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IN THIS ISSUE...

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President's Message

M.B. Hawkins
President

Managing Our Capabilities

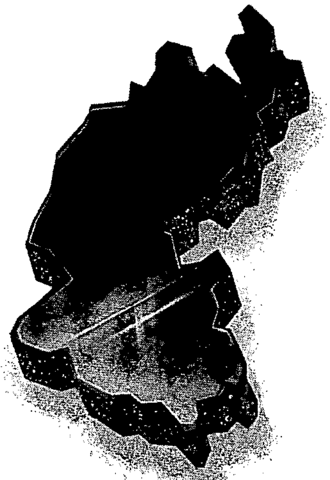
We are all aware that we have talent and aptitude. We are probably also aware that when we chose to harness and discipline those talents and aptitudes they became skills. These skills, when used properly, unleash a tremendous power. Many of us have chosen to put this power to work in a real legitimate way. We developed service businesses. Many have become extremely successful with lengthy lists of clients.

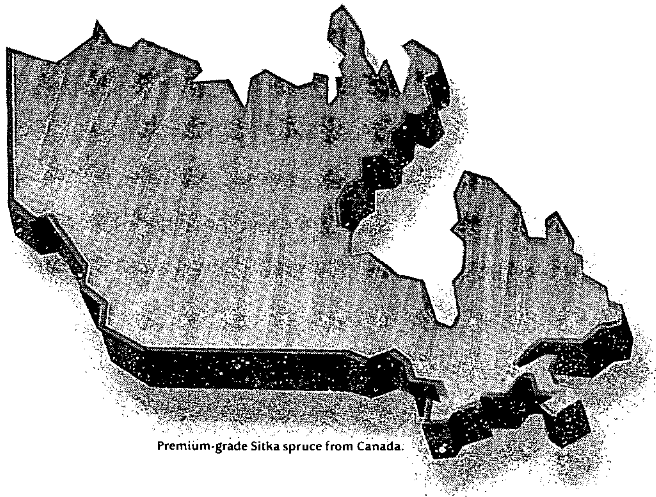
My concern here is managing and continuing to manage our capabilities. Too many technicians run into problems because managing our capabilities well means using an intelligent approach. It means denying oneself, sacrificing, and failing in order to perfect what we are attempting to succeed at doing. There is one pattern that seems to dominate many aspiring technicians; that is, the difficulty in delaying gratification.

As I look about our organization, I see frustration and even anger among some aspiring to greater development who are doomed to suffer throughout their career until they become willing to submit their strengths to discipline. There are also those who have submitted to discipline but, somewhere along the way, they evidently got the idea they had it all; that they had arrived and there was nothing more to learn. They retire unto themselves failing to realize the need to continue their education and how much benefit they would get if they would choose not to be selfish but rather to share their knowledge with those younger ones in the business who are coming along behind them.

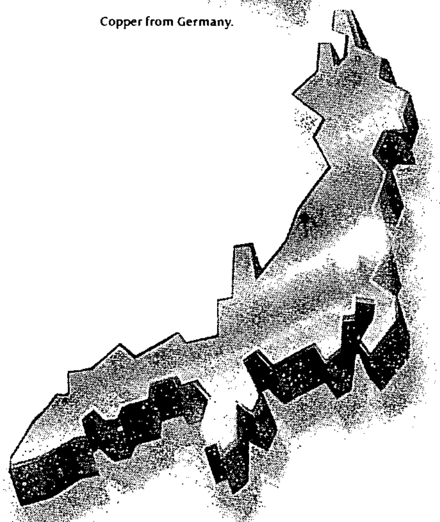
Well-managed talents and skills, on the other hand, lead to a strong sense of purpose and value. Help is given us to counter the overwhelming pressure from society that makes us feel insecure. Did you know insecure people are never static with their insecurities? It seems they invariably impose their insecurities on the people around them. You may be aware that insecurities are really difficult to overlook as they are often deep-seated and complex. It is not my aim here to offer an analysis of insecurities but I can offer one remedy. Develop the ability to harness your capabilities and use them in a positive way.

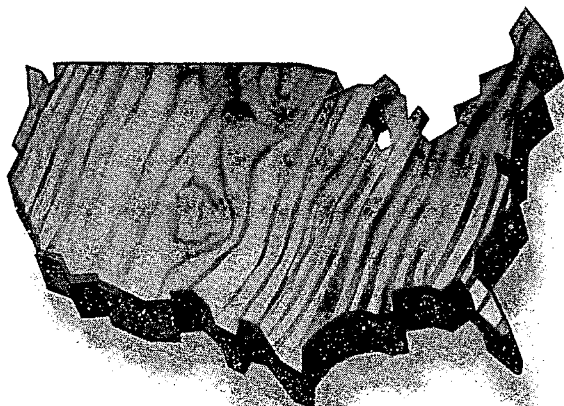
Each member receives a *Journal* every month. While a tremendous amount of excellent information comes to us via our *Journal*, it alone is not sufficient to round out our skills. It is sincerely hoped you will choose to be among those that will gather in St. Louis next month to hone our skills as well as benefit from the warm friendship.■


Copper from Germany.


Premium-grade Sitka spruce from Canada.


Felt from Great Britain.


Steel from Japan.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From The Home Office

Larry Goldsmith
Executive Director

Americans And The Arts Less Leisure Time, More Interest

There's good news and bad news, according to Louis Harris.

Harris, who has asked Americans for their opinions on every topic under the sun, recently announced completion of "Americans and the Arts V," fifth in a series of nationwide surveys initiated in 1973. For this survey, conducted for Phillip Morris Companies, Inc., Harris polled 1,501 adults over age 18 last spring.

First, the bad news. Overall, the arts have lost 12 percent of their audience since the last survey in 1984, Harris reported. The number of adult Americans who say they attend live classical music concerts has declined from 34 percent in 1984 to 31 percent. Leisure time, in which Americans could presumably play an instrument or take in a concert, has also declined from an average of 26.2 hours per week in 1973 to 16.6 hours per week in 1987.

"Time," Harris says, "may be the most precious commodity in the land."

Perhaps the most interesting aspect to the decline in leisure time is the way it breaks down among various demographic groups. Women report less average leisure time per week, 14 hours compared with the 19 hours reported by men, but women reported greater or equal levels of participation in every arts category tracked by the survey except photography. Thirty percent of both men and women play a musical instrument, up from 18 percent in 1975.

The work week itself has plateaued, according to the survey, going from 40.6 hours in 1973, to 43.1 in 1975, to 46.9 in 1980, to 47.3 in 1984, to 46.8 in 1987.

Who's working hardest? Groups with the least leisure time are Hispanics, with 13 hours per week; women, with 14 hours; 30- to 49-year-olds, with 14.6; and Blacks, with 15.0.

Now the good news. Americans want their children to draw, sing and play musical instruments, as well as read, write and add. And they are willing to pay higher taxes to make it happen in public schools.

Two out of three adults say the arts belong in the classroom, along with such traditional subjects as English, math, science and social studies. In fact, two-thirds of the total public thinks that arts education is essential for producing well-rounded students. Seventy-two percent say they would pay more taxes to "make sure that children in school will be able to learn more about the arts," and 75 percent say that arts instruction should be included in regular school budgets. Eighty-one percent say that full scholastic credit should be given for playing a musical instrument.

So what does it mean? It means that our society has changed dramatically in the past 14 years, and not always for the better. Our lives are more stressful, and as a society, we have less time for such soul-satisfying activities as playing the piano. In the midst of this, however, we still make time for these activities, and we definitely want our children to appreciate and participate in arts-related activities.

What it means for the future of the piano and piano technicians may be anyone's guess, but at least the potential is there. ■

Tech Gazette

Yamaha Piano Service June, 1988

SPECIAL PRE-CONVENTION ISSUE!

As you all know, the 31st Annual PTG Convention and Institute is just around the corner. It has always been a pleasure to be a part of the Annual PTG Convention, and we're sure this year will be no exception. This month, we're going to depart from our usual "Tech Gazette" format so we can give you an idea of what we'll be doing, where we'll be, and when we'll be there. We hope **you'll** be there—for the most exciting event in PTG convention history!

Yamaha Exhibits

Beginning with our first "Tech Gazette" in October of 1987, we began talking about the world of MIDI. Since then, we've touched on two revolutionary instruments only recently introduced to the music industry—our MIDI Grand and Disklavier™ pianos. Some of you may think that this is all leading to something even more "grand" (pun intended) and you couldn't be more correct!

All week long on display in our exhibit area will be a Disklavier piano and a MIDI Grand, complete with enough bells and whistles to more than satisfy your curiosity. We've been talking about it, you've been hearing about it, and now—for the first time at an annual PTG event—you'll be able to experience firsthand the power of MIDI! We invite you to test the recording and playback capabilities of the Disklavier piano—record a song to a floppy disk, and with remote control in hand, play it back, change the tempo, transpose to a key no composer would dare to write in, control the volume, and more... It's all at your fingertips! And let's not forget the MIDI Grand. Find out why artists and composers consider this to be the ultimate keyboard instrument. Try your hand at recording a drum track on a digital sequence recorder. Experiment with layering strings, winds, and percussion voices. If you don't like one set of voices, we'll show you how to change them with the push of a button or by pressing a foot pedal. Don't remain in digital darkness! We'll be close at hand to guide you. Along with our two MIDI pianos, we'll also have on display some representative instruments in our recently started Concert and Artist program. We're confident that this blend of tradition and new technology will offer something for everyone.

Yamaha Institute Classes

Of course, the main focus of any Annual PTG Convention is the Technical Institute. Check your class schedule and plan ahead, because you won't want to miss:

PROFESSIONAL SERVICE...
THE NEXT STEP

The performance piano. Remember? We started talking about it in Toronto last summer. We introduced the idea of a definite step-by-step service procedure—an easy-to-follow checklist—that you can use for servicing these special instruments. "So, what's next?" you ask. Well, redirecting our focus from the little white grand they use for the summer concert series in the park, we'll concentrate on the more posh recital hall variety, played by someone you may have already heard about. And we'll touch on some new levels of truly sophisticated service.

THE DISKLAVIER AND MIDI GRAND... an overview

As you know, Yamaha has recently introduced two exciting new pianos: the Disklavier and the MIDI Grand. 21st century electronic and fiber optic technologies have been incorporated into these acoustic pianos, giving them musical potential never before possible. But because they're both acoustic pianos, they require the same service that other pianos need. This class, in addition to showing how to perform standard piano maintenance on these unique instruments, will give you a taste of their many performance capabilities.

Yamaha After Hours

On Wednesday evening, when classes are done, and the Exhibit Hall closes for the night, we hope you'll join us at the Convention Awards Banquet. For your listening (and dining) pleasure, our Disklavier pianos will be tirelessly serenading us while we indulge to excess. After we're done, though, the Yamaha bunch will have something really special in store for you. So, don't eat & run!

Our reception on Thursday evening will be a significant departure from Conventions past, and we'd like for you to be there. We'll be showcasing renowned keyboard artist, **Mike Garson**, and the sounds of the MIDI Grand. Those of you who were lucky enough to hear Mike at the California State Convention already know a little of what's in store. And we know **you'll** be there, for sure. If you weren't so fortunate... well... see you in St. Louis!

See You In St. Louis!

Schedule Of 1988 Institute Classes

Well, here it is. I'm ready — are you? I think we have included just about everything. There are classes for the technician who is about to start in this exciting career, something for those who are planning ahead and want to be better technicians, and those who have been at it awhile and feel that there is always a way to improve.

No matter which of the above is your motive, I am looking forward to seeing you for the first time — or again. See you in St. Louis!

Mini-Techs — More Information In Less Time

Mini-Technicals are classes which crowd a lot of information into a half-hour session. These classes, coordinated by Fred Fornwalt, feature the following instructors:

Mark Anderson — Shank Extraction
Bill Balamut — Glassing In A Pinblock
Dave Barr — Business Practices
Fred Blumenthal — Appraising Pianos Using Real Estate Techniques
Vivian Brooks — Business
Ruth Brown — Pitch Raising
James Coleman Sr. — Listening With Your Accu-Tuner (Electronic Tuning Tips)
James Coleman Jr. — Key Bushings
Gary Crabb — Overcoming Your Knotty Problems
Brent Fischer — Ebony Finishing And Spray Equipment (Soundboard Construction And Materials)
Fern Henry — Diagnosing Sluggish Upright Action Problems
Michael Kimbell — Tempering The Untempered
Leon Levitch — The Born-Again Piano
Richard McAllister — The Piano Technicians Management System
Keith McGavern — Repinning Flanges
Gary Neie — Leg And Lyre Replacement (Replacing Screws With Bolts)
Teri Powell — Manufacturer-Dealer-Technician Relationships
Kenneth Sloane — The Effects Of Felt Grain On Grand Damper Regulation
Jack Sprinkle — Coping With Plastic Backchecks, Jacks And Flanges
Bill Spurlock — Seven Shop Jigs For Grand Hammer Shaping and Installation
William Stegeman — Equal Temperament
Ralph Stilwell — Squeaks, Rattles and Groans
Sid Stone — Pitch Raising
Scott Welton — Three Ways To Set The Glide Bolts In A Grand Keyframe

Tutoring — A Special Opportunity

What do you want to know? Whatever the subject of your special interest, we'll find a tutor for you. Choose tuning, rebuilding, grand or vertical regulation — or pick a topic. Each 1 1/2-hour session costs just $35, a real bargain for such a unique opportunity. The only catch is that you must sign up by June 10, and bring your own tools to St. Louis.

