER HOBBS
RALPH E. JOHNSON
OSCAR H. MERWIN
GEORGIA PAINE
RALPH PAINE
ELROY PETERSON
A. W. QUIMBY

The jade transparency which forms the cover background came from a large jade table belonging to L. J. Bergsten.

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THE JADE CLOCK

By Helen Stiles Chenoweth

SAN FRANCISCO GEM & MINERAL SOCIETY

San Francisco Gem and Mineral Society members are making a jade clock.

Why a jade clock? Time is that precious thing that so many of us waste. Time never stops, never turns back; it is impartial to all of us. We squander it, try to hold it back and yet it passes on to the eternity of yesterday. We cannot make one second of time ourselves and yet we *can* make the instruments with which time is reckoned —clocks!

Time was when the hour was noted by shadows and stars, with sundials, water clocks and hour glasses. The first real clock was made late in the 10th century. In the fabled town of Nuremberg, shortly after the discovery of America, lived Johann Coeuleus who in 1511 wrote: "Every day produces more ingenious inventions. A young man named Peter Henlein creates works that are the admiration of the leading mathematicians, for out of iron he constructs clocks with numerous wheels which, without any impulse and in any position, indicate time for forty hours. and strike."

Wood and the assortment of materials used in making clocks runs the gamut from iron, brass and costlier metals through tortoise shell, rock crystal, ivory, enamelled metals, snake skin and glass, with jewelled embellishments worth a king's ransom. The making of clocks has always meant designs and plans, precision, and many days and years of complicated work. Wood carvers and carpenters, die and tool makers, lapidaries, painters, etchers, and rock buyers, collectors and plain every day rockhounds have been concerned with the making of clocks. Research shows that clocks have been made of many materials by many different people under all sorts of conditions but we have not unearthed one line of information that tells of a group of amateur gem and mineral society members making a clock of jade! This clock of the *San Francisco Gem and Mineral Society* is made of ideas and mathematics, of sweat and tears and some mistakes, from exquisite jade contributed by many people. It is a clock made from history and precious memories and the fine, precise work of many people in the Society. It may well be within the span of our Society's members, *the only jade clock in the world!*

Drawings for clock case by George Randolph (right). Leon Burton (left) made the numerals from Randolph's patterns and Randolph carved the hands. Wooden clock model by Ted Bhend.

PHOTO BY TOM VANO

Two members of the Society put their heads together and planned the jade clock. Alden Clark is Lapidary Vice-President of the Federation and Ted Bhend is former Curator of the San Francisco Society. Our story starts with Bhend and his inspiration for the project. As a boy Ted Bhend remembers his father talking about clock and watch factories in Switzerland. His father was apprenticed for seven years to a clock making factory at a weekly wage of 10 cents. He never received any benefits from this stipend because Ted's grandfather collected his salary. After two years Mr. Bhend decided that he'd learned all they were going to teach him at the factory and he quit. As soon as he was of age he left for America and went to work for the Studebaker Company building buggies. In his spare time he gathered fine woods and materails for inlays and told Ted that he was going to make a grandfather's clock "of great beauty". The idea fascinated the young boy but he waited in vain to see the finished project. Ted's father died, but he left behind him an idea and a hope that stayed with Ted through the years.

Charles Goelz, his mother's brother, born in Oberlinngen, Germany, came to this country at the age of 16. He renewed Ted's interest in clock building. Among many other jobs, Charles Goelz was a carpenter and wood carver. After he retired he had several assets for his hobby, his love of rocks as a miner and his understanding of woods through his carving. He combined his talents and became a builder of clocks with several handsome grandfather clocks and a dozen or so novel clocks to his credit before he died.

He started with a clock plan that he found in a science magazine. The plan was

so inaccurate that before he was half finished making his first clock he was forced to refigure gear sizes and related works and make an entirely new set of directions correcting these faults. This plan was passed on to Ted Bhend, who then made his first all wooden clock. It took 2 years of spare time to make tools and jigs, gather material, and build that first clock and case. The clock ran, but it was a noisy affair and had a variation of time that meant the clock was ten minutes slow or fast each day.

Fortunately, before his enthusiasm was bogged down by these imperfections, Ted Bhend met Sydney Fisher. Sydney was a draftsman-engineer at the Herman Safe Company. He became fascinated with the clock plan and promptly devised a completely new gear system and a more efficient, smoother working tooth design. The usual gear system is 5 and 7 but Syd made all pinions 8 tooth to see if the clock would run, and it did!

The final contribution toward making a good, reliable clock was Syd's design of a dead beat escapement. The dead beat escapement is being used in the jade clock. Ted made 7 complete wooden clocks using Syd's plans.

For material Ted used pin oak for the gears. He explained to me that "the pin oak grows at about 3000′ elevation in the Sierra, on the north side of a hill or in a shady canyon. The whole limb or trunk of a tree is cut in cross sections and 2 holes are bored in the center of each section so that the wood has room to shrink and not crack. It is cut in half inches and it takes about 6 months to dry. This pin oak has a curved or irregular medullary ray which keeps it from cracking or even checking in extremes of temperature.

Ted went on with details about the materials he used because they presented different problems than those that would be encountered in the use of jade. *Yet wood or jade, with this pattern, a clock could be produced that would run and keep time!* "I used mountain mahogany or iron wood for my bearings. This wood is hard and brittle with little expansion in weather extremes," he said. There are 2 wooden clocks in Ted Bhend's house that have been running continually and keeping time for 10 years, an indication that he has licked the problems that wood presents in the making of wooden grandfather clocks. So Ted looked around for new fields of clock making and jade presented the most unusual and toughest challenge.

Early in 1957 Ted Bhend spoke to Alden Clark about jade and a clock. With the persistency of the dreamer whose dream has not entirely materialized, Ted persuaded Alden to consider a project that required so much skill and imagination, so much flawless material and research work, and so many diversified activities that Alden paused to say: "Do you think we can do it?" Being assured by Ted that the work would be a challenge to the Society's many fine workers, both men went ahead wholeheartedly with what promised to be the most unusual undertaking ever promoted by any gem and mineral society.

The course of this jade clock-making would not be a smooth one. There could be no trial and error methods used because everything, being made of jade, must have the perfection of its wooden counterpart in order to keep the jade clock running on time! The list of its parts is a formidable one for it includes two parts of the clock's mechanism, 7 big gears, 6 pinions and 1 ratchet for the time train; 5 large gears, 1 ratchet and 5 pinions for the strike train; 3 hands, hour, minute and second; 2 weights of 10 pounds, pendulum and pendulum rod, 3 spacers, fly or governor, verge on escapement wheel, the gong (part of the strike train), 2 sprockets for the chains, chains, pawl holders, adjustment for the escapement and a carved pediment for the top of the clock.

Ted Bhend and Alden Clark selecting jade for use in making the jade clock. Note patterns for the clock parts on the table.

PHOTO BY TOM VANO

Alden and Ted plunged into the task of rounding up materials and people who could work these materials. The tools and machinery for shaping and carving jade are vastly different from those used in making a wooden clock, and these had to be made before any jade work could be done. The clock principles and dimensions remain the same as the original one, the same as the idea of Ted's father, the plan of his uncle, and the corrected gear system and dead beat escapement design of Sydney Fisher.

While there was some of Jimmy Durante's "everybody wants to get into the act" business at first, and what seemed to be a plethora of workers, Alden Clark, who himself is one of the San Francisco club's fine jade workers, knew those members who could be counted on to do superlative work in jade. Ted Bhend, "father" of the clock idea and plan, with Alden, assigned all volunteers to tasks according to their abilities in designing and working with jade, to make a variety of precision tools and to build special machines as they were needed.

Ted Bhend, who was familiar with the tool and machine work necessary for the jade clock project (having made the model from which the clock was copied), made special machines and supervised the work of others, along with cutting gear teeth on pinions and gears himself.