Schedule Of Institute Classes

	Class Period														
	Tuesday				Wednesday				Thursday				Friday		Room
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	
Administering The PTG Technical Exam (RTTs Only) *Spurlock*					■				■						44
All About The Baldwin Grand Action *Vincent, Fandrich (Baldwin)*	▬	▬							▬	▬			▬	▬	F
Aural Fine Tuning — For Electronic Tuners *Sanderson*			■		■							■			46
Basic Piano Tuning *Defebaugh*				■	■						■				B
Bosendorfer — Servicing And Product Features *Burger, Vincent (Bosendorfer)*					▬	▬					▬	▬			C
Bushings, Bushings Everywhere *Jameson*		■							■					■	H
College And University Forum *McNeil*							■								F
Computer Applications — From Learning To Earning *Jones, Manners*		■			■							■			41
The Disklavier And Midi Grand — An Overview *Brandom (Yamaha)*							■		■						G
Efficient Piano Tuning *Huether*		■										■	■		42
The End Of Agraffe Aggravation *Sadigursky*	■										■			■	43
Grand Piano Remanufacturing *W. Snyder, D. Snyder*			▬	▬	▬	▬					▬	▬			F
Grand Regulation *Lassiter, Light, Weisensteiner (Kimball)*	▬	▬	▬	▬											C
Hammer Filing *Ford*		■					■			■					A
How To Pass The PTG Technical Examination *Spurlock*											■				44
Inventing The Steinway *Garlick (Steinway)*				■		■				■					42
Ivory — The Good, Bad And Ugly *Green (Sohmer)*		■					■					■			47
Joints And Splices May Show — But No One Will Know *Phillips*		■					■							■	46
Learning To Listen *J. Rappaport*	■									■			■		46
The Magic Touch *Isaac*			■		■							■			43
Making Grand Dampers And Trapwork Work *Zeiner*							■			■			■		43
A Master Class In Temperament Tuning *Garlick (Steinway)*	▬	▬											▬	▬	G
Mini-Technicals (See Separate Schedule)			■	■		■	■			■	■		■	■	41
The Mystery Of Aftertouch *Whitting (Young Chang America)*	■						■							■	B
Nickel And Dime Quality Tools *Harvey*				■	■				■						47
No Felts — No Pianos. Why? *Van Stratum (Chas. House)*	■								■						41
Piano Diagnostics *Chandler (Kawai)*				■		■					■				46
Pianos — A Moving Experience *Geiger*							■		■						C
Please Speak Up — I Can't Hear You *Bohne, Clark*										■			■		C
Practical Applications Of Downbearing Theory *Krefting*	■									■			■		H
Practical Touch-Up And Piano Case Repair *Mastagni*			■						■					■	42
Professional Service — The Next Step *The Yamaha Team*			▬	▬	▬	▬					▬	▬			G
Regional Meetings								■							
Regulating The Vertical Piano *Elrod (Wurlitzer)*					■		■				■				42
So You Want To Be A Concert Technician *Neblett*			■			■						■			B
Spinet Repairs — The Ins And Outs *Hess*	■					■								■	47
Support Your Local Grand Piano *Graham*		■								■			■		B
Tone And Friction — Facts And Fiction *Baldassin*	■								■			■			A
Upright Hammer & Damper Installation — Factory Style *P. Rappaport*			▬	▬	▬	▬									H
The Voicing Project *Robinson*			▬	▬	▬	▬							▬	▬	A
Wood, Pianos And Humidity *Phillips, Smith (Dampp-Chaser)*				■					■						43

Key: ▬ = **Two-period class**; ■ = **One-period class**

Class Periods: ***1*** **— 8-9:30 a.m.;** ***2*** **— 10:30 a.m.-noon;** ***3*** **— 1:30-3 p.m.;** ***4*** **— 4-5:30 p.m.**

THE TECHNICAL FORUM

Rebushing

Susan Graham
Technical Editor

Working our way through possible causes of "heavy touch" in a grand action we have discussed cleaning, condition and lubrication of parts and action center treatment. This month we will finish with action centers by discussing rebushing, and then continue with a brief guide to troubleshooting regulation factors involved in touchweight.

Action part rebushing is something that some of us do a lot and some practically never. Most are probably like me — somewhere in between. Regardless of how often they are used, rebushing skills must be included in every technicians' repertoire, and the subject is well worth some page space.

To prepare this section of the Forum I have consulted with two more experienced rebushers: Shari Weissman, who in five years working for Sheldon Smith and five more as a freelance action rebuilder, has done more rebushing than seems humanly possible. (You may not know her but you've been seeing her hands in the illustrations accompanying these articles). The other is the invaluable and encyclopedic Wally Brooks. I also had a chance to speak briefly with Peter Van Stratum of Charles W. House, Inc., makers of woven felt, on the subject of "shrinking" bushing cloth. I owe them all my thanks, and if I can put what they know with what I know into a useful article, we all are in their debt.

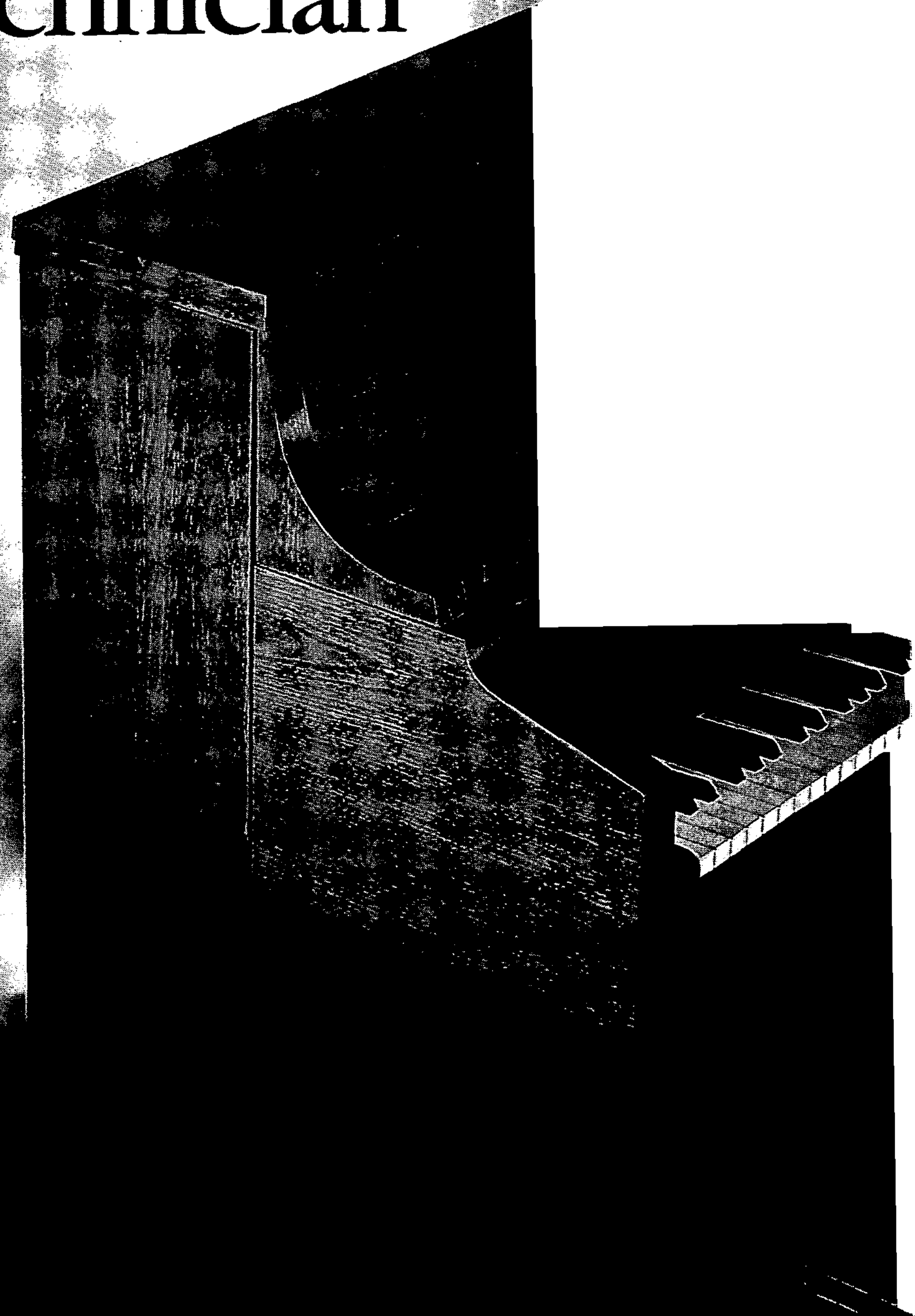
Bushing cloth. We've been harping on using the good stuff, recognizable by its white core, carried by most supply houses as "special" or "extra quality." It is denser and soft without the furriness of cheaper cloth. Action rebushing usually requires the thinnest available. It will frequently come partly stripped to a width which may or may not be correct for your job. We are often advised to wash the cloth in Woolite and cold water and let it air-dry. This is frequently referred to as pre-shrinking, but actually has the effect of making the cloth thicker and softer. According to Peter Van Stratum, wetting relaxes the stresses in the cloth and the fibers expand. He advises against wetting before inserting the cloth into the bushing, since the expansion makes it that much more difficult to pull through. He advocates soaking the parts in a dipping solution *after* the bushings and a sizing pin are in place.

Other technicians and some action companies do routinely pre-wash their cloth as well as dip the parts afterwards, and they get good results. There seems no absolute answer except that it is beneficial to soak the cloth at some point. If pre-washed cloth does become too fuzzy, my experience is that it can be rewet, ironed ("wool" setting, of course) and tamped with a smooth piece of wood. (Beat on it a little to settle the fibers, in other words.) This is useful if you dye cheap bushing cloth for understring felt.

Attempt to determine the correct width — approximately three times the diameter of the hole to be bushed — and tear the strips. Tearing leaves loose fibers at the edges which will reknit when the cloth is formed in the hole. The width must be correct: too wide, and it won't go in; too narrow and the bushing will have a gap, producing a very bad result. I usually tear strips a little over width and then peel off strands until the width is correct.

Glue. Hot hide has everything to recommend it for felt work. It grabs quickly but doesn't set hard for some time. It's reversible, and the thickness can be controlled to prevent too much glue absorption into the cloth. Cold hide glue also can be used, as can a good quality polyvinyl (white) glue. Aliphatic

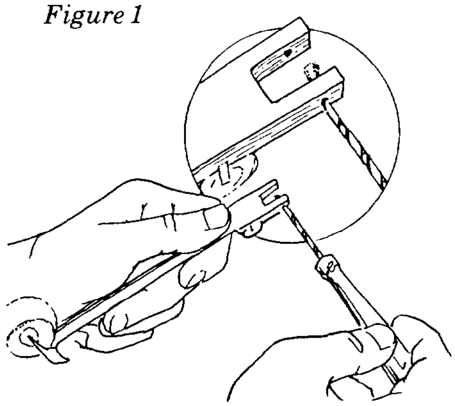
continued on page 12



(yellow) glues are not recommended. They make the bushing very difficult to remove, tend to soak into the cloth and prevent sizing, and may cause squeaks.

The simplest way I find to remove the old bushing (other than inadvertently punching it out with a centerpin) is to use a drill bit — usually a #42 — in a pin vise or handle *(fig. 1)*. The bit should remove just cloth, not wood. It

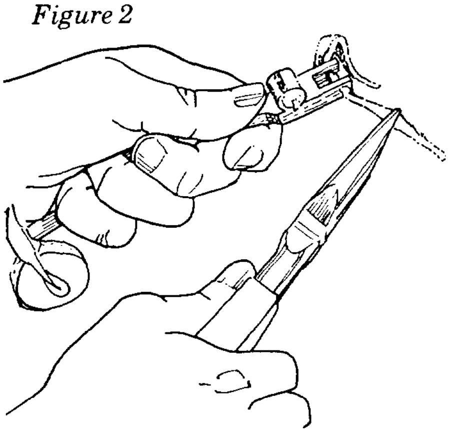
Figure 1



doesn't make a lot of sense to rebush just one side of a part when it is no more work and makes for a better job to do both sides. The result will be uniform and more stable.

Trim the end of the cloth strip to a long, gradual taper about three inches long. Dip about half of the taper into hide glue or melt some paraffin with a heat gun and coat the end. Then roll it on the bench to form a tip. Let this dry until hard. The first flange or shank is the hardest and you may need pliers to pull the cloth through *(fig. 2)*. Grab with the pliers just behind the hardened tip or you

Figure 2



may pull it off (you may pull it off regardless of what you do). Pull that part several inches down on the cloth and keep threading on parts — depending on how quickly you work and what glue is used, as many as 20 or so. Spread a light coat of glue on the still-exposed section of the strip, and pull the flanges down onto it, leaving room between them to get in with a stick to clean up excess glue. Too much glue is more of a problem than too little. A small collar should form but this is a tacking, not a nailing, operation.

As soon as all the flanges on the strip are pulled down onto the glue section, cut them apart with scissors — don't worry about trimming at this point. Insert a center pin to size the bushing as it dries. In the factories a long "shrink pin" is used. The point on the strip is formed around the end of a long piece of center pin wire so the cloth rolls around it as the parts are pulled onto the strip and they are simultaneously bushed and strung on the wire for drying and sizing. These pins are not available, so we cut the parts apart and insert the pin (usually a fairly small size) as a separate operation.

After the glue has dried overnight the parts should be dipped. This relaxes the cloth and forms the fibers around the pin. The maker of bushing cloth actually suggests soaking the parts overnight to ensure thorough saturation. Methanol and water (10 to 1) is the traditional dip and then the parts are allowed to air dry. Most makers of Japanese parts are now using silicone and naphtha as a dip, and the importers advise using it on those parts if centers are troublesome. If you anticipate using a fairly large pin in reassembling the parts, you may want to insert that size into the bushing before dipping.

When the parts are again dry the bushing is trimmed with a very sharp blade so it is perfectly flush to the wood *(fig. 3)*. Glue and protruding fibers are not only sloppy but create friction and alignment problems.

The parts are now ready for reassembly. They may need reaming and will definitely need travelling — all the usual steps in action part replacement which we have come to expect.

As an alternative to overly large centerpins, as a repair to damaged or contaminated bushings, and as a way to preserve original parts, rebushing is a skill we all utilize. Good materials and good techniques make for good results. Good luck!

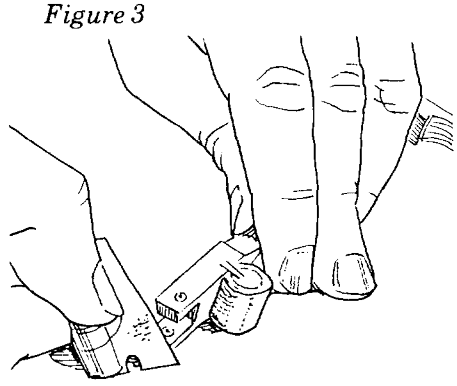
Grand Regulation

And now, back to the heavy action...

The preparatory steps which have been outlined in the past months are part of any regulation, not just an attempt to reduce touchweight or friction. For those of us who learn our grand regulation in manufacturers' classes at conventions, this may be overlooked or forgotten. Although those classes are excellent presentations of an ideal, those who teach them are the first to say that their material assumes an action in good working condition. Cleaning and lubricating, and adjusting action center friction are what comprises good working condition. It is the first and equally important stage in the two-part operation of regulating any action.

An intrusive bit of reality as regards grand regulation is that regulating an action to match a particular set of specifications will not always yield the best result, even to specifications supplied by the manufacturer. Factors of wear,

Figure 3



slight variation in manufacturing procedures and materials, and individual taste and requirements of pianists all play a part in making a "cookbook" approach to regulation unrealistic, unproductive and highly frustrating.

The most intelligent way to go about regualtion is to work with samples within the action, completely working through the regulation procedure and checking the results before embarking on wholesale adjustment. Manufacturers' specifications are a starting point, but the skill we develop as technicians and the feedback we get from our customers cannot be ignored for the sake of some numbers on a page. This makes it doubly advantageous that the preliminary stages be completed before the actual regulation is attempted. Performance of the samples can be accurately evaluated without questions such as, "Is there really no drop or does it appear that way because the spring is too strong because the hammer flange pinning is too tight and so I have overstrengthened the spring?" Confidence that the preliminary procedures have been completed will free the mind to creatively and accurately evaluate the regulation.

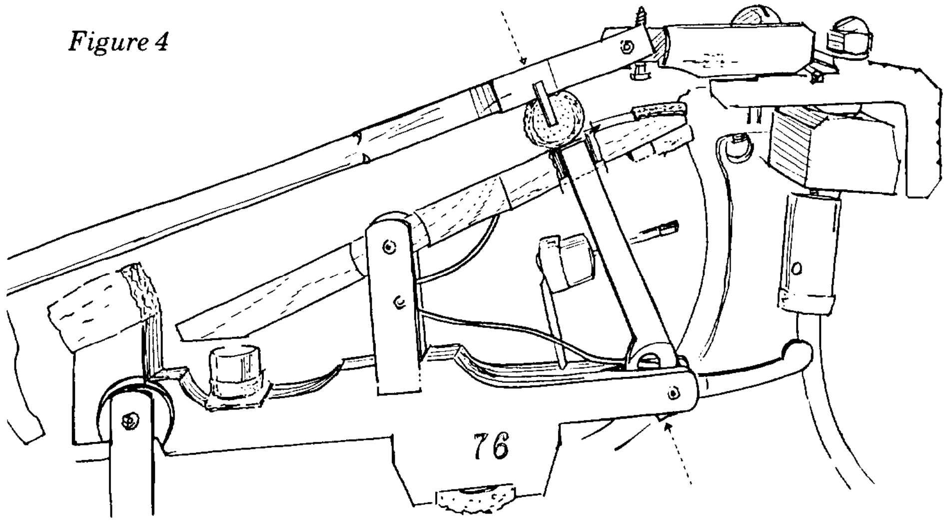
Here, then, are some likely regulation-related causes of excess friction (any of which are likely to be perceived as weight).

Jack position. This is a primary source of friction as well as action malfunction. Regulating it is a matter of striking a balance. There must be enough friction for the part to work, but not so much it causes problems. Figure 4 shows a correctly adjusted jack: the back edge of the jack is aligned with the back edge of the knuckle core.

In the case of pear-shaped extrusions of the shank wood itself, called Thayer knuckles, referencing from the front or keyboard edge of the knuckle, superimpose a conventional round knuckle and adjust the jack to its imaginary core. These actions are difficult to regulate well, but if they are rebuilt, a conventional shank can usually be substituted. If the jack is regulated or has settled too far back toward the hammer *(fig. 5)* it is under the knuckle too long during the keystroke. More of the top surface of the jack contacts the knuckle and the leading edge of the jack may be tilted so far back that it digs into the buckskin and the hammer blow and/or key dip may have to be altered just to cycle through let-off. Any of these may lead to complaints of heaviness.

Obviously, the condition of the knuckle is important. Wear and settling cause the knuckle to flatten *(fig. 6)*. It just naturally wants to conform to the top of the jack causing more surface contact than is desirable. Flat knuckles also develop "corners" which the jack must jerk past on its way toward let-off. It may hang up on the corner on its way back to rest causing it to cheat on the next blow. If there is excess friction between the knuckle and the *back* edge of the

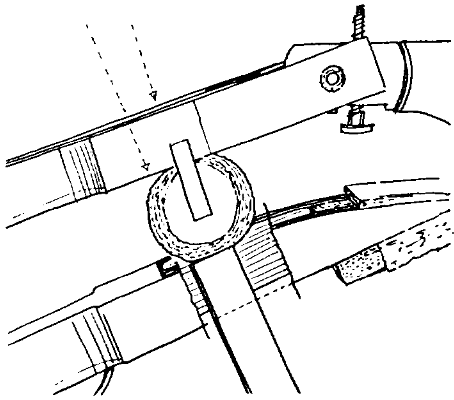
Figure 4



jack (two surfaces which contact during return) it will affect the upweight and speed of return of the key which will also be identified as "heavy action."

Although a correctly regulated jack will reduce touchweight, it cannot be too far forward or it may cheat. On a hard blow, it can skip out from under the knuckle without engaging it sufficiently to lift

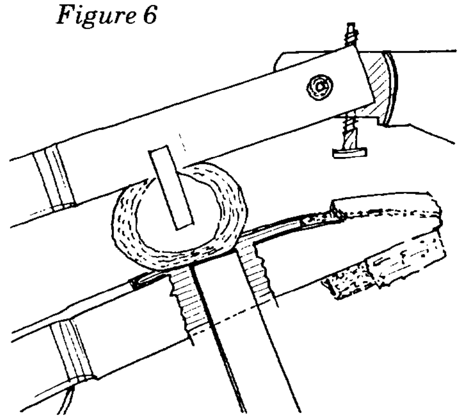
Figure 5



the hammer. Check for jack cheating by placing one hand just above the hammers at rest — not pressing them down, but restricting them from rising — and pushing firmly on each key. This will pop out any incipient cheating jacks which need to be regulated slightly further back.

I regulate jacks standing behind the action — the hammer side rather than the key side. This gives a more comfortable position and a clearer line of sight as I depress the repetition lever with one hand and lean over slightly to reach between the letoff buttons to engage the button regulating screw. (Be sure to buy or modify a tool to have a narrow enough shank to reach between dowel-type letoff buttons.) Some technicians adjust the #1 and #88 jacks and stretch a string across the

Figure 6



repetitions, filing a tiny groove alongside the back edge of the jacks in the sides of the repetition lever to hold the string in place, and adjust the jacks to the string line. I prefer to adjust the jacks to the individual knuckles, however, since it is the relationship between those two parts and not an absolutely straight line of jacks which is important. The hammer line (blow distance) must be reasonably correct for this operation to be accurate. At the least, the shanks must be up off the rests and supported by the repetition lever/jack.

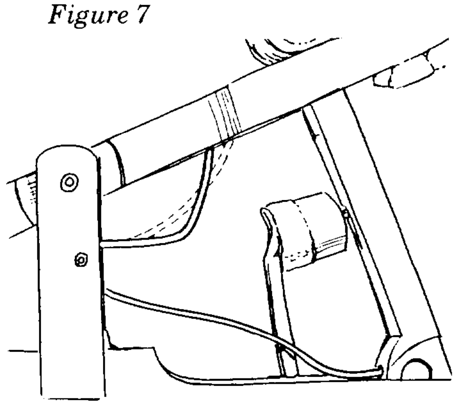
Repetition lever-to-jack height. Speaking of that support, here is another place in regulation which can affect touchweight. Although there must be sufficient clearance between the top of the jack and the knuckle for the jack to return to rest position, the top of the jack actually assists in supporting the hammer. The weight of the knuckle/hammer at rest is not supported by the repetition lever alone. If the jack protrudes above the level of the window it will support too much of the hammer weight and the touch will be very heavy. And, it is likely that the jack will hang up on return. If the repetition lever is too high above the top of the jack, there is lost motion between the jack top and the knuckle, which is inefficient and causes other regulation problems (such as lack of aftertouch — also interpreted as "heavy").

Lost motion here accelerates knuckle wear and flattening, since the jack gets a running start before impacting the knuckle. This condition also results in an unstable hammer line since each return of the hammer compresses the spring to a slightly different degree, changing the height of the lever. Adjustment is made with the regulating button on the lever, raising or lowering the window end so it is just slightly above the top of the jack. A fairly close regulation can be done by feeling across the window to determine if the top of the jack is just slighly below it. It is more accurate to "wink" the jack. When the hammer is at rest (as above, it must be up off the support, and spring tension must be nearly correct as well) gently trip out the jack by hand and feel for the brush of wood against buckskin as the jack slides out from under the knuckle. Watch for a small but definite drop in hammer position. The jack, when released should return almost all the way, although sometimes it needs a little help for the button to recontact the spoon.

This adjustment also depends greatly on the condition of the knuckle. Once again, as the knuckle flattens it forms corners which impede smooth working of the jack. It also wears unevenly — the narrow sides of the repetition window dig into the buckskin and the top of the jack wears a groove as well. This results in an uneven knuckle surface. It is impossible to really balance the weight between the two parts. The worse the condition, the more space must be left between the jack and the lever to ensure jack return. This results in the problems just mentioned but the knuckle condition makes them necessary evils.

Spring tension. If the spring tension is too weak, it contributes to problems with the jack/lever adjustment and may allow the knuckle to rest too heavily on the top of the jack, causing extra friction as the jack trips. If spring tension is too tight though it may also add "weight." If the hammer weight and shank pinning are correctly resisting the spring, the extra strength of the spring may be transmitted into resistance of the wippen and key. It will also create a noticeable kickback in the key as it is released — a sensation many pianists find unpleasant, and which they may describe as "heavy touch."

Figure 7

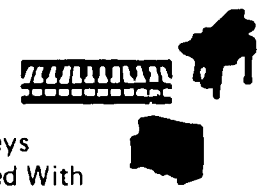


If butterfly-type springs are kinked instead of properly strengthened (or weakened) at the coil *(fig. 7)*, then the head of the spring may dig into the groove, requiring that excessive force be used to break it free. The test for correct spring tension is to strike the key, cycling the hammer into check, and then slowly release the key just until the backcheck releases the hammertail. Stop the key movement at this point. The hammer should rise. It should lift positively, but not jump. Adjust the spring tension with the set screw, if any, or by releasing the spring from the groove and pulling up to expand the coil and strengthen, or by pushing down to weaken. In some situations it may be prudent to leave the springs quite strong to ensure a functioning action that will run the risk of that unpleasant kickback as the key is released.

Blow distance/key dip. If the blow distance is too great, the timing of hammer travel to key dip is thrown off and the pianist may feel he or she is having to do too much work to get sound out of the instrument. In addition, although it is the distance between hammer and string which concerns us most, it is actually adjusted by raising or lowering the wippen. An excessively long blow distance is usually associated with a wippen body which has dropped significantly below parallel. The angle of the wippen in relation to its axis — the flange centerpin — makes for an inefficient action. A long blow distance is also frequently associated with lack of aftertouch. Unless the keydip is very deep, there isn't enough key travel to cycle the action through the long blow and completely through letoff with that margin of key travel remaining which we identify as aftertouch. A shallow keydip will create the same problem. Playing an action without aftertouch feels a lot like banging your fingertips on a desktop. On the other hand, if the blow is too short or the dip too deep, or both, there may be so much aftertouch that the jacks jam.

After the cycle of the hammer is complete, until the key is released, the jack remains in contact with the letoff button and will continue to trip forward, possibly resulting in jamming the jack against the cushion in the front of the lever window. This runs a high risk of breaking jacks, and also can be felt as a resistance at the bottom of the keystroke. In checking regulation samples, depress the key firmly all the way through aftertouch and then gently press on the jack toe by hand to be sure there is still a little space left between the jack and the window cushion. If there is not, something in the regulation needs to be adjusted: blow distance, keydip, letoff or drop (or all four). Too deep a keydip, even if the action is regulated to match, also may feel heavy because of the sensation of slow response — too much key

continued on page 16

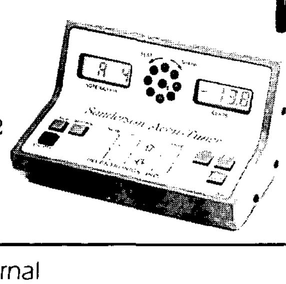


travel happens before the hammer hits the string.

Key height. It is possible to raise the keys so high on the balance rail that the capstan is tipped toward the wippen flange. The key then loses mechanical advantage in lifting the wippen and hammer.

Timing of damper lift. Often, due to settling, especially in a new piano, the damper lift is almost immediate and a lot can be done to improve the "touch" just by correcting the damper timing. If the key end contacts the damper underlever relatively soon in its travel it has not built up much momentum and the additional weight is more noticeable. The tradeoff is that a later damper timing may result in a more noticeable bump of contact.

I have assumed a basic knowledge of grand regulating. You may assume there can be other factors in regulating which affect touchweight, but that these are the primary. A good learning and diagnostic practice tool is the grand action model — buy or borrow one and just experiment with it a little when you have questions about regulation. ■



Notes and Comments.