The roughing out of pieces of jade in-

cluded first the sawing or slabbing, then cutting the slabs to an approximate shape of the pattern and finally perfecting the individual parts.

Ted Bhend, carpenter, Elroy Petersen, warehouseman, and Paul Baer, salesman, designed a machine that was highly complicated and difficult to make because it was used to grind out and perfect the spindles and spacers of the clock. It took more than a week to make the machine. Walter Hobbs did the welding of all parts. Between them, Baer and Petersen are making all spindles for the clock. Hobbs is making the pendulum rod of jade and the "keys" to hold the three sections of the rod together.

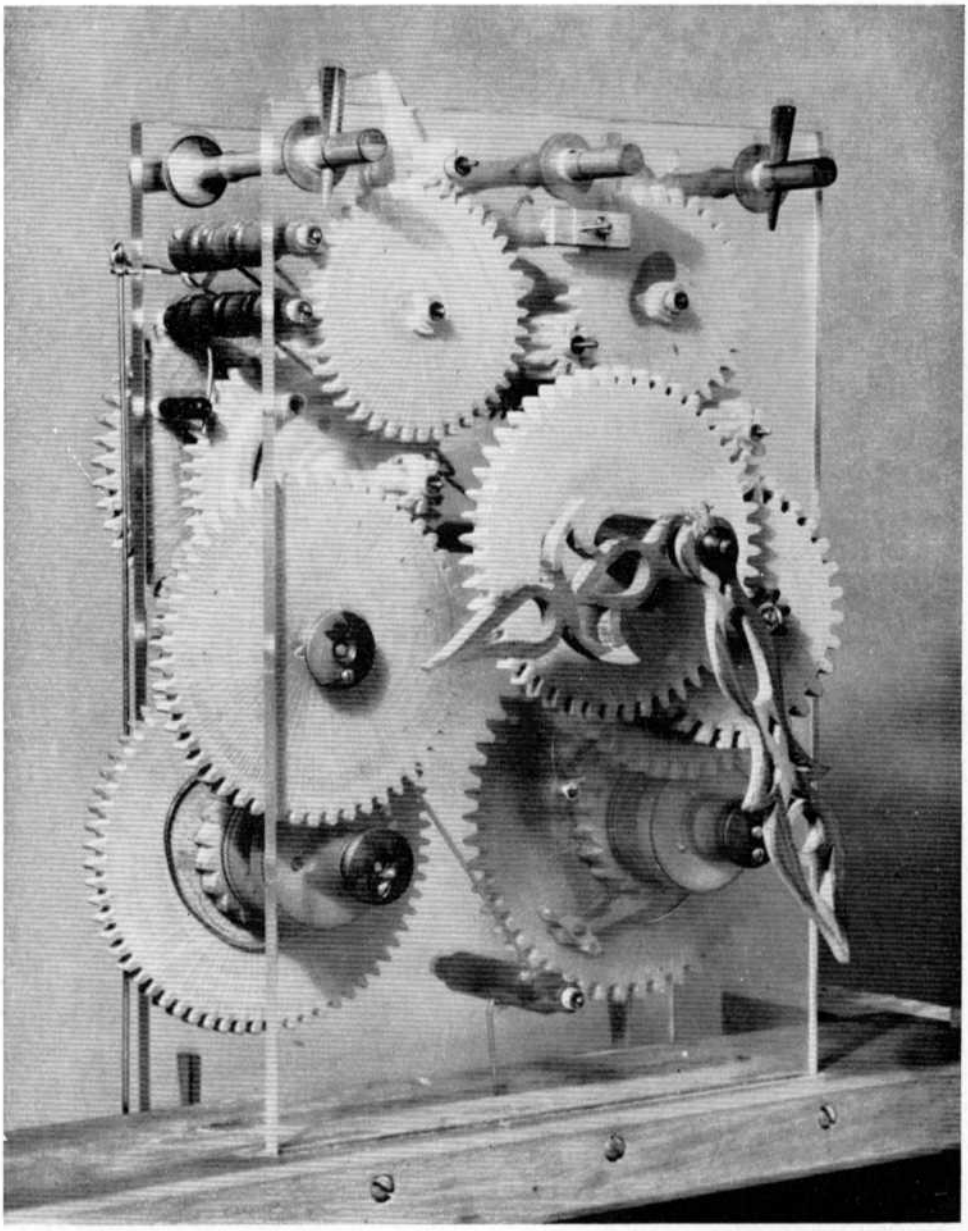
These are mere words about "meticulous," "superlative" workmanship. The evidence is in the machines themselves and the work that is being done. I saw colored slides by Henry Reinecke that presented pictures of the various stages of making the jade clock parts. These slides are gradually being assembled as the work progresses, and will be used later as illustrations of a lecture on the making of a jade clock. Only the pictured intricacies of the machines and tools, the variety of color and types in the jade material, and the earnest, dedicated expressions on the faces of the workers will complete the story when words somehow fail.

A special jig for shaping the pendulum bob was made by Alden Clark. A diamond saw was used for rough-cutting and 75 cuts were made on the radius surface of one side of the bob! Tough, highly resistant jade from Clear Creek, California, is the material, and the spare time and weekends of grinding, sawing and polishing hours are the time elements involved in making one side of the bob. The making of the back, which is a duplication of the front, means about 100 hours devoted to that single project by Clark. In its less than half-finished state a fantastically lovely scene of trees and snow and an ambling creek has emerged on the bob's surface, and the scenic beauty will greatly enhance the interest in that swinging pendulum.

All diamond-impregnated precision tools for drilling holes to size were made by Henry Reinecke, a tool and die maker. He charged all gear hobs with diamonds and has made some very small special tools that will be used in the final hard-to-reach places of the various parts of the clock. He made most of the gear hobs after Frank Kutis, machinist who finished one, switched to making all of the index heads for spacing of the gear teeth.

Carroll Chatham has contributed the emeralds for the jewel parts of the clock and perhaps this is the first time that Chatham emeralds will be found in the sixteen bearings of any clock. These jewels are being drilled by Reinecke, using some of his specially designed tools for the work.

Those who have followed the annual exhibitions of the *San Francisco Gem & Mineral Society* in these past several years are familiar with the perfection of George Randolph's carvings, a variety of animals, fish, and birds that are amazingly realistic, alive, though carved from jasper, rhodonite, agate, crystal and jade. It is his flawless jade work that has earned him the title of "the finest jade carver in the San Francisco society." With more than four hundred members, many of whom have done exquisite work with jade, this



Front view of the wooden clock model. Note the wood rays of the pin oak.
PHOTO BY SIDNEY FISHER

amounts to an "Oscar." George made the patterns for the hands from designs that Ted Bhend's daughter, Virginia Herring, a school teacher, drew for the clock project. George made his own special hand tools to grind out the curves and corners of the lovely hands and the finished job is like gorgeous, fantastic oriental pieces of jewelry that some oriental princess could wear with pride as earrings! Approximately thirty hours were spent on making each hour and minute hand and about eight hours were needed to finish the second hand. Five of these special tools were made of *titanium alumina* because of its hardness and its reliable abrasive action on jade. Following the patterns that George made for the numbers, Leon Berton, retired plumber, carved and polished the numbers 12, 3, 6 and 9. Leon developed a special heat treatment for whalebone that greatly enhanced its appearance for jewelry work.