Ray Chandler of Kawai has written to ask me to remind technicians that metric gauge numbers stamped on the bridges of some pianos do not correspond with American wire sizes. German wire, such as Roslau, runs approximately (although not exactly) a half size smaller. For instance, the number 14 stamped on a Kawai bridge at note 88 is actually size 13 1/2 in American size. To further confuse the situation, some American supply houses have had so much trouble with technicians restringing entire pianos with German wire, assuming that the sizes corresponded and then finding that they had inadvertently rescaled the pianos, that some suppliers now get the wire rewrapped before shipping so the sizes *do* correspond to American. Not only that, some manufacturers stamp their wire sizes to the bass end of a section, and some to the treble. The solution? Try to find out what type of wire is used in a given piano, and in all instances, use a micrometer and measure the broken string or the remaining unison to be sure of getting the correct size. And, measure the new wire before installation.

This months' *Journal* includes an article by Dr. Richard Brown of Portland, OR, and Franklin Lundak of Traer, IA. It outlines the process and results of a rescaling of a Steinway K upright. Although it is product-specific, there is enough general information to be gathered from studying the changes they chose to make that I think it will be of interest.

My thanks to James H. Donelson, author of *The Piano Rebuilders Handbook of Treble String Tensions*, for reading and evaluating this article for me.

I hope as you read this that you've already made plans to attend our convention in St. Louis. If not, let me urge you to do so. The benefits of attending seem particularly acute to me this year. I attended my first convention in St. Louis in 1973, as a very new craftsman member. Now I will be returning, in my first year as technical editor. The transition between one and the other is almost entirely the work of the PTG — the classes I have taken and the assistance I have received from so many. If you aren't there, you don't get it, so I say — be there!

TUNING UP

Setting The Temperament

Rick Baldassin
Tuning Editor

I have received communication recently from technicians stating that they have been having problems setting temperament. The temperament is, of course, the foundation of a good tuning. There are several ways to approach the setting of a temperament, both aurally and with an electronic aid. This month we will examine the temperament.

Before we start tuning the temperament, we must decide exactly what it is we are striving to achieve. In general, we agree that we are striving to tune an equal temperament. In the last several issues, however, it has been demonstrated that it is impossible to tune equal temperament on the piano. If it is impossible to tune the piano in equal temperament, what is it then that we are trying to achieve when we tune?

Generally speaking, we are attempting to set a temperament which has as many characteristics of equal temperament as we can achieve. What then are some of the characteristics of equal temperament? As has been mentioned in previous issues, equal temperament is defined as having fundamental frequencies which progress in the ratio of the twelfth root of two to one. As a result of this, the beat rates of the various intervals also progress in the ratio of the twelfth root of two to one. It has been demonstrated that in equal temperament, all of the intervals of a given type (Major thirds, for instance) have the same cent width (13.7 cents). If we examine the beat rate tables, we would also find that intervals of a like kind which share a common note (referred to as contiguous intervals) would have beat rates in the same ratio as the coincident partials for that same type of interval. For the Major third, the ratio of the coincident partials is 5:4. If we were to examine the beat rates for a pair of contiguous Major thirds (FA-AC;#), we would find that these beat rates were also in the ratio of 5:4 (or 4:5, depending on how you look at it).

We have established four characteristics of equal temperament. First, the fundamental frequencies progress in the ratio of the twelfth root of two to one. Second, the beat rates of the various intervals progress in the ratio of the twelfth root of two to one. Third, intervals of like kind have the same cent width. And fourth, contiguous intervals of like kind will have beat rates in the ratio of the coincident partials for that interval. Let us now examine how many of these characteristics can be executed on the piano.

The first characteristic was that the fundamental frequencies progressed in the ratio of the twelfth root of two to one. It has been demonstrated frequently that because of inharmonicity in the piano, the fundamental frequencies cannot progress in the ratio of the twelfth root of two to one. This is the reason for the failure of early electronic tuning devices to set good-sounding temperaments. These devices set the fundamental frequencies to the theoretical values (as accurately as they could, usually plus or minus three cents). The inharmonicity, unfortunately, distorted the partials and hence the beat rates did not sound acceptable.

If the beat rates do not sound acceptable when the fundamental frequencies are set to the theoretical values, we can conclude that in order for the beat rates to sound acceptable, the fundamental frequencies cannot be set to the theoretical values. If the fundamental frequencies cannot be set to the theoretical values, then, by definition, the piano cannot be tuned in equal temperament.

The more accurate and advanced tuning devices of today do not tune the fundamental frequencies to the theoretical values, but tune the partials with stretch to accommodate the inharmonicity. Since the partials generate the beats, a good-sounding progression can be achieved by this method. If we discount the fundamental frequencies and concentrate on the other characteristics we have established, we can then determine what we are striving for when we tune what we call "equal temperament" on the piano.

The second characteristic mentioned was that the beat rates of the various types of intervals progressed in the ratio of the twelfth root of two to one. In the piano, it is crucial that the beat rates, particularly of the fast beating intervals, do progress evenly. Even so, they will not likely progress in the theoretical ratio. If the progression is even, however, our ears will not be able to determine if it is in the theoretical ratio or not.

The third characteristic was that like intervals had the same cent width. This means, for instance, that all of the Major thirds would be +13.7 cents, all of the fourths would be +2.0 cents, all of the fifths would be −2.0 cents, and so on. Because of inharmonicity, the thirds in a given piano might all be 12.5 cents wide rather than 13.7, and the progression would still sound fine.

We might notice that the beat speeds of the former were a little slower than the latter, but we would have no complaint about the smoothness of the progression. In the Sanderson data presented previously, it was demonstrated that the cent widths actually decrease slightly in the temperament region rather than remaining equal.

Even so, there can still be a nice progression of beat rates. In the temperament area of the piano, the cent widths of the intervals should be equal or decrease slightly in an orderly fashion, even though these widths may not be the same as the theoretical width, in order to maintain an even progression of beat speeds.

The fourth characteristic was that the beat speeds of contiguous intervals should be in the same ratio as the coincident partials for the same interval. As was demonstrated previously, this would mean that for the Major thirds FA and AC♯, the beat rates would be 6.93 and 8.73, which are in the ratio of 4:5. Even though the actual beat rates may not be the same as the theoretical rates, the 4:5 (or 5:4) ratio should still hold true.

While it is true that several temperament systems have been taught, they are all attempts at the same result — tuning "equal temperament" on the piano. The sequence of tuning is only important inasmuch as it facilitates the end result.

Anyone who has participated in Bill Garlick's Master Class in Temperament Tuning has experienced this. In Bill's class, volunteers come to the piano and are permitted to tune any one note of their choosing which has not previously been tuned. This approach defies any one system, as the volunteers are never the same, and there are those who prefer to tune by thirds or fourths or fifths or sixths. Maybe the note you would have tuned next has already been tuned. Even so, in each demonstration which I have observed or participated, the end result has been a good-sounding temperament.

Why then are we in search of the

> "While it is true that several temperament systems have been taught, they are all attempts at the same result — tuning equal temperament on the piano. The sequence of tuning is only important inasmuch as it facilitates the end result."

perfect temperament system? It has been demonstrated that we can get to the same place in a myriad of ways. I guess we each need to be in search of a system which helps us individually achieve consistent, good sounding results in a reasonable length of time. Certainly this order or sequence of tuning will vary from individual to individual.

This is not to say that any one sequence is better than another. A person may be able to tune a temperament using minor seconds. Crazy, you might say. But if the final product is acceptable, then it does not really matter how it was achieved. This is why I have so little sympathy with points of view which state that tuning can only be done this way or that, and that any other way is inferior. If the end result is acceptable, it justifies the means.

Obviously, there are several ways to go about tuning a temperament. Some advocate tuning by fourths and fifths, others by thirds and sixths, still others by stopping the lights. What is one to believe? One thing is for certain, it is imperative that all intervals which are to be played be given consideration.

Since all of the intervals cannot be given equal consideration, it forces us to prioritize which will be given most importance, next most, and so on. It can be very dangerous to place too much weight on any one interval. Try an experiment which illustrates this point. Tune four independent chains of contiguous Major thirds from F3 to F4. During the tuning, it is only permissible to listen to Major thirds. Before you start, and without listening, nudge F♯ up, G down, and G♯ up.

Begin by tuning A3 from F3 about 7 BPS. Next tune C♯4 from A3 such that the beat rate is in a 5:4 ratio with F3-A3. Finally tune F4 from C♯4 such that the beat rate is in a 5:4 ratio with A3-C♯4. This completes our first chain of thirds, F3-A3-C♯4-F4. Begin tuning the second chain by tuning A♯3 from F♯3, slightly faster than F3-A3. Next tune D4 from A♯3 such that the beat rate is in a 5:4 ratio with F♯3-A♯3. This completes our second chain of thirds, F♯3-A♯3-D4. Begin tuning the third chain by tuning B3 from G3 slightly faster than F♯3-A♯3. Next tune D♯4 from B3 such that the beat rate is in a 5:4 ratio with G3-B3. This completes our third chain of thirds, G3-B3-D♯4. Begin tuning the fourth chain by tuning C4 from G♯3, slightly faster than G3-B3, and slightly slower than A3-C♯4. Next tune E4 from C4 such that the beat rate is in a 5:4 ratio with G♯3-C4. This completes our fourth chain of thirds, G♯3-C4-E4. Every note from F3 to F4 has now been tuned, and if you did everything correctly, you should be able to play a perfect progression of Major thirds, FA, F♯A♯, GB, G♯C, AC♯, A♯D, BD♯, CE, and C♯F. If you have any problems, you may correct them now, but remember, you can only play Major thirds. Finally, when you are satisfied that you have established a perfect series of thirds, play the fourths, then the fifths, then the sixths.

With an electronic aid, this experiment can be performed with a great deal of accuracy. The tuning sequence is identical to the above. In each case, set the tuner two octaves above the note being tuned, stop the light display on the reference note, add 13.7 cents, then tune the note. This will give a progression of Major thirds which are all 13.7 cents wide just like in equal temperament. When you have completed tuning all of the notes, be sure to listen to this perfect progression of thirds, as above, then listen to the fourths, fifths, and sixths.

After you have completed this experiment, you will understand the consequences of placing too much emphasis on any one interval. Knowing now that emphasis must be placed on the other intervals as well, we must prioritize them. Some prefer to prioritize by thirds, sixths, fourths, then fifths, while others prefer fifths, fourths, thirds then sixths.

No way is any more correct than another, providing the final result sounds acceptable. Some intervals may be easier for you to work with. In the temperament, there are slow beating intervals and fast beating intervals. Some prefer to work with the slow beating intervals because they can detect when they have made a very slight change, while others prefer to work with the fast beating intervals because they feel they can establish the critical progression of thirds and sixths more easily.

I would suggest you try both and see what works best for you. It is my opinion, however, that we should tune with the intervals which we consider most important in our final analysis. Otherwise, we rely on a series of resultant intervals. In short, I would not advise tuning with a chain of fourths and fifths, then listening for a perfect progression of resulting thirds and sixths, or vice-versa. It is my preference to tune with thirds and fourths, and listen with fifths and sixths. I say this with some hesitation, because I do not wish to imply that this is better than any other way, just that it works best for me.

When considering a temperament system, not only is it important to prioritize the intervals, but also to consider how the intervals are tuned within the system, how many notes have to be tuned before there is a confirmation that they have been tuned correctly. Some systems tune note 2 from note 1, note 3 from note 2, ... and note 13 from note 12. Tuning a chain of fourths and fifths would fall into this category. Other systems tune three or four key notes from which the remainder of notes are tuned. Tuning a chain of contiguous Major thirds from which the remaining notes were tuned would fall into this category. The latter helps to minimize cumulative errors.

A few years back, I was teaching a tuning class at the Pacific Northwest Conference. During the class, I outlined a temperament system which works very well for me. After the class, one of the participants presented me with an envelope and asked if I would read it in my spare time. To my amazement, this gentleman had published the exact same system nearly 30 years prior in *The Piano Technician*. It is the earliest record of which I am aware of what we have come to call a Direct Interval Tuning system. The gentleman's name was Donn Foli of the Vancouver B. C. Chapter.

In Foli's preface, he states that the system is like tuning a banjo or guitar. You start with the outside notes, and the other notes must fit between. The system begins by tuning a chain of contiguous thirds from F3 to F4 as above. The position of the second chain is determined by the tuning of contiguous fourths, both up from F3, and down from F4. Linking the chains of contiguous fourths together with the second chain of contiguous thirds cements the foundation, and determines the position of the remaining two chains of contiguous thirds. This system attacks the temperament in three stages. During each stage, adjustments are made until everything is in order, then the notes are left untouched for the duration.

It is interesting to me that the editor at the time called Foli's system an unusual approach. Thirty years ago, I am sure it was. In my mind, the fact that the work is so valid today makes Donn Foli a man ahead of his time. The system, as Foli described it, was, of course, designed to be executed aurally. The fact that it can also be executed with extreme precision by direct interval measurement with an electronic aid makes it even more valuable. Here is the system: (Please note that while the system presented below is essentially the same as was published by Donn Foli over 30 years ago, the description here is my own).

Step 1 - Tune A4 to 440 Hz, using note F2 as a reference note.

Step 2 - Tune A3 to A4 using the M3-M10 test.

Step 3 - Tune F3 from A3. Make a guess as to the speed (approximately 7 BPS).

Step 4 - Tune C♯4 from A3, such that the beat rate is in a 5:4 ratio with FA.

Step 5 - Tune F4 from F3 using the M3-M10 test.

Step 6 - Test C♯4-F4 M3 to see if it fits in the 5:4 progression FA-AC♯-C♯F. If C♯F is too fast, then FA and/or AC♯ are too slow. If C♯F is too slow, then FA and/or AC♯ are too fast. Adjust F3, C♯4, and F4 until the 5:4 progression of contiguous thirds is good, including F4-A4.

Step 7 - Tune A♯3 from F3. Make a guess as to the speed (less than 1 BPS). Test A♯F fifth.

Step 8 - Tune D♯4 from A♯3, slightly faster than FA♯.

Step 9 - Tune C4 from F4, about the same speed as A♯D♯. Test FC fifth.

Step 10 - Tune G3 from C4, about the same speed as FA♯. Play parallel fourths FA♯-GC-A♯D♯-CF.

Step 11 - Tune B3 from G3. GB must fit between FA and AC♯.

Step 12 - Test B3-D♯4 M3. It must fit between AC♯ and C♯F, and be in a 5:4 ratio with GB. Play parallel M thirds FA-GB-AC♯-BD♯-C♯F. If BD♯ is too fast, then fourths were tuned too wide. If BD♯ is too slow, fourths were tuned too narrow. Repeat Steps 7 - 11 until Step 12 is satisfied.

Step 13 - Tune F♯3 from A♯3. It must fit between FA and GB, and F♯B fourth, F♯C♯ fifth, and F♯D♯ sixth must sound good.

Step 14 - Tune D4 from A♯3. It must fit between AC♯ and BD♯, be in a 5:4 ratio with F♯A♯, and AD fourth, GD fifth, and FD sixthh must sound good.

Step 15 - Tune G♯3 from C4. It must fit between GB and AC♯, and G♯C♯ fourth, G♯D♯ fifth, and G♯F sixth must sound good.

Step 16 - Tune E4 from C4. It must fit between BD♯ and C♯F, be in a 5:4 ratio with G♯C, and BE fourth, AE fifth, and GE sixth must sound good.

Now that all temperament notes have been tuned, test all parallel M thirds, fourths, fifths, and M sixths. Since all of these intervals have been tested along the way, all progressions should sound good. Make any minor adjustments as necessary, bearing in mind all of the tests used in the step the note was originally tuned.

As you may have noticed, in this system M thirds and fourths are tuned, testing with other thirds, fourths, fifths, and sixths. Because the M sixth is a M third plus a fourth, the M sixth progression is fairly well controlled. Because no fifths are tuned, every fifth in the temperament is the result of notes which have been tuned via other intervals. For this reason it is very important to listen carefully to each fifth as the instructions indicate to ensure good sounding fifths. This system also requires listening to parallel intervals in a slightly different fashion than usual. It begins by listening to the progression of Major thirds which are four half-steps apart (contiguous), then two half-steps apart (whole tone), and finally one half-step apart (chromatic). With practice, it can be as easy to predict the contiguous and whole tone progressions as it is the chromatic progression.

As was mentioned previously, the same temperament can be executed with an electronic aid using direct interval measurement. Using the electronic aid, the interval widths would be set either equal, or in a slightly decreasing fashion. It is a complicated procedure, but it gives quite satisfying results. Because of its length and complexity, I will not publish the instructions for tuning this temperament with an electronic aid at this time. Anyone wishing these instructions may obtain them by sending me a self-addressed, stamped envelope, accompanied by a short statement requesting the instructions, *and* either an article for publication in this column, or a good question which may be of interest to our readership. If there is enough interest, I may publish the electronic setting instructions at a later time.

In conclusion, it has been demonstrated that there are four main characteristics of equal temperament. While it has been shown that it is impossible by definition to tune the piano in equal temperament, it has also been shown that the other characteristics can be executed readily in what we call "equal temperament" on the piano. It was mentioned that the sequence or manner of tuning has little bearing so long as the final result sounds acceptable. Likewise, the intervals used to tune with should be chosen based on the individual's ability to achieve consistent, good sounding results in a reasonable length of time. Emphasis must be placed on all intervals which will be played, and caution was issued against placing too much emphasis on any one interval. The intervals given highest priority in the final analysis should be used to tune with. Finally, a temperament system which employs the characteristics of equal temperament mentioned was presented.

My sincere thanks to Donn Foli for his great insight and for being a pioneer in the tuning profession.

When the Heat is On

Recently, the Music Teachers National Association (MTNA) held its national convention in Salt Lake City. Ralph Barrus and I did most of the tuning for the convention. We were on very tight schedules, sometimes having less than an hour to tune two pianos together. I wish to share a couple of experiences which may be of help if you find yourself in a similar situation in the future.

Before the convention began, Ralph and I determined that in the areas with more than one piano, each time the pianos were tuned, they would be pitched strictly at A440. This was cumbersome at times, especially when an instrument was basically in tune with itself but, say, two cents sharp. Just moments prior to one of the Winners Concerts, I learned that one of the performances required two pianos. Fortunately, the piano which Ralph had tuned the day before was right at A440. The piano which I had just finished tuning was also right at A440. When I started the tuning, the piano was slightly above pitch, but in keeping with our agreement, I lowered the piano to 440. The fact that both pianos were tuned precisely to A440 averted a near disaster, and the two pianos were matched together beautifully for the performance.

Another experience happened which brought home the fact that at times we must have decisions made in advance, so that when a situation occurs we do not have to decide what to do, only to do it.

Because of the tight scheduling at the convention, I had only 45 minutes to tune for an important recital. Just 15 minutes before the performance was to begin, a string broke at the capo bar. The string comprised the center and right strings of the unison, so the string could not simply be removed, as there would be nothing for the hammer to strike in the shift position.

My car (with the piano wire) was parked a good 10 minutes away. I knew I had only one option — tie the string with the existing wire. I quickly removed the short piece of wire which extended from the tuning pin to the capo bar, backing the tuning pin out about one and a half turns. I then backed off about two turns from the other tuning pin, and unhooking the string from the bridge pins, pulled the wire toward the rear of the piano, straightening the bends from the capo bar, bridge pins, and hitch pin.

I tied the string by making the first bend in the short piece of wire, and slid it on to the longer piece. I then made the second bend in the long piece of wire. Because the coil was still wound on the short piece of wire, I had to do some fancy maneuvering, but finally got the knot together.

Placing the needlenose into the coils of the short piece of wire, I pulled toward the rear of the piano and tightened the knot as much as possible. The adrenaline was really flowing. I placed the wire through the bridge pins, around the hitch pin, through the bridge pins again, under the capo bar (the knot just cleared), and onto the tuning pin. I quickly pulled the string to pitch, stretched the string to tighten the knot, straightened the previous bends a little more, and spent the last few minutes getting the tuning stabilized.

When I was done, there were two and a half coils on each tuning pin, and a cute little knot between the capo bar and the front duplex. I closed my tuning case, and in front of the audience, walked away like nothing had happened, with five minutes to spare. In this instance I did not have time to spend deciding what to do. I had only time to do it. Fortunately for me, I remembered how to tie a knot as well.

Until next time, practice tying a knot in a string. Pretend it is a bass string through an agraffe — that makes it more fun.

Please send your questions and comments to me:

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COMPUTERS

AND PIANOS

Hardware

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Last month I discussed possible reasons why you might want a computer. This month I want to cover the basic hardware available. The whole computer industry, both hardware and software, is very unlike the piano industry in that it is changing very rapidly.

Computer. First you need a basic computer.This is the heart of the system and includes the keyboard and central processor. Two acronyms often associated with computers are ROM and RAM. ROM stands for "Read Only Memory." This is the memory in the computer that is unchangeable and tells the computer how to be a computer.

It is the same as the memory in a calculator that tells it how to add and substract. RAM stands for "Random Access Memory." This is the memory which you are free to use for programs and data. Memory is usually measured in "K." One K equals 1,024 bytes. A byte is one letter or number. The amount of RAM you want in your computer is partly determined by the software you want to use. All software has a minimum RAM requirement. The larger the program, the more functions it can perform.

Monitor. Your computer can't communicate with you without a monitor to display information. A monitor can be a TV set or a monitor made for computers. Monitors usually have finer detail than a TV and may be amber or green to minimize eye strain. Color monitors, although more expensive, give you both the color of the TV plus the detail of the monitor.

Storage Devices. When the computer is turned off it loses all the information stored in the RAM. In order to eliminate keying in a program every time the computer is turned on we need a storage device. The least expensive is a cassette recorder. But you get what you pay for and this is also the slowest way to store and load information. A simple program could take as much as 30 minutes to load with a cassette recorder. The most common storage device on small computers is the floppy disk. These are 5 1/2-inch flexible plastic disks with recording material similar to recording tape. Typical storage capacity is from 140K to 360K depending on how tightly the information is packed together and whether the disk drive writes on both sides or only one side of the disk. Because the disks are removable there is no limit to storage capacity other than how much data is available on any one disk. Several computers now have 3 1/2-inch disks available which will store 800K per disk. It is typical of the computer industry that newer products are smaller yet do more.

Hard Drives. Hard drives contain a fixed rigid disk that can pack information much more tightly.

Hard drives usually start at 10 Megabytes (10 million bytes) and units up to 120 Meg are becoming more readily available. There are even hard drives with removable disks but these are very expensive and not really necessary for most piano technicians. A hard drive spins faster so data access is five to ten times faster than on floppies. Its large capacity gives you access to a large amount of data at once without the need to swap disks constantly. Once the fixed disk unit is full you cannot add more data but you can copy less used data onto floppies and free up the space. It is unlikely that a piano technician would have more than 10 Meg of data that required constant updating. How much storage space a technician needs will depend on how many customer records he has and how much information is kept on each record.

RAM Disks. RAM disks are really just extra RAM which is set up to store data in the same format that a disk drive does. RAM drives are the fastest storage devices, but all memory is lost when the computer is turned off so the information must be loaded onto a disk before turning off the computer. We are beginning to see

RAM drives with a battery on them so they will keep their memory even when the computer is off. RAM disks are becoming available in large capacities but keep in mind that on an Apple with 140K capacity on its floppies, to back up a 10 Meg hard or RAM disk takes 72 floppies. If you had to back up the whole thing every time you turn off the computer you would not have saved much time with the computer.

I bought a hard disk along with my floppies rather than a RAM disk for the following reason. At the end of each day I have four or five customer records to enter in the computer. The hard disk just saves each new entry and I'm done. With a RAM disk I would need to load seven disks of customer records, make my changes and then load it back onto the seven disks. This procedure would take too much time.

If you only enter customer information weekly or less frequently this might not be a problem to you.

Printers. To get information out of your computer and onto paper you need a printer. There are two main types of printers available today: daisy wheel and dot matrix. A daisy wheel printer has a small wheel with 96 spokes and a character at the end of each spoke. It is similar to the wheel in a Dymo label maker. The wheel spins and a small hammer hits it at the precise moment to print the correct letter. This type of printer is letter quality and is similar to a high quality IBM typewriter. It is slow as printers go — 12-20 cps. (character per second).

However, this is about 250 words per minute, which is still faster than most of us can type.

Dot matrix printers have a head with a column of wires that prints dots. As the head moves across the paper, precise timing of the dots produces letters. These can be quite fast, as high as 600 cps. Most dot printers offer several speeds, giving a high speed draft quality and a lower speed of near-letter quality or, in some cases, true letter quality. They slow down and print more dots per letter so they fill in the spaces between the dots.

Both dot matrix and daisy wheel printers offer a selection of type styles. Daisy wheels are removable and can be replaced with other type styles, similar to an IBM selectric typewriter. Dot printers change type styles electronically and the limits are in the software only.

There are even multilingual word processors that let you print in Russian, Hebrew, Japanese and other languages that use different alphabets. Dot printers can also print graphics for software that use them. Dot printers can more easily change type styles in the middle of printing. A daisy wheel would require a pause to change wheels or to overprint where the printer skips a place for the second typestyle on the first pass. This method requires the paper to be backed up and a second pass made to fill in the blanks with the second typestyle.

On the high end of the market are laser printers which print with print shop quality at speeds up to two to three pages per second. It is doubtful that most of us would need such a printer but it has created a whole new field of desktop publishing.

Modems. A modem is a device that allows your computer to communicate with another computer over the phone. This communication might be desirable for businesses needing to share information between several locations.

Modems provide access to a number of services which tie your computer into a large mainframe computer. On a subscription basis you can get up-to-the-minute stock reports, make airline reservations, browse through a legal library, order merchandise through catalog services, etc. Many computer user groups have a bulletin board service in which a computer acts as a contact point for the exchange of information. This allows for electronic mail — you could type a letter; send it to the bulletin board computer; the recipient accesses the data into his computer and then prints it out. Our PTG home office staff currently uses a modem to send *Journal* text to the typesetter who can then run it without having to key it in again. The possibilities are endless and we have just begun to see the kinds of things that will be available by modem.

Other hardware. Other than the basic hardware discussed there are circuit boards called "cards" which plug into your computer and make it do other things. For example, printers often need an interface card so that the computer can properly run the printer. There are cards with extra RAM so you can upgrade your computer to run larger programs. There are cards that make your computer run with an operating system different than it was built with. This would allow you to use a whole library of software which would not work otherwise. There are cards to speed up your computer in case you find it so slow this expenditure is warranted. There are even cards with permanent programs so you can run popular software without having to load it from a disk. Another interesting card creates a cache memory which is used to store the data you use most often from your hard disk. As you operate your computer this card analyzes what data is accessed most and stores it in RAM, thus giving you RAM speed for your most used data. It also loads this data when the computer is turned on so you don't have to think about it the way you would with a regular RAM disk.

With an overview of hardware accomplished, next month we will begin to look at software. There are three main types of programs used for business: Word Processor, Spread Sheet and Data Base. I will take each one separately for the next three months. In no way do I expect these articles to be definitive since computers change very quickly. I also will avoid dealing with specific programs since they may not be available for your computer. ■

Rescaling the 1905 Steinway Upright

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We analyzed a 1905 Steinway upright to evaluate the quality of the original scaling. We found serious flaws in the original conception, and design errors involving both bass and treble bridges. Although these flaws are structural and significant, it is possible to circumvent most of the present limitations of this instrument.

The following tables depict the original scaling specifications, as measured from a well-preserved instrument with original stringing. Calculations of tension and inharmonicity were performed on the TI-66 programmable calculator, using Dr. Al Sanderson's scaling equations. A cursory glance at the graphs will illustrate some of the errors of the original scaling, as well as what improvements can be made by redesign of stringing.