Ralph Dotter, jeweler, and Oscar Merwin, bank messenger, have been rough grinding all of the gears; Georgia Paine, housewife, and Ralph Paine, civil engineer, have been flat-polishing them. Warren Quimby is doing a sizeable job of slicing jade and Al Grapes, machinist, who has a large saw, has cut forty-five pounds of the tough Clear Creek jade for the pendulum bob and weights. Charles Bishop, electroplater, has made the escapement according the Sydney Fisher plan. *The deadbeat escapement is the "brains of the clock."* Ralph Dotter is making all of the metal parts, the ratchets that control the wheels and the escape adjustments. He is also doing the precision grinding of all the rounds into which Ted Bhend is putting the teeth. Robert Hardenbrook is concerned with grinding the curved surfaces on weights, using a wooden jig devised by Alden Clark.

The clock case was designed and is being made in three sections, of American black walnut by George Randolph. The base on which the clock rests is solid walnut. The center section, where the pendulum swings, will have plain plexiglass on three sides, and walnut on the back panel. The upper part houses the jade works and will have four sides of plexiglass for visibilty and uncomplicated removal of panels from the

top, in case of emergency. The case has been carefully planned around the clock so that all of its working parts are visible.

The project runs with the precision of a clock that keeps perfect time. The unknown factor of how much time is needed to cut and polish each part of the jade works has been no deterrent to progress. Hours have been found, along with materials, workers, and the spirit to complete the making of the first jade clock.

At this time of writing there is no magic in the jade clock for it has not yet started to tick-tock its way to fame. Jade material has been slabbed and cut into necessary pieces. All work has long since been assigned to members of the *San Francisco Gem & Mineral Society*. Work is being done consistently conscientiously and continually. The handsome American walnut clock case is finished down to the four jade spheres that top the cabinet. It took George Randolph seventeen working days of eight hours each to make that piece of perfection, and the hours of shopping for materials were not counted. There are multiples of figures concerned with the jade clock making, but only a single purpose in the minds of Ted Bhend, Alden Clark and all the workers: to have the clock ticking by the opening day of the *Gem and Mineral Society of San Mateo County's* Show for the 20th Annual Convention of the *California Federation of Mineralogical Societies,* June 26, 27, 28 at San Mateo, California. This series of articles has been written to present a picture of specific interest in a hobby, a picture of generosity, faith, ingenuity and unselfish work on the part of human beings who have put aside personal interests to make a jade clock. The dreamer with the idea is Ted Bhend. He has "master-minded" the clock. A running mate with indefatigable energy, with knowledge of talents and willingness among members, is Alden Clark, Vice President of the *California Federation of Mineralogical Societies.* These two men have worked with jade, machines, people . . . and against time. Time has seemed like a bastion that now stands against any prognostication of the day that the clock will be completely finished. This year's threnody will be based on a factor that was unknown until the work was more than half done on the time train of the clock: "We need more time to finish the strike train." (Ted says it will be at least another year before the strike train is done.)

On Ted Bhend's desk was evidence of the generous, thoughtful kind of help that has furthered the work of the jade clock. An old friend of Ted's, Dr. Paul Sikora, a dentist at Columbia, Calif., sent Ted a package of diamond drills and dentist tools, "a few accessories that may be useful in your jade clock work," he wrote.

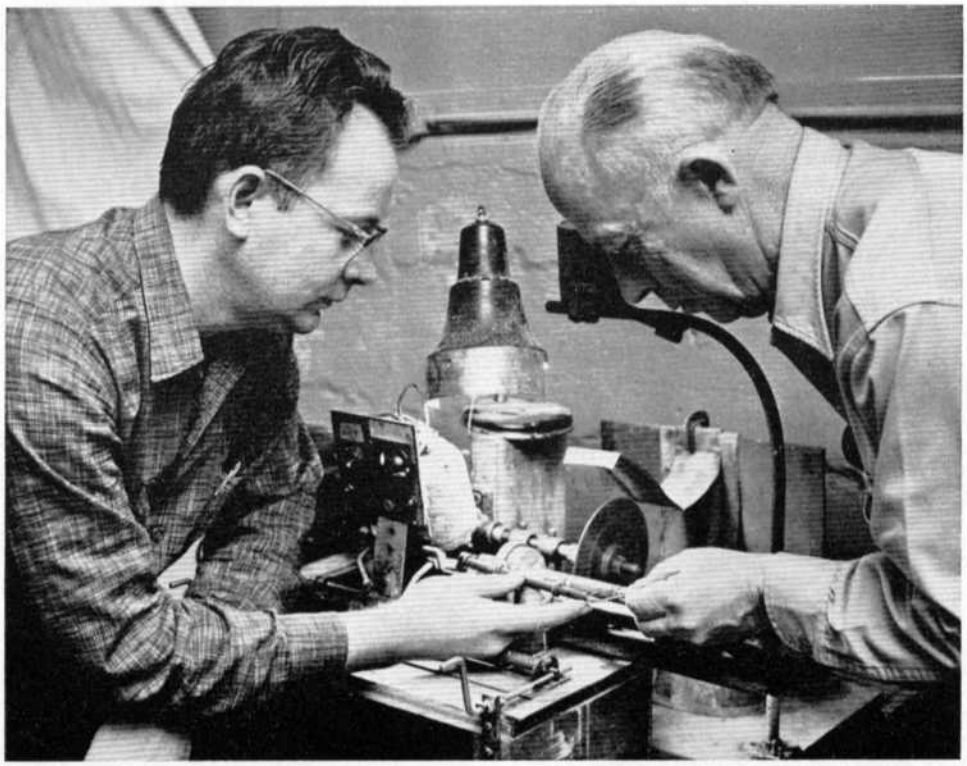
Getting down to the brass tacks of how many pieces of machinery were necessary to make the jade clock, the writer found that actually there were two machines, a gear hob and a lathe, and the fifteen or more supplementary devices used to implement the work were jigs! Fifteen different jigs held a variety of sizes and shapes of jade pieces, all specially designed to insure uniformity in shape and mathematical accuracy in size.

The winding device has a center shaft, a large gear with a pawl, a holder for the pawl and spring, a ratchet gear, and fastened to this, a sprocket, all jade except the spring and pawl holder. The center shaft that drives the hands has four sections. This round shaft has square ends with a hole drilled to hold the minute hand, one fifteen-tooth gear, running free, a sleeve with a forty-eight tooth gear on one end and the hour hand on the other.

The unit that drives the hands has five different diameters on the shaft, each one absolutely accurate. The end ten-pitch eight-tooth pinion gear drives a forty-eight-tooth gear. This same shaft holds the driving gear that turns the hands, a combination thirty-tooth pinion ten-pitch gear with an eight-tooth, twelve-pitch pinion fastened to it. This last combination is used to set the hands.

The escape wheel has a shaft of two diameters with an eight-tooth pinion, twelve-

Ted Bhend and Henry Reinecke using special gear cutting jigs devised by Bhend.
PHOTO BY TOM VANO



Above: Elroy Peterson and Oscar Merwin using lathe for cutting jade shafts. Lathe devised by Peterson and Paul Baer.
PHOTO BY TOM VANO

pitch gear. The escape is a thirty-tooth gear, *all* exact in length, spaced evenly, and *all teeth pointed. If one tooth breaks the wheel is useless.* There is the verge, which intermittently locks the escape wheel to the pendulum; there are the three spacers that hold the clock in position, each shaft with two collars and two tapered holes that have two tapered pins. The center one has a slot from which the pendulum hangs. *These are all jade parts made by the workers on the jade clock.* They are all parts of the time train which include, in addition, eight Chatham emerald bearings, two sides of the plexiglass case with eleven holes drilled in each side, a pendulum rod in three pieces with keys that hold the pieces together, a pendulum bob, a finial from which the bob hangs, two weights of eight pounds each and four spheres for the top of the clock case.

The writer jotted down the above to obtain some idea of the number of jade parts necessary to make the time train of the clock. Ted Bhend furnished the following technical descriptions which give a running idea of the time train's busybody actions:

"The escape wheel has thirty teeth, moves a half tooth per second, a revolution per minute and sixty per hour. Pinion gear, on the same shaft as the escape wheel has eight teeth with sixty revolutions per hour.

"The thirty-two tooth gear will turn fifteen revolutions an hour (eight-tooth pinion, thirty-two teeth, in the driving wheel makes a four to one ratio). The escape gear must turn sixty times to turn this gear fifteen times.

"The forty-tooth gear with eight-teeth in pinion makes a five to one ratio. This gear turns three revolutions per hour.

"The forty-eight-tooth gear (eight teeth in pinion) has a six to one ratio and will turn a half revolution per hour. On the end of the shaft that turns this gear is a thirty-tooth gear with an eight-tooth pinion. The minute hand is connected to a fifteen-tooth gear. This runs against a thirty-tooth gear and makes one revolution per hour, ratio two to one. The minute hand is carried once around the clock dial in an hour.

"The hour hand is connected to a forty-eight tooth gear against the eight-tooth pinion on the end of the shaft that turns a half revolution per hour. Ratio is one to six or in one half turn, one twelfth of the dial, or as indicated, one hour.

"The last large gear of the time train has no part in the time train element. It furnishes the power to drive the mechanism and increases the length of time needed before rewinding."

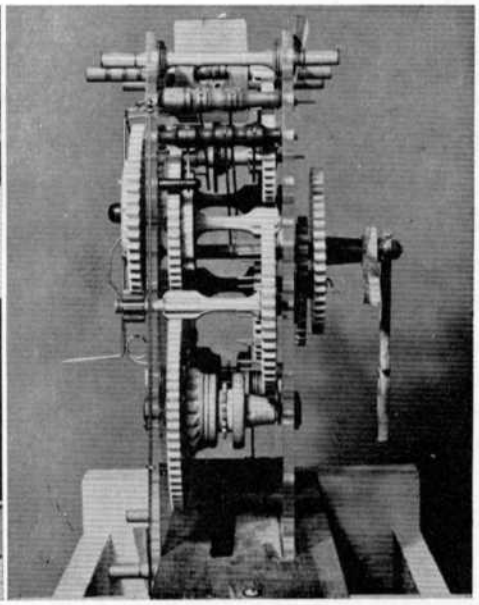
A clock cannot be made from these descriptions but understanding of the prodigious tasks and meticulous work necessary must register with the reader.

Ralph Dotter made a locking arm for the center shaft, a piece of jade 4" long, ¼" wide and 1/16" thick. It is probably the most delicate piece of work in the clock. Another small piece was made by Walter Eyestone, the finial from which the pendulum hangs.

Walter Hobbs used a special lap and jigs for precision work in lapping the joints of the three pieces that make up the pendulum rod and the keys that "lock" the joints. The entire rod is 41" x ¾" x ¼". No piece of jade long enough could be found so the rod was made in sections. The fitting of the keys was Walter's trickiest job. The rod weighs about a pound and it took more than forty hours of homework for Walter.

Georgia and Ralph Paine polished *ad infinitum,* the teeth on eight gears and the flat gears themselves. Georgia, after finding that a flat buff gave a frosty finish to the jade, finally used plate glass, grit and water, 120, 200, 400, 600, and 1200 grit and a mirro-like polish was obtained with well-worn 320 and 600 cloth on a drum sander. Ralph devoted more than sixty hours to polishing the teeth themselves and those fiendish little interstices between the teeth of eight gears. He put strips of sandpaper on venetian blind slabs to expedite his work. His numbed hands didn't uncurl readily at times.

President Cyrus Dam faceted the Chatham emerald bearings, using special dop sticks and keeping the exact diameters of



On left above: Alden Clark using a special device for sawing the curved face on pendulum bob. Robert Hardenbrook puts coolant on the saw.

PHOTO BY TOM VANO

On right above: Side view of the wooden clock model used as an inspiration for the jade clock workers.

PHOTO BY SIDNEY FISHER

THE JADE CLOCK WORKERS

Seated, left to right, Alden Clark, Henry Reinecke, Ralph Dotter, Frank Kutis, Charles Bishop, Ted Bhend. Standing, left to right, Walter Hobbs, Lawrence Bergsten, Warren Quimby, Susann Clark, Bob Hardenbrook, Georgia Paine, Elroy Peterson, Ralph Paine, Paul Baer, Cyrus Dam and Oscar Merwin.

the holes in each bearing. He worked at home, trying different laps and polishing agents on the emeralds until he found that Linde A on a tin lap made a perfect finish. His equipment included a Taylor faceting head. In addition to weekends, trying different materials, he spent more than forty hours on his project.

The emerald bearings were drilled by Mort Bachrach on the new "supersonic" Raytheon Impact Grinder. He also broached the wedge slots in the spacer shafts that hold the gears, using the same grinder.

Charles Bishop who made the escapement gear also made fifteen tool tips of silicon carbide to cut teeth in the gear. He made the verge of black jade. Polishing was his biggest problem, and he spent more than fifty hours working nights and week ends in his shop. It took Frank Kutis two months to make the machine that produced plates to divide teeth on the gears. He did his work at home in his own machine shop. The special machine was made of surplus tools and materials. The indexing head can be used to make any number of holes. A precision tool that has this useful future to it is one of the valuable contributions to the jade clock picture.

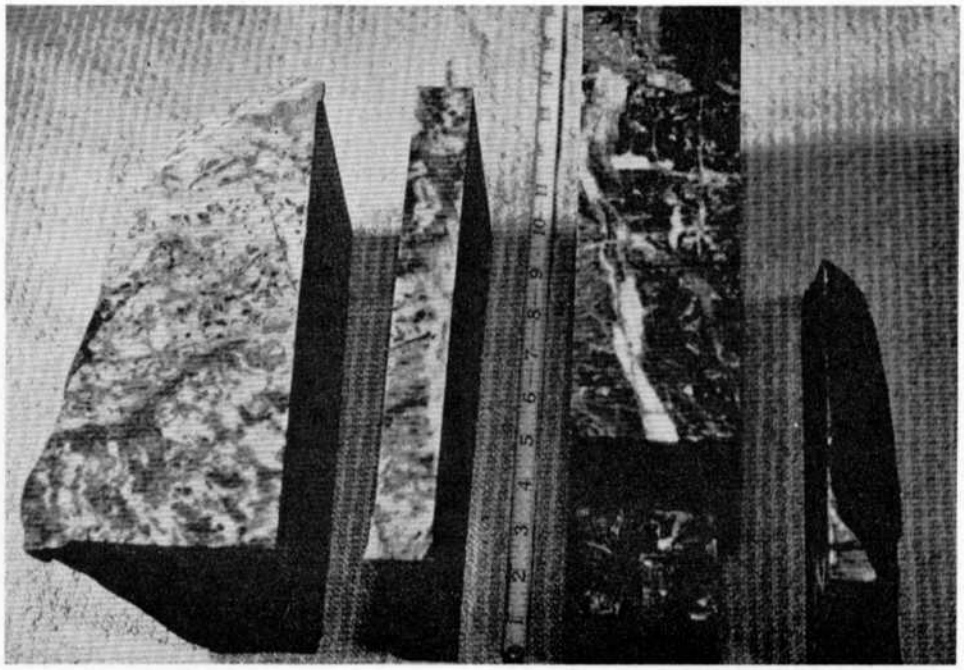
The metal parts of the clock were made by Ralph Dotter who rough-ground the rounds of jade into which Ted Bhend put teeth. A dozen or more hours at home and in the Society's club shop have been used in actual work including putting silver bezels on two emeralds used in the metal parts. He thought out his problems and things seemed sort of hit-and-miss until he understood the objects on which he was working. Trial and error eventually produced perfection in his work.

Warren Quinby who "felt great pride in being asked to help with the project" cut out the blanks for spacers. He used Clear Creek, California jadeite which he furnished. His cutting was done at home.