The total plate tension is not significantly altered: computation gives original scaling tension at 35,891; redesigned scaling gives 37,345 — an increase of 1,454 pounds (4 percent), well within the tolerance of the plate.

We can find five good reasons to rescale this instrument: 1) Rescaling significantly decreases inharmonicity in all wound strings; 2) Redesign for proper monochord tension achieves increased carrying power of the lower bass; 3) Monochord and bichord sections will be homogeneous in volume, respectively, with equitension scaling each section; 4) Better balance of monochord and bichord power levels results from rescaling with 10 percent greater monochord tension compared to bichords; 5) Improved balance results throughout the treble section (see tension scatter graph). The lowermost two unisons of the treble bridge cannot accommodate unwrapped strings, being of insufficient length. With redesign for wrapped strings, a smooth "break" can be achieved.

However, there are three serious intrinsic flaws in this instrument: 1) The bass bridge is not notched in the bichord section. There is a one-eighth-inch difference in speaking length within the bichord unisons, which will preclude "clean" unison tuning; 2) The treble bridge lacks "pauses" in its curve at the braces, resulting in excessive increment of speaking length across the strut. One must reverse trend in wire gauge to accommodate this faulty design; 3) The lowermost treble is significantly understressed with original scaling, smoothing the "break" and pulling up the tenor volume necessitate wrapped strings notes #27 and #28, requiring minor plate modification.

We offer these suggestions to our colleagues who may encounter this instrument and who wish to rebuild it. The acoustical quality will be much enhanced by rescaling.

EXPLANATION OF SYMBOLS

MBT = monochord bichord trichord
LMR = left middle right
D/S = doubly wound string / singly wound string
L_s = speaking length, inches
L_a = length from front bridge pin (nearest tuning pin) to hitch pin
L_t = length of string from hitch pin to agraffe (used to calculate elongation at pitch tension)
d = core diameter, inches
D_2 = outermost diameter of wound string
L_1 = length unwrapped end of bass string, assumes equal measurements each end of string
L_2 = 'step,' length outer winding protrudes beyond inner winding, assumes equal measurements each end of string
T = tension in pounds
P = percentage breaking point
e = elongation in inches at pitch tension
B = inharmonicity (cents)
L_h = length end of loop to start of winding, used for ordering wound strings

Original Bass Scaling

Nt. #	Strg. #	MBT	D/S	L_s	L_a	d	D_2	D_2/d	L_1	T	P	B
1	1	M	S	45.75	4.375	.060	.225	3.7	.875	165	18	.514
2	2	M	S	45.75	4.875	.056	.212	3.8	.875	165	21	.408
3	3	M	S	45.25	5.25	.056	.205	3.7	.875	169	21	.408
4	4	M	S	45.31	5.675	.052	.192	3.7	.875	167	24	.324
5	5	M	S	45.0	6.125	.049	.183	3.7	.875	168	28	.274
6	6	M	S	44.81	6.50	.049	.173	3.5	.875	167	28	.277
7	7	M	S	44.56	6.675	.043	.166	3.9	.875	171	37	.195
8	8	M	S	44.25	6.675	.042	.161	3.8	.875	178	40	.183
9	9	M	S	44.0	6.50	.040	.156	3.9	.875	185	46	.163
10	10	M	S	43.75	6.375	.040	.154	3.8	.875	200	50	.159
11L	11	B	S	43.5	6.94	.042	.131	3.1	.675	161	36	.157
11R	12	B	S	43.5	6.0	.042	.131	3.1	.675	161	36	.157
12L	13	B	S	43.25	6.81	.041	.121	2.9	.675	153	36	.153
12R	14	B	S	43.25	5.94	.041	.121	2.9	.675	153	36	.153
13L	15	B	S	42.875	6.19	.041	.123	3.0	.675	175	41	.142
13R	16	B	S	42.875	5.875	.041	.123	3.0	.675	175	41	.142
14L	17	B	S	42.56	6.125	.041	.119	2.9	.675	181	43	.140
14R	18	B	S	42.56	5.81	.041	.119	2.9	.675	181	43	.140
15L	19	B	S	42.25	6.0	.041	.116	2.8	.675	190	45	.137
15R	20	B	S	42.25	5.75	.041	.116	2.8	.675	190	45	.137
16L	21	B	S	41.56	6.0	.041	.112	2.7	.675	193	45	.141
16R	22	B	S	41.56	5.675	.041	.112	2.7	.675	193	45	.141
17L	23	B	S	41.675	5.875	.039	.107	2.7	.675	199	52	.119
17R	24	B	S	41.675	5.56	.039	.107	2.7	.675	199	52	.119
18L	25	B	S	41.31	5.876	.039	.106	2.7	.675	215	56	.115
18R	26	B	S	41.31	5.50	.039	.106	2.7	.675	215	56	.115
19L	27	B	S	41.0	5.75	.040	.102	2.6	.675	221	55	.123
19R	28	B	S	41.0	5.375	.040	.102	2.6	.675	221	55	.123
20L	29	B	S	40.69	5.69	.039	.098	2.5	.675	225	59	.115
20R	30	B	S	40.69	5.375	.039	.098	2.5	.675	225	59	.115
21L	31	B	S	40.375	5.675	.038	.093	2.4	.675	225	62	.109
21R	32	B	S	40.375	5.31	.038	.093	2.4	.675	225	62	.109
22L	33	B	S	40.06	5.56	.038	.089	2.3	.675	228	62	.110
22R	34	B	S	40.06	5.25	.038	.089	2.3	.675	228	62	.110
23L	35	B	S	39.69	5.50	.037	.085	2.3	.675	229	66	.104
23R	36	B	S	39.69	5.19	.037	.085	2.3	.675	229	66	.104
24L	37	B	S	39.375	5.44	.038	.077	2.0	.675	209	57	.117
24R	38	B	S	39.375	5.06	.038	.077	2.0	.675	209	57	.117
25L	39	B	S	39.125	5.375	.037	.070	1.9	.675	192	56	.115
25R	40	B	S	39.125	5.0	.037	.070	1.9	.675	192	56	.115
26L	41	B	S	38.75	5.31	.036	.068	1.9	.675	200	61	.107
26R	42	B	S	38.75	4.94	.036	.068	1.9	.675	200	61	.107

Original Treble Scaling

note #	L_s	G	d	T	P
27	42.69	18	.041	107	25
28	42.13	18	.041	117	28
29	41.94	18	.041	131	31
30	40.81	18	.041	139	33
31	39.62	18	.041	147	35
32	38.12	18	.041	153	36
33	36.69	18	.041	159	37
34	34.38	18	.041	156	37
35	33.50	18	.041	167	39
36	31.94	18	.041	170	40
37	30.31	18	.041	172	40
38	28.86	17	.039	158	41
39	27.38	17	.039	160	42
40	25.94	17	.039	161	42
41	24.69	17	.039	164	43
42	23.50	17	.039	167	43
43	22.37	17	.039	170	44
44	21.06	17	.039	169	44
45	19.94	17	.039	170	44
46	18.94	16 1/2	.038	163	45
47	18.0	16 1/2	.038	165	45
48	17.125	16 1/2	.038	168	46
49	15.56	16 1/2	.038	156	43
50	14.75	16 1/2	.038	157	43
51	14.125	16 1/2	.038	162	44
52	13.375	16 1/2	.038	153	45
53	12.75	16 1/2	.038	166	45
54	11.24	16	.037	137	40
55	10.69	16	.037	139	40
56	10.24	16	.037	144	41
57	9.75	16	.037	146	42
58	9.25	16	.037	148	43
59	8.87	16	.037	152	44
60	8.37	16	.037	152	44
61	8.0	16	.037	156	45
62	7.625	16	.037	159	46
63	7.3	15 1/2	.036	155	47
64	6.81	15 1/2	.036	151	46
65	6.43	15 1/2	.036	152	46
66	6.125	15 1/2	.036	154	47
67	5.81	15	.035	147	48
68	5.43	15	.035	144	47
69	5.18	15	.035	148	48
70	4.87	15	.035	146	47
71	4.625	14 1/2	.034	140	48
72	4.375	14 1/2	.034	140	48
73	4.19	14 1/2	.034	145	49
74	3.94	14 1/2	.034	144	49
75	3.75	14	.033	137	50
76	3.44	14	.033	130	47
77	3.375	14	.033	140	51
78	3.19	14	.033	140	51
79	3.06	13 1/2	.032	137	53
80	2.94	13 1/2	.032	142	55
81	2.75	13 1/2	.032	139	54
82	2.625	13 1/2	.032	142	55
83	2.50	13	.031	136	56
84	2.375	13	.031	138	57
85	2.25	13	.031	139	57
86	2.125	13	.031	139	57
87	2.0	13	.031	138	57
88	2.0	13	.031	155	64

Rescaled Design — Wound Strings

Note	String	MBT	D/S	L_s	L_a	L_t	d	D_2	D_2/d	L_1	L_2	T	P	e	B
1	1	M	D	45.75	4.375	50.1	.049	.245	5	.5	.5	196	32	.18	.216
2	2	M	D	45.75	4.875	50.6	.047	.235	5	.5	.5	202	36	.21	.186
3	3	M	D	45.25	5.25	50.5	.045	.225	5	.5	.5	203	40	.23	.167
4	4	M	D	45.31	5.675	51.0	.042	.210	5	.5	.5	199	45	.26	.140
5	5	M	D	45.0	6.125	51.1	.040	.200	5	.5	.5	200	49	.29	.126
6	6	M	D	44.81	6.50	51.3	.038	.190	5	.5	.5	201	55	.33	.113
7	7	M	D	44.25	6.675	51.2	.036	.180	5	.5	.5	200	61	.36	.103
8	8	M	D	44.25	6.675	50.9	.035	.171	4.9	.5	.5	200	65	.38	.099
9	9	M	D	44.0	6.50	50.5	.035	.162	4.6	.5	.5	199	64	.39	.100
10	10	M	D	43.75	6.375	50.1	.035	.153	4.4	.5	.5	198	64	.37	.101
11L	11	B	D	43.5	6.94	50.0	.034	.139	4.1	.5	.5	181	62	.35	.100
11R	12	B	D	43.5	6.0	59.5	.034	.139	4.1	.5	.5	181	62	.35	.100
12L	13	B	D	43.25	6.81	50.1	.034	.132	3.9	.5	.5	181	62	.36	.101
12R	14	B	D	43.25	5.94	49.2	.034	.132	3.9	.5	.5	181	62	.36	.101
13L	15	B	D	42.875	6.19	49.1	.033	.125	3.8	.5	.5	179	65	.37	.098
13R	16	B	D	42.875	5.875	48.75	.033	.125	3.8	.5	.5	179	65	.37	.098
14L	17	B	D	42.56	6.125	48.7	.033	.119	3.6	.5	.5	180	65	.37	.098
14R	18	B	D	42.56	5.81	48.4	.033	.119	3.6	.5	.5	180	65	.37	.098
15L	19	B	S	42.25	6.0	48.2	.038	.114	3	.5	-	184	50	.29	.092
15R	20	B	S	42.25	5.75	48.0	.038	.114	3	.5	-	184	50	.29	.092
16L	21	B	S	41.56	6.0	47.6	.036	.108	3	.5	-	179	55	.31	.082
16R	22	B	S	41.56	5.675	47.2	.036	.108	3	.5	-	179	55	.31	.082
17L	23	B	S	41.675	5.875	47.6	.034	.102	3	.5	-	180	62	.35	.068
17R	24	B	S	41.675	5.56	47.2	.034	.102	3	.5	-	180	62	.35	.068
18L	25	B	S	41.31	5.875	47.2	.034	.097	2.8	.5	-	180	62	.34	.069
18R	26	B	S	41.31	5.50	46.8	.034	.097	2.8	.5	-	180	62	.34	.069
19L	27	B	S	41.0	5.75	46.7	.034	.092	2.7	.5	-	179	61	.34	.070
19R	28	B	S	41.0	5.375	46.4	.034	.092	2.7	.5	-	179	61	.34	.070
20L	29	B	S	40.69	5.69	46.4	.034	.088	2.6	.5	-	182	62	.34	.070
20R	30	B	S	40.69	5.375	46.1	.034	.088	2.6	.5	-	182	62	.34	.070
21L	31	B	S	40.375	5.675	46.0	.034	.084	2.5	.5	-	183	63	.34	.070
21R	32	B	S	40.375	5.675	46.0	.034	.084	2.5	.5	-	183	63	.34	.070
22L	33	B	S	40.06	5.56	45.6	.034	.079	2.3	.5	-	179	61	.33	.070
22R	34	B	S	40.06	5.25	45.3	.034	.079	2.3	.5	-	179	61	.33	.070
23L	35	B	S	39.69	5.50	45.2	.034	.075	2.2	.5	-	179	61	.33	.074
23R	36	B	S	39.69	5.19	44.9	.034	.075	2.2	.5	-	179	61	.33	.074
24L	37	B	S	39.375	5.44	44.8	.034	.072	2.2	.5	-	182	62	.33	.073
24R	38	B	S	39.375	5.06	44.4	.034	.072	2.2	.5	-	182	62	.33	.073
25L	39	B	S	39.125	5.375	44.5	.034	.068	2.0	.5	-	181	62	.33	.074
25R	40	B	S	39.125	5.0	44.1	.034	.068	2.0	.5	-	181	62	.33	.074
26L	41	B	S	38.75	5.31	44.1	.034	.065	1.9	.5	-	182	62	.33	.075
26R	42	B	S	38.75	4.94	43.7	.034	.065	1.9	.5	-	182	62	.33	.075
27L	43	T	S	42.69	*	*	.033	.054	1.6	.5	-	174	63	.34	.055
27M	44	T	S	42.69	*	*	.033	.054	1.6	.5	-	174	63	.34	.055
27R	45	T	S	42.69	*	*	.033	.054	1.6	.5	-	174	63	.34	.055
28L	46	T	S	42.13	*	*	.033	.052	1.6	.5	-	176	64	.35	.056
28M	47	T	S	42.13	*	*	.033	.052	1.6	.5	-	176	64	.35	.056
28R	48	T	S	42.13	*	*	.033	.052	1.6	.5	-	176	64	.35	.056

* Note #27 and #28 are the lowermost unisons on the treble bridge. These unisons were originally designed for unwrapped strings, and the plate will thus require modification: additional hitch pins will need to be drilled, ideally aligned with the bridge pins for equal side bearing. This will probably involve removal and plugging of the original hitch pins for these two unisons. One can estimate 1/3" elongation at pitch tension for these redesigned wound strings. To order, subtract 1 1/3" from the speaking length (1/2" unwrapped length each end plus elongation factor = 1 1/3") to obtain appropriate length of wrap. Measure from newly located hitch pin to front bridge pin and add 1/2" to obtain length from loop to start of winding.