Tube drills, saws and hobs were all diamond-charged by Henry Reinecke. A total of almost thirty inches drilling holes in various parts of the jade clock took more than sixty hours. The making of special tools for jigs took another hundred hours plus several other tasks that will add time to his record, Henry will double that number of hours before he is finished with the jade clock.

Keeping jade from getting too hot was Bob Hardenbrook's problem as he used forty hours to grind and polish the eight pound weights. He had a specially constructed jig for holding the heavy pieces, and he did all of his work at the Club's shop.

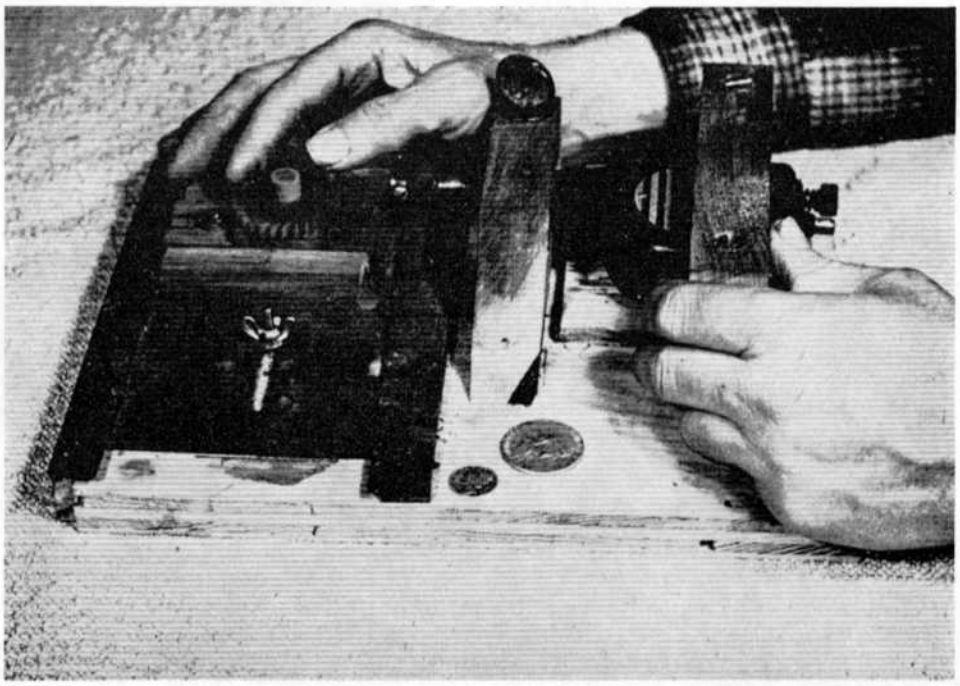
Elroy Peterson is "amazed to see the jade clock taking shape." He and Paul Baer work together in the basement of the Baer house. They have made twelve shafts of jade for the time train and four corner spacers from a Willow Creek, California, jade boulder. The work done by Paul and Elroy caused so much wear and tear on the machine they used that additional parts had to be bought and the machine completely rebuilt a couple of times. Paul says "he can't wait to hear the clock running" and he counts the work done by Elroy and himself in those hours actually spent on making the jade shafts (thirty on each one) and not in the scrounging around for additional parts and rebuilding a machine.



Clear Creek, California jadeite donated by Lloyd Underwood for pendulum bob and weights.

Alden Clark has spent over a hundred hours making the pendulum bob and at least three hundred hours being "errand boy" for all of the people concerned with making the jade clock, gathering materials, allocating tasks, and making a variety of jigs for the different kinds of work involved. He has lectured several times, using colored slides that have been made from time to time as the work progresses. He has contributed both Wyoming and Monterey, Calif. jade to the project. "I've tremendous admiration for the people who have built machines out of scraps," he said. "I haven't lost the feeling of excitement about this fabulous project. I listen to comments around me and I'm convinced that practically everybody thinks it's 'out of this world' and that includes me. I've gained a lot of information in working out various problems and though I've been in this thing since the beginning I'm still anticipating the effect on people when they see that jade clock and hear it ticking at the San Mateo show."

Ted Bhend has been everywhere that work is being done on the clock. He has been in the middle of the making of machines and jigs. He devises short cuts and contrives to make work both simple and perfect; he makes suggestions, takes over any seemingly impossible tasks and has given time, energy and enthusiasm that never wanes. He is having a good time in the middle of a demanding task and he continually reassures those who develop



Finishing teeth on the escapement wheel, using vibrator with carborundum point.

qualms about their abilities to do the required perfect job. Up in his shop on a windy hill in Brisbane, Calif., he has a gear hob and a lathe, in addition to countless jigs, tools, pieces of jade and plexiglass, wooden patterns of clock parts and all the etceteras that belong to the making of the first jade clock. Two or even three hundred hours is a mere guess at the time he has spent on seeing his dream come true. "I don't know how a woman feels who has just had a baby," he said, "but I know that I'll feel as if I've given birth to something when I first hear my clocks' tick." The list of things he has not done would be simpler to compile than to tell of all his jade and machine work.

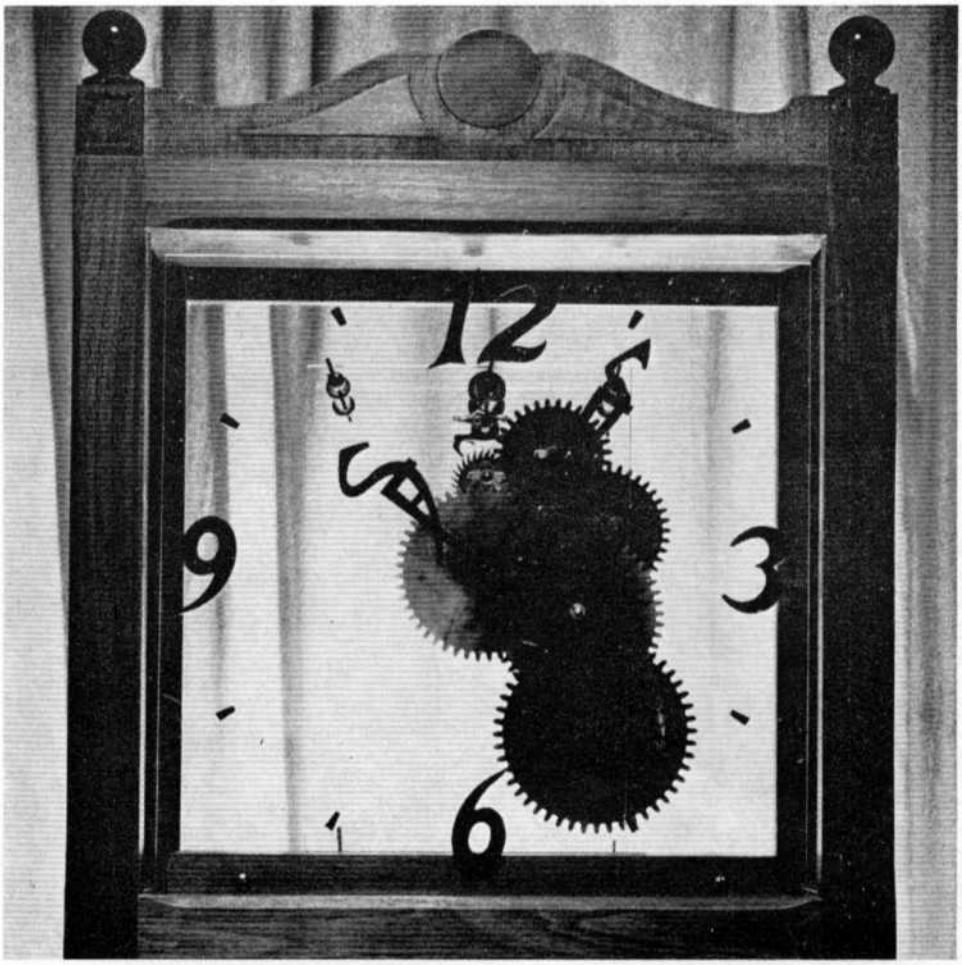
Generosity has flanked every small or great piece of work on the clock. Lawrence Bergsten of Oakland has given the major amount of jade to the project. He has slabbed all the larger pieces and his gifts have included apple and dark green jade from Wyoming, snowflake jade, black jade for the hands and numerals, and the deep, translucent Yukon jade for spheres. The five largest wheels and spindles are made from Lawrence Bergsten's jade and, more important, from his generous, unfailing support of the jade clock plan.

A large piece of Clear Creek jadeite was given by Lloyd Underwood, charter member of the *Gem & Mineral Society of San Mateo County*. This was used to make the pendulum bob and weights (see cut). A piece of Wyoming gray jade was also given by Lloyd. This has a special connotation because the jade gong used by the San Mateo Society to call meetings to order was made from this same jade. (Illustrated on page 170, June 1954 *Lapidary Journal.*) W. E. Brown of Redwood City gave a fine slab of Fraser River jade to the Society. Wm. E. Meader, busy on his Alexander prune ranch, sent in a handsome piece of green and white mottled jade. Ted Bhend, Alden Clark, Henry Reinecke, Charles Bishop, Al Grapes, Mort Bachrach, and Frank Brady all gave fine jade to make the world's first jade clock.

The end is not yet in sight but we will meet at the Gem and Mineral Fiesta on June 26, 1959 in the Fiesta Building of the San Mateo County Fairgrounds in San Mateo, Calif. And while members of the host society welcome visitors we'll wager they'll be listening for the first ringing tick-tock that marks the birth of Ted Bhend's and the *San Francisco Gem and Mineral Society's* jade clock.

Chatham emeralds used for bearings.

L. J. Bergsten cutting a one-ton jade boulder on a mud saw in his backyard.



Top section of the jade grandfather's clock showing the jade workings assembled in a glass and walnut case. Note the jade spheres at the top.

PHOTO BY TOM VANO

The Jade clock was first shown at the California Federation of Mineralogical Societies show in San Mateo, California, June 26th, 1959 but it was not until the Fall of 1962 that the strike-train was added. The account of its building follows:

THE JADE CLOCK

Now Chimes the Hours

By Ted Bhend

San Francisco Gem and Mineral Society

A grandfather clock, to be complete, must not only show the correct time, but should announce it in a pleasing tone. To build a bar, a tube, or a slab of a material that will sound a certain note, is a simple matter. However, to put tone and a lingering resonance *with* that note has been a trade secret of the Europeans, and others, who jealously guard their formulas for sound making devices.

The experiment of adding chimes to strike the hours, made by the San Francisco Gem and Mineral Society members who first made the "Jade Clock," started with a ninety-pound piece of jade given to us by Dr. Blaylock, of Salinas. Warren Quimby sliced this Monterey jade (nephrite) in the direction which would give us the largest flawless slices. There were different shapes and thicknesses, but for some unknown reason *none of this material would ring,* (perhaps because of the minute seams of tremolite found in this material.)

The next material to be experimented with was a nine by eighteen inch piece of Wyoming jade. The clock's pendulum rod is cut from this piece. The adjacent slice (cut after this one) is being used as a gong by the San Mateo Mineral Society. It was donated to us by the Underwoods of Belmont Lapidary. This slice was approximately one-half inch thick. It was split with great difficulty. The results were again negative. George Randolph made a triangle and I made a tuning fork of stone. Neither of these had a pleasing nor sustained sound. A piece of Washington black jade from Al Gilfillan was tried with poor results.

The hands and numbers of the clock were made from two slices of black Wyoming jade that Mr. L. J. Bergsten donated. This jade was then used to make the gong from the portion left after the hands and numbers were made. This jade slab was about five by nine inches. Henry Reinecke found that if properly held, *this piece of jade would ring like a bell, sustaining the tone for a long period of time.* After two years of searching, the piece for the gong was finally found by accident. First George Randolph mounted this piece in the block using a sounding board, with the jade suspended in front. Then we used a pillar block between the jade and the sounding board and clamped it together. Next we experimented with suspending the jade on strings without a sounding board. This has given us the best results. To strike the jade we tried hammers of wood, plastic, and rubber, finally ending up with a lead rifle bullet that had a hard leather cap glued on it. (While this arrangement is now working satisfactorily, we will not hesitate to adopt other methods if they work better.)

The mechanical part of the strike train was the final job ahead of us. The teeth on the gears are smaller than the teeth used in the time train. They are now down to 14 pitch. The power to run the clock is reduced to a greater degree, requiring a balance to the parts and ease of operation to all bearings and shafts.

The wires must rise and fall freely and with precision. The shape and width of a slot will change the relation of one wire to another. Bending one wire changes the relation of the two other wires to each other. The counter-balance we use to balance the large hand took up some of the room normally used by the wires. By curving the wires we managed to get around this obstruction. Mel Drefke, who has specialized in gold and silver work on jewelry, is our head man in the wire department.

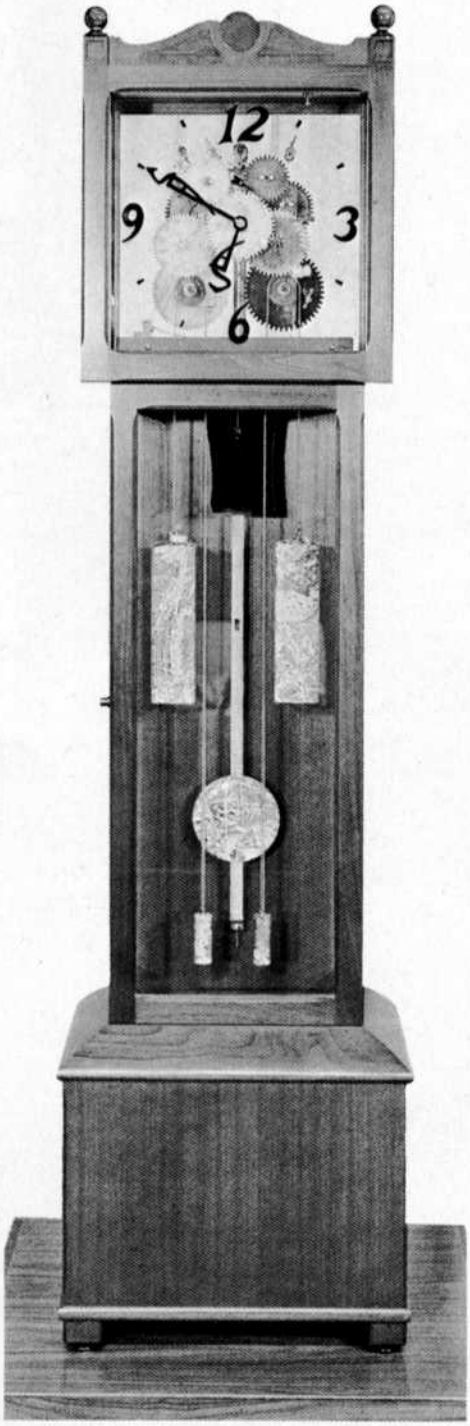
The bearings for this part of the clock are made from natural beryl, (Morganite). Henry Reinecke drilled the holes and made the containers to hold the bearings. Cyrus Dam spent about four hours of faceting time on each bearing. These bearings are cut in a hexagonal shape with a flat top and bottom. All edges are dubbed off in a 45% cut. This was done to make a snug fit on the bearing to the mounting. Ralph Johnson is working on the large bearings that support the weight and carry the large drive shaft. These are mounted directly into the clock case.