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Rescaled Treble Strings

Note	L_s	G	d	T	P
27 (see wound string specifications)					
28 (see wound string specifications)					
*29	41.94	21	.047	172	31
30	40.81	20	.045	167	33
31	39.62	20	.045	177	35
32	38.12	19	.043	168	36
33	36.69	19	.043	175	37
34	34.38	18 1/2	.042	164	37
35	33.50	18 1/2	.042	175	39
36	31.94	18	.041	170	40
37	30.31	18	.041	172	40
38	28.86	17 1/2	.040	167	41
39	27.38	17 1/2	.040	168	42
40	25.94	17 1/2	.040	170	42
41	24.69	17 1/2	.040	172	43
42	23.50	17	.039	167	43
43	23.37	17	.039	170	44
44	21.06	17	.039	169	44
45	19.94	17	.039	170	44
46	18.94	16 1/2	.038	163	45
47	18.0	16 1/2	.038	165	45
48	17.125	16 1/2	.038	168	46
49	15.56	16 1/2	.038	156	43
50	14.75	16 1/2	.038	157	43
51	14.125	16 1/2	.038	162	44
52	12.375	16 1/2	.038	163	45
53	12.75	16 1/2	.038	166	45
*54	11.24	17	.039	152	40
55	10.69	17	.039	155	40
56	10.24	17	.039	159	40
57	9.75	16 1/2	.038	154	42
58	9.25	16 1/2	.038	156	43
59	8.87	16	.037	152	44
60	8.37	16	.037	152	44
61	8.0	16	.037	156	45
62	7.625	16	.037	159	46
63	7.3	15 1/2	.036	155	47
64	6.81	15 1/2	.036	151	46
65	6.43	15 1/2	.036	152	46
66	6.125	15 1/2	.036	154	47
67	5.81	15 1/2	.036	156	48
68	5.43	15 1/2	.036	153	47
69	5.18	15 1/2	.036	156	48
70	4.87	15 1/2	.036	155	47
71	4.625	15 1/2	.036	157	48
72	4.375	15 1/2	.036	157	48
73	4.19	15	.035	153	49
74	3.94	15	.035	152	49
75	3.75	15	.035	155	50
76	3.44	15	.035	146	47
77	3.375	14 1/2	.034	149	51
78	3.19	14 1/2	.034	149	51
79	3.06	14	.033	145	53
80	2.94	14	.033	151	55
81	2.75	14	.033	148	54
82	2.625	14	.033	151	55
83	2.50	13 1/2	.032	145	56
84	2.375	13 1/2	.032	147	57
85	2.375	13	.031	147	57
86	2.125	13	.031	148	57
87	2.0	13	.031	138	57
88	2.0	13	.031	155	64

*Tied string bass side of note #29
*Tied string bass side of note #54

Bass String Order Sheet

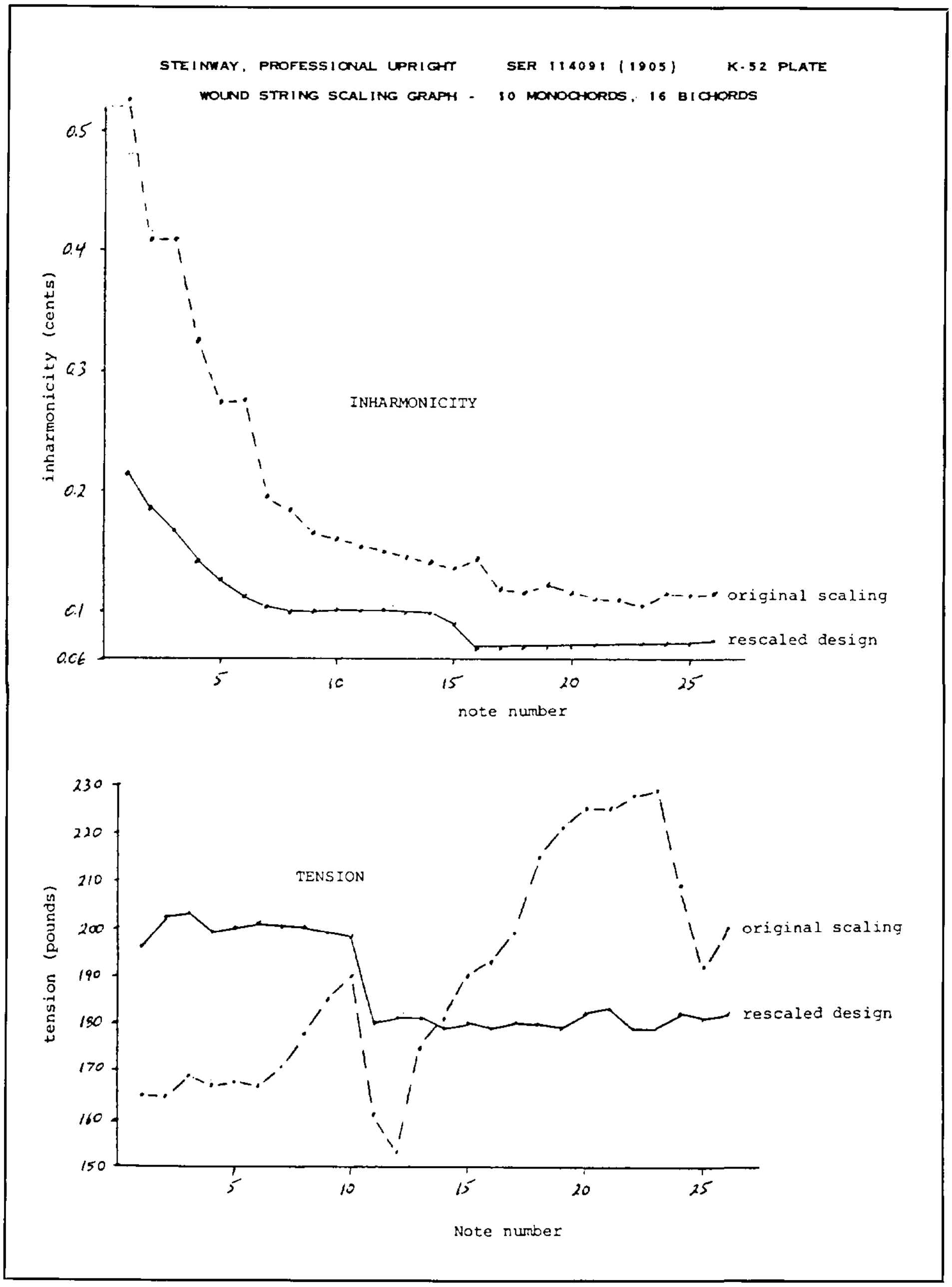
Note #	Strg. #	D/S	d	G_{core}	D_2	L_w	L_h
1	1	D	.049	22	.245	44 9/16	47/8
2	2	D	.047	21	.235	45 1/2	5 3/8
3	3	D	.045	20	.225	44	5 3/4
4	4	D	.042	18 1/2	.210	44	6 3/16
5	5	D	.040	17 1/2	.200	43 11/16	6 3/8
6	6	D	.038	16 1/2	.190	43 1/2	7
7	7	D	.036	15 1/2	.180	43 3/16	7 1/8
8	8	D	.035	15	.171	42 7/8	7 3/16
9	9	D	.035	15	.162	42 5/8	7
10	10	D	.035	15	.153	42 3/8	6 3/8
11L	11	D	.034	14 1/2	.139	41 1/8	7 7/16
11R	12	D	.034	14 1/2	.139	41 1/8	6 1/2
12L	13	D	.034	14 1/2	.132	41 7/8	7 5/16
12R	14	D	.034	14 1/2	.132	41 7/8	6 7/16
13L	15	D	.034	14 1/2	.125	41 1/2	6 11/16
13R	16	D	.034	14 1/2	.125	41 1/2	6 3/8
14L	17	D	.034	14 1/2	.119	41 3/16	6 5/8
14R	18	D	.034	14 1/2	.I19	41 3/16	6 5/16
15L	19	S	.038	16 1/2	.114	41	6 1/2
15R	20	S	.038	16 1/2	.114	41	6 1/4
16L	21	S	.036	15 1/2	.108	40 1/4	6 1/2
16R	22	S	.036	15 1/2	.108	40 1/4	6 3/16
17L	23	S	.034	14 1/2	.102	40 5/16	6 3/8
17R	24	S	.034	14 1/2	.102	40 5/16	6 1/16
18L	25	S	.034	14 1/2	.097	40	6 3/8
18R	26	S	.034	14 1/2	.097	40	6
19L	27	S	.034	14 1/2	.092	39 5/8	6 1/4
19R	28	S	.034	14 1/2	.092	39 5/8	5 7/8
20L	29	S	.034	14 1/2	.088	39 3/8	6 3/16
20R	30	S	.034	14 1/2	.088	39 3/8	5 7/8
21L	31	S	.034	14 1/2	.084	39	6 3/16
21R	32	S	.034	14 1/2	.084	39	5 13/16
22L	33	S	.034	14 1/2	.079	38 3/4	6 1/16
22R	34	S	.034	14 1/2	.079	38 3/4	5 3/4
23L	35	S	.034	14 1/2	.075	38 3/8	6
23R	36	S	.034	14 1/2	.075	38 3/8	5 11/16
24L	37	S	.034	14 1/2	.072	38	5 15/16
24R	38	S	.034	14 1/2	.072	38	5 9/16
25L	39	S	.034	14 1/2	.068	37 3/4	5 7/8
25R	40	S	.034	14 1/2	.068	37 3/4	5 1/2
26L	41	S	.034	14 1/2	.065	37 7/16	5 13/16
26R	42	S	.034	14 1/2	.065	37 7/16	5 7/16

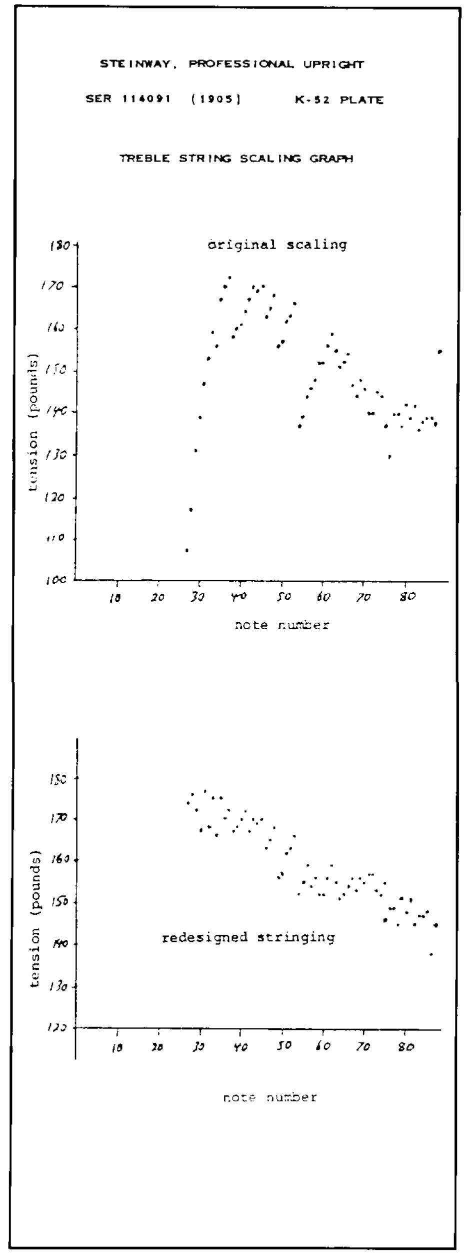
Franklin Lundak, RTT, 300 Walnut, Traer, IA 50675 (319) 478-8180

Note to Stringmaker: Please be sure that for doubly wound strings, the outer winding protrudes no more than 1/2 inch beyond inner winding.

D/S = *doubly wound vs singly wound*
d = *core diameter, inches*
D2 = *outermost diameter, inches*
Lw = *length winding unstretched*
Lh = *length unwound end from loop to start of winding, inches*

Outermost diameters should be achieved to close tolerances. Stringmaker should be aware of approximately five percent flattening in doubly wound strings, three percent in singly wound, to make appropriate allowances in choice of wrap size.


STEINWAY, PROFESSIONAL UPRIGHT SER 114091 (1905) K-52 PLATE
WOUND STRING SCALING GRAPH - 10 MONOCHORDS, 16 BICHORDS
inharmonicity (cents)
INHARMONICITY
original scaling
rescaled design
note number
tension (pounds)
TENSION
original scaling
rescaled design
Note number


STEINWAY, PROFESSIONAL UPRIGHT
SER 114091 (1905) K-52 PLATE
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Piano Virtuosos and Development of the Grand Piano in England in the Late Eighteenth Century

Jack Greenfield
Chicago Chapter

Broadwood built few grand pianos before the last decade of the Eighteenth Century. Company records indicate Grand Pianoforte serial number 40 to have been built in 1788 (Wainwright, *Broadwood by Appointment*). Meanwhile, during the last half of the 1780's, average annual sales amounted to about 200 square pianos and about 25 harpsichords. Harpsichords still retained an aura of prestige. Purchasers of Broadwood harpsichords during the period included Francis Hopkinson and Charles Carroll of the United States, both signers of the Declaration of Independence.