Elroy Peterson and Paul Baer had the double satisfaction of finding a beautiful green boulder of jade in Wyoming, and they turned out spindles for the clock from their own find.

Walter Hobbs and I made the first makeshift compound lathe arrangement, for turning these spindles. Peterson and Baer, both mechanics, have twice since remodeled this machine. *There has been no money spent on any of the special equipment except for diamond bort.*

It has been by patient and skillful manipulation of regular rock grinding equipment that most of this work has been done. For the sanding on the shaft a fine Cratex wheel was used. For polishing, a piece of stiff sole leather was made into a wheel. Tin oxide with a little detergent applied to the edge did the polishing. The turning machine is a simple arrangement of screws and shafts. A rod of jade is kept turning between two points. Then there is another shaft with a grinding wheel or saw on it that can be moved into the turning rod of jade, or slid along it so that material can be removed from it in any direction. All cutting, sanding and polishing was done before the rod was removed, and the ends cut off.

To get a number of varieties of jade incorporated into the clock we have used many kinds, but in the end where strength and durability were needed, we have gone



THE JADE CLOCK

The Strike Train will be added by the time of the Oct. 1962 show "THE GEM AND MINERAL FAIR, Scottish Rite Auditorium, Sutter St. and Van Ness Ave., San Francisco, Calif., where its voice will be heard striking the hours for the first time.

back to Wyoming jade. The long thin ends of the shafts and spindles caused most of the breakage, due to the type of material used.

Henry Reinecke has made some special diamond charged hole-saws or drills for this part of the work on the clock. Two large gears have a rim protruding from the side. These were formed by using large core drills. Hobbs to cut fourteen-pitch gear teeth were made and charged. These are three-eighths inch copper disks, two inches in diameter. The edge of the disk was shaped into the gear teeth form. About one carat of diamond bort was rolled into the edge.

Blanks for the pinion gears were made by drilling the center hole first, and then without moving the stone, replacing the drill with a core drill, the pinion size, and redrilling the stone. Tiny drills were also made to drill for the bearings and to make holes for inserting pins to activate the striking hammers. Ambrose Canziani is helping Henry Reinecke with the jade brackets that hold the strike wires, at the same time finishing off the curved centers that are on the flanged gears.

Bob Hardenbrook rough formed the large weight on a rocking jig, in front of a grinding wheel. A slight curve was given to these large pieces to bring out the color and pattern of the jade, and to get away from the glare of a flat surface.

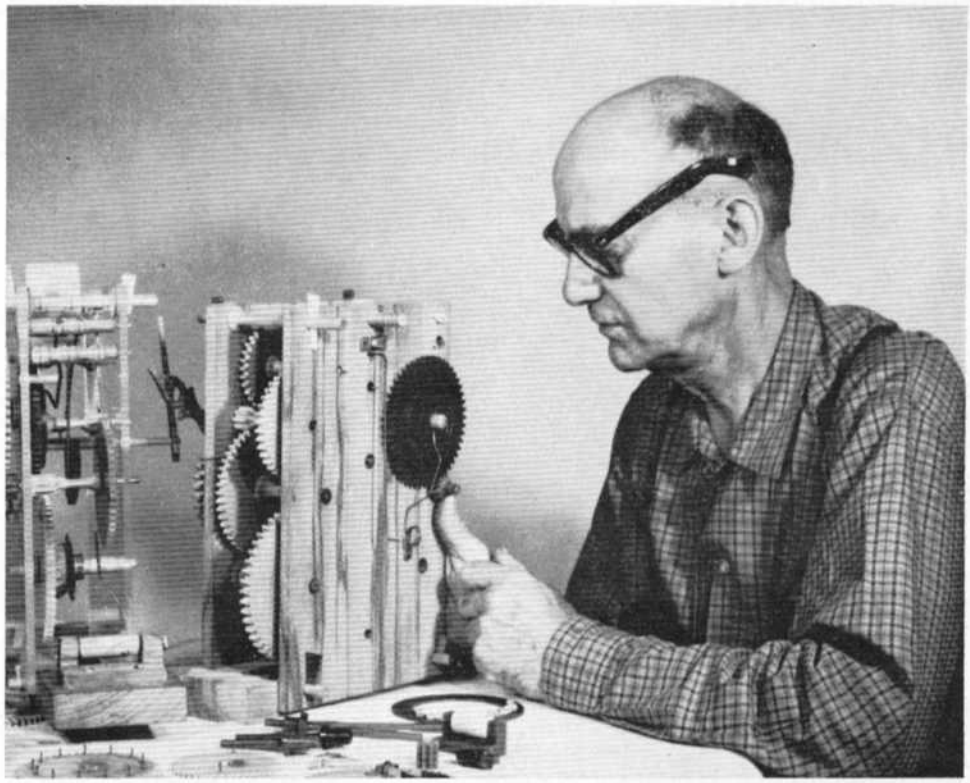
Hub Dafoe did a brilliant job of sanding and polishing the weight. The sanding was done on a drum sander, the polishing on a muslin buff, with tin oxide. One small gear and the fly of the governor were made from a piece of Burma jade that Mr. Marshal of Morgan Hill gave us.

Walter Eyestone did the work on the fly. This is one of those projects where nine-tenths of the material must be carefully removed and the balance left as thin and light as possible. It must balance and still be strong enough to be serviceable.

Mrs. Charlotte Dille gave us a white and green mottled piece of jade from Vashon Island, Washington. This was of nephrite and a beautiful color. I cut two pinion gears from this piece, and in both gears the white broke loose from the green. W. E. Brown of San Jose, Calif., gave us a piece of Yukon jade. It was a beautiful slice, but it broke on a hidden seam while being cut. Wm. E. Meader, former instructor of ADULT EDUCATION Lapidary Classes at Galileo High School in San Francisco, gave 2 large slices of Covelo jade to the clock project. This material had beauty of pattern but not consistency of strength. Bill taught lapidary to more than 75% of the makers of the Jade Clock.

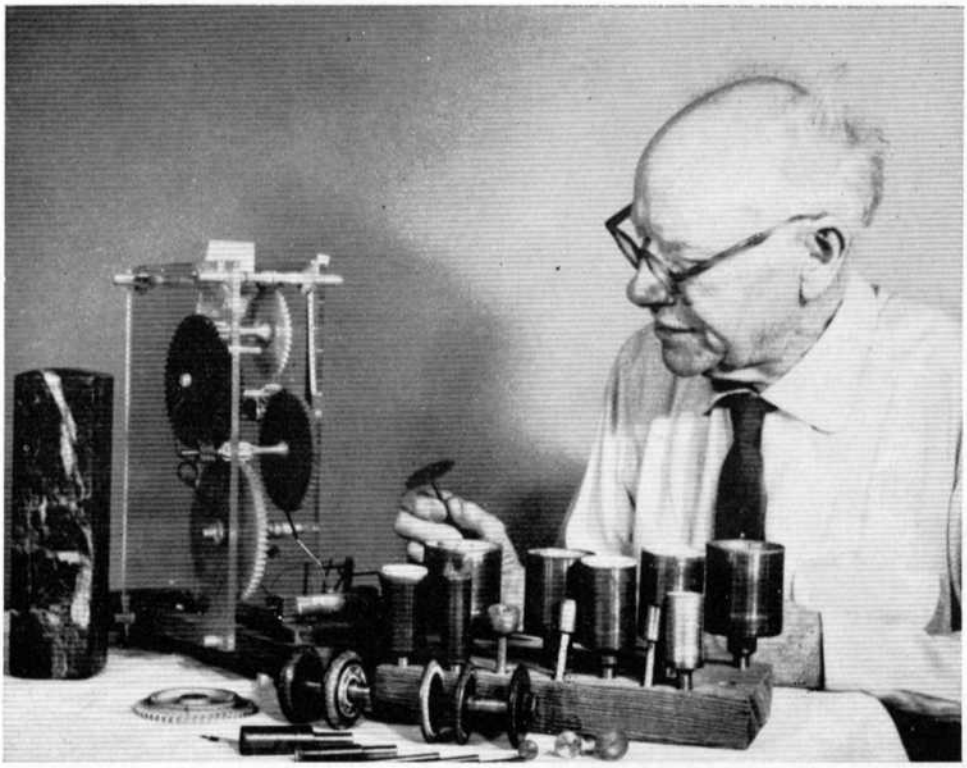
Ralph Johnson furnished a piece of green Wyoming jade from which the largest sixty-four tooth gear was cut. Through some fault of my own there was one tooth slightly smaller than the rest so we made a smaller gear out of this one. We made another large gear from a slice of Burma jade "Pop" Grapes cut for us. It was a pleasure to work on this beautiful piece of jade. The color is light green with a lavender cast in places.

Jade is a difficult material to hold in a vise. I generally cover the piece to be held with masking tape and in the case of small pieces or pinion gears, I heat the mandrel and cover it with dopping wax, then slide the warmed-up gear over it. None of the pieces treated this way have slipped for me.



Ted Bhend trying out the various gears on the all-wooden model, and by interchange in the wooden model with the plexiglass frame.

Polishing the teeth on the gears is one of the most tedious jobs. Georgia and Ralph Paine worked so hard and long on the time part of the clock that I divided this work between Canziani and George Randolph. George Randolph polished the teeth by taking a piece of plate glass about a half-inch wide and six inches long, and grinding the long edge of the glass down to the shape of the space between the teeth on the gear. Using a fine grit abrasive and the glass as a file, he removed the scratches made by the gear hobb. Then making another similar file out of maplewood and using tin oxide, he finished polishing. *Careful horizontal strokes are*



Henry Reinecke with some of the special, diamond charged, tools he has made for use on the Jade Clock project. These consist of copper hobs for cutting 10, 12, and 14 pitch teeth on gears and pinions; small saws for slitting and undercutting; core drills ranging in sizes from 3mm through 94mm; cored end mills; and very small solid drills, reamers, bevellers.

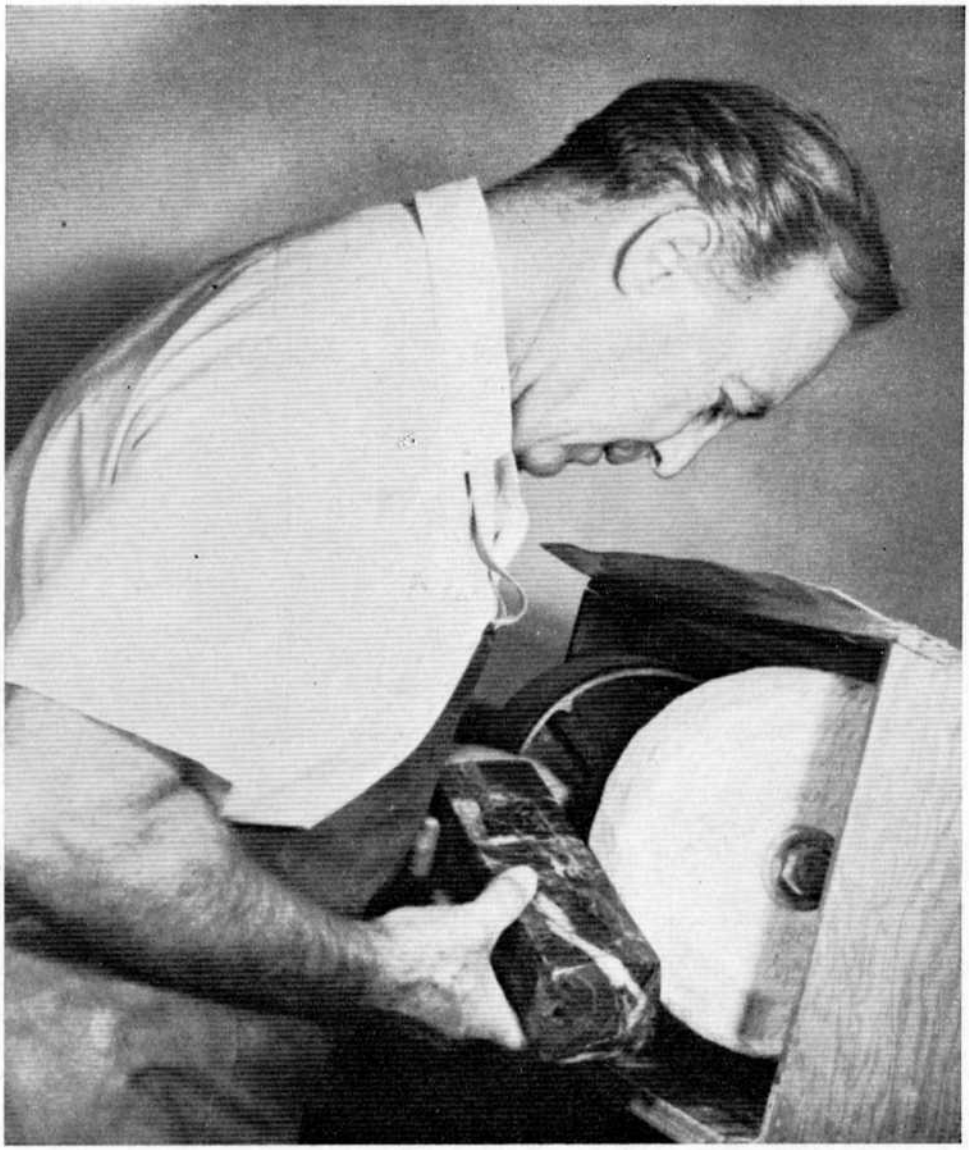
necessary to preserve the shape of the teeth. Every tooth was polished with loving care.

The strike train and the time train gears are entirely separate units in a clock. We were able to build and operate this new addition of the strike train without interfering with the normal operation of our Jade Clock.

At the time of this writing the parts of the clock are almost finished. We have a wooden clock the same size as the Jade Clock. When a jade is finished we substitute the jade part for the similar part in the wooden clock. This is the trial and error method we have used to test the parts. There are bound to be some anxious moments when we incorporate these new parts into the frame of our Jade Clock. We made the frame out of plexiglass so that all parts of the works could be seen. We have to drill many holes into this plexiglass frame. There is always the danger of cracking it. Sometimes parts are dropped. The jade survives an unusual amount of punishment. Henry Reinecke dropped one shaft on the cement floor of his shop. The shaft fell squarely on it's end and bounced at least two feet up into a rock bin. *No damage was done.* Paul Baer finished a shaft in the lathe. The chuck wouldn't open so he tapped it with a hammer. He accidentally hit the flange on the jade shaft instead of the chuck. This time the jade did break!

There is a committee of our club members that has charge of storing the Jade Clock, of making it available for various exhibitions, and keeping track of its movements. These people are thoroughly familiar with the operation of the clock and can set it up at given notice. However, they do not have time to go to all meetings where there is a demand for exhibiting the Jade Clock. This is so strictly a "club clock" that only club members are permitted to assemble and dismantle its parts.

If the sum total of the numbers of hours it took to make this clock were translated into the same number of years, imagination could take hold and future members would find that the next destination for the Jade Clock of the San Francisco Gem and Mineral Society might be the moon!



Hubert A. Dafoe, ("Hub," as we affectionately know him), putting the final polish on the weight for the Strike Train. It is the companion weight from the same piece of Clear Creek Jadeite as that which operates the clock, and weighs over 8½ pounds.

COPIES OF THE JADE CLOCK BROCHURE MAY BE OBTAINED BY ADDRESSING:

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