Broadwood's competitor, Kirkman, produced even more harpsichords. Thomas Jefferson, while on a short visit to London in 1786, ordered a Kirkman harpsichord for himself and a second one for Carroll.

Broadwood's improvement of the grand piano. In arriving at his decision and planning his course of action for work on a better grand piano design, Broadwood received guidance from his friend, Clementi. Clementi, who had returned in May 1785 from a long concert tour and then settled in London, provided Broadwood with his observations on the Viennese grand pianos he had become familiar with during his tour. Departing from the customary trial-and-error methods of piano makers of the past, Broadwood obtained the assistance of two scientists who were customers of his firm — Tiberias Cavallo and Edward Whitaker Gray. Although specialists in other fields, they had a knowledge of acoustics and had become interested in Broadwood's project.

Broadwood's early grand pianos were similar to those of Backers and Stodart (*Journal*, December 1987, p. 31). The instruments consisted of grand piano actions placed in cases constructed and scaled like the contemporary harpsichords. Harpsichord scaling followed well-established patterns for gradations in string length and diameter.

Athough the relation between pitch and string tension was known, theoretical mathematical calculations do not appear to have been a factor in establishing string measurements.

Contemporary English harpsichords had a five-octave range, F1-F6 with unwound brass strings for the bottom octave and iron for the rest.

The point at which a harpsichord string was plucked was not critical and was generally at one-half to one-eighth the vibrating length. Distances as close as one-twelfth were not unusual and lute stop jacks were even closer. The early pianos built in England, as well as in Germany and Austria, also contained wide variations in hammer strike locations.

It was Gray who conducted the actual experiments to determine changes that might improve the weak and poor quality of the tone from the bass strings, the most serious fault of the first grand pianos. In work completed in 1788, Gray concluded: 1) The hammers in the bass section struck too close to the speaking length terminations, and 2) string tensions were unbalanced with the lower tension in the long thin bass strings.

Gray's experiments demonstrated that tone could be improved by having the hammer strike at one-ninth the vibrating length. To make corrections, Broadwood divided the single continuous bridge copied from the harpsichord and placed a smaller segment for the bass strings further forward from the rear. This change permitted the use of shorter, heavier bass strings held under higher tension with the ends of the speaking lengths at the desired distance from the hammer strike points.

In addition, the placement of the bass bridge closer to the central area of the soundboard also contributed to better tone. Broadwood began to build grand pianos with separate bass bridges in 1788. The split bridge design, not patented, was soon copied by other piano builders.

Piano concerts become more popular in London. The improvement of the grand piano came just in time to serve the needs of the large number of concert pianists that performed in London during the last decade of the century. Some were young artists who had trained and made their debut in England. Others were famous virtuosos that came to London instead of Paris because of the unsettled conditions brought on by the start of the French Revolution in 1789.

Clementi's influence on piano playing. Some of the finest young pianists — Johann Baptist Cramer, Johann Nepomuk Hummel and John Field — who played in the London concert halls were students of Clementi although he himself did not perform piano solos publicly after 1790. He had been Great Britain's foremost piano virtuoso since his return to London in 1785.

Composer of keyboard works he performed, he was the first to develop a true piano technique exploiting the capabilities of the instrument even though his writings were not the equal of Mozart's judged from a purely musical standpoint. Clementi passed on his pianistic style to his pupils. Other pianists were influenced indirectly by the study of Clementi's sonatas and technical exercises. Clementi was highly regarded by many of his younger contemporaries. Beethoven, who had little interest in the works of Mozart and Haydn, had praise for Clementi and collected many Clementi sonatas.

In contrast to the finances of many other musicians and composers of his time, Clementi derived a large income from fees for concert appearances, payments from music publishers and money earned in teaching. He charged very high fees for his lessons and crowded as many lessons as he could into his busy concert schedule. His students were for the most part members of wealthy families or professional musicians eager to acquire some of his brilliant technique.

Clementi was less successful in his efforts as a symphony composer. Most of the symphonies he wrote to be performed by orchestras he conducted have been lost and forgotten. While continuing to compose, teach and direct symphony concerts (but not perform piano solos after 1790), Clementi took steps to change careers and become a businessman.

He began to invest his money in Longman and Broderip, the London music publishers and musical instrument dealers. The firm manufactured the pianos it sold. In 1796, Clementi gave up all of his previous activities except composing to join the firm as an active partner. Longman and Broderip then went through several partnership reorganizations and title changes, finally emerging as Clementi and Company around 1800. The early pianos with the Clementi name on their labels resembled the Longman and Broderip pianos of preceding years. But Clementi soon became involved in piano production, where his experience and knowledge of piano construction benefitted development of later designs.

Dussek's influence on piano playing. Clementi's immediate successor as England's leading virtuoso, the Czech pianist and composer, Jan Ladislav Dussek (1760-1812), also took special interest in the development of the piano. Internationally famous before his arrival in London in 1789, his handsome appearance and gracious manner combined with good musicianship and great pianistic quality made him a celebrity.

He was the first to sit at a grand piano with his right side toward the audience. This enabled him to exhibit his noble profile while the raised lid projected the tone into the auditorium. Dussek is given credit for initiating the extension of the piano keyboard from the previous five-octave compass. Soon after he came to London, he persuaded Broadwood to build a grand piano for him with an additional half-octave in the treble.

Dussek was also the first to investigate the possibilities of the pedals and the technique of producing a true legato "singing style" by shifting fingers on the same key without actually striking it. His published compositions were the first with pedaling indicated. He encouraged use of the extended keyboard compass by designating "additional keys" in the titles of his sonatas and scores.

His Op. 25 title is an example which also illustrates the profuse descriptive titles then in use! *Three sonatas for the Piano Forte, And also arranged for the Piano Forte with additional Keys, in which are introduced The Fife Hunt, A Scotch Reel, and the National Air of Rule Britannia, as Rondos, with an Accompaniment for a Violin or Flute Dedicated to the Right Honorable Lady Elizabeth Montagu.*

Another example of an odd Dussek title, *A Favorite Sonata for the Michrocordon or Piano Forte with Drum and Triangle (Ad Libitum)..., Op. 45.* was intended for small upright pianos with pedal-operated attachments. The pedal mechanisms had escapement actions driving hammers which struck a triangle inside the piano or the soundboard for a "drum" effect.

Dussek left London in 1799 and during the rest of his career elsewhere in Europe he continued to use his influence to urge manufacturers to make improvements in the piano.

Haydn's use of English pianos. Haydn made two trips to London, 1791-1792 and 1794-1795, to conduct a series of orchestra concerts. Soon after his first arrival, Dussek loaned him his Broadwood grand to use at the country estate where Haydn was staying. Dussek rented another Broadwood piano for himself. Haydn used the piano for composition work. His last sonatas, numbers 50-52, and symphonies and chamber music written while in London are among his finest. The slow movement of *Sonata No. 50 in C Major* makes use of the "additional keys" of the Broadwood piano.

Haydn took an interest in English pianos and also visited shops of Stodart, Longman and Broderip and others in London. A Longman and Broderip grand piano, the only one ever found in Austria and now in a collection in Vienna, is believed to be the instrument listed in Haydn's estate. It was a gift from Longman and Broderip, the firm which published Haydn's work in Great Britain. Haydn is not known to have expressed any preference for either English or Viennese pianos but he preferred Schantz pianos over other Viennese instruments.

Later Broadwood changes. By 1793, most Broadwood grand pianos being built had the five and one-half octave range, F1-C7. During the following year, the range was extended further in the bass to C1-C7, grand piano number 607 was the first of these constructed.

Broadwood built no more harpsichords after 1793 although the firm still bought, sold and rented used harpischords and supplied parts. Wealthy customers who formerly purchased harpsichords with intricately ornamented cases could now obtain special order Broadwood pianos in designer cases. A grand piano for Manuel DeGodoy, Premier of Spain in 1796, was assembled in an elaborate case designed by Thomas Sheraton. The satinwood case was ornamented with inlaid banding, plaques by Wedgewood and a miniature portrait of DeGodoy on the nameboard. Broadwood also supplied piano actions fitted into ornate square piano cases built by Chippendale and other fine furniture manufacturers.

Changes also were made in the 1783 Broadwood square piano design which had an improved structure but an inferior action originally. The more efficient English double action designed by Geib, first available as an option in the 1780's, became standard after Geib's patent expired. Broadwood also adopted a crank type damper to replace the original curved brass underlever arrangement.

James Shudi Broadwood becomes a partner. In 1795, John Broadwood took his eldest son, 23-year-old James Shudi, into partnership, giving him a one-half share of the business. His son had started as a clerk at the age of thirteen and was now capable of sharing the burden of management. With average annual production that had risen to one hundred grand pianos plus three hundred to four hundred squares, the firm of John Broadwood and Son enjoyed large profits.

However, there still had been no change from the craft methods of building instruments to the more efficient factory production systems of the Industrial Revolution used in other industries.

When the firm was smaller, the shops were in the same house as the Broadwood family living quarters in a four-story building on Great Pulteney Street. The family moved to a separate new residence in 1787 to allow more space for expanded production. As the business continued to grow, adjoining real estate was acquired. By the late 1790's, Broadwood and Son also occupied three adjoining houses and the building of a former corner pub on Great Pulteney Street as well as nine coach houses on a back street behind the houses. The stables in the coach houses provided convenient access for wagons delivering lumber or picking up pianos for shipment. The elegant Broadwood showrooms were located in the houses fronting Great Pulteney Street.■

Front and Rear Bearings

Nick Gravagne
New Mexico Chapter

That aspect of downbearing called front and rear bearings continues to be a fruitful source of confusion. Recently I have been privy to instances where new grand pianos have been sent back to manufacturers because certain tonal problems were supposedly traced to downbearing deficiencies. The dealers, according to the technicians, said the pianos had negative bearing or too much rear and not enough front. In actuality, the pianos needed voicing and the technicians needed a more well-rounded understanding of downbearing. Improper diagnostics can be a nuisance, an embarrassment and quite costly.

The general idea of front and rear bearings seems clear enough to most, but it is in measuring these bearings and interpreting the relationships where the idea becomes fuzzy. This is due, in part, to imagining downbearing as synonomous with these component bearings. (For the remainder of this article "front and rear bearings" will be referred to as "component bearings," a term I am reluctantly pressing into service to reduce wordiness and to impart clarity. Although the term is technically apt, I am not advocating its general adoption).

Obviously there exists a close relationship between downbearing and component bearings; still, there is enough of a difference to warrant sharp distinction. This series has recently shown downbearing to be a force exerted on the soundboard assembly. This force, or pressure, indicates that the strings are pushing on the bridge maintaining favorable conditions for reliable energy transference. But pressure on the bridge is only part of the story. The plot thickens as we consider the character of that pressure, that is, the manner in which the compressive string force is applied to the bridge. And that is where component bearings enter the picture. Were the bridge a wedge shape in cross-section as is a violin's, there would be no discussion. But a piano bridge is roughly square in cross-section which, as we will see, complicates everything quite nicely.

The distinction that component bearings are a consequence of downbearing may seem like hairsplitting. In fact, the differentiation is natural and elucidating and can be simply understood as the relative orientation of bridge to string. Let's see why. Downbearing has been shown to be a force applied to the soundboard by a string deflecting downward over the bridge, thereby causing pressure on the bridge. The small angle at which the string deflects or departs from a straight line is called the angle of deflection and has been shown to be one angle, not two.

So, for the moment forget about a front angle and a rear angle. In terms of pressure only it makes no difference what relationship exists between string and bridge so long as the angle of deflection exists. Please refer to Figure 1 where four string-to-bridge conditions are illustrated (an infinite number is possible). The angle of deflection, hence, the force applied to the soundboard, is identical in each case. But it is the way in which the string pushes on the bridge which now has our attention. The speaking length string should be making firm contact with the front of the bridge — it must be pushing down on it, and in all seasons.

There is no better assurance that the vibrations in the string will transfer to the soundboard. A solid tone, free from falseness and jingling bells, depends on it. Drawings *a* and *d* show good contact at the front of the bridge while drawings *b* and *c* show poor or negative frontal contact. Drawings *c* and *d* show a peculiar problem: were it not for the grip-

Figure 1

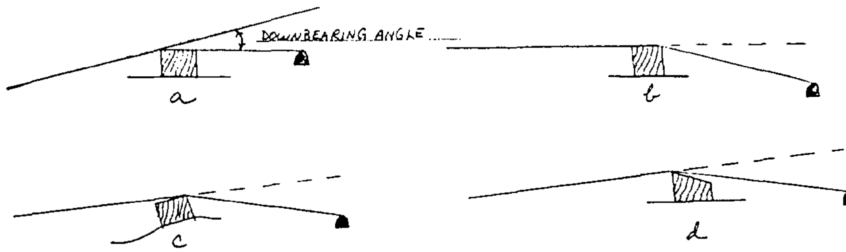


Figure 2

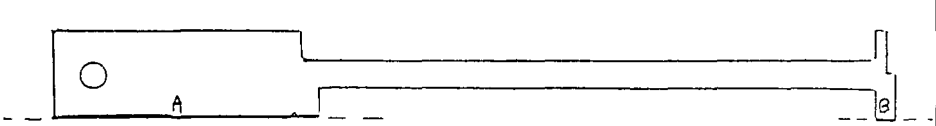
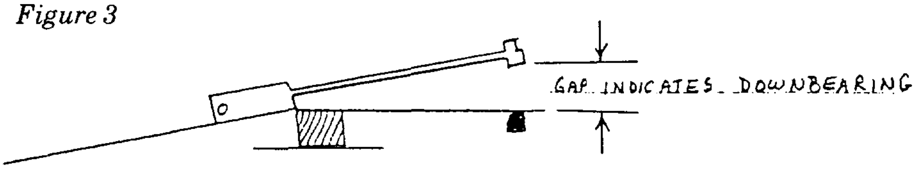


Figure 3



ping effect of bridge pins (not in the drawings), the string would make no contact at all at the front and the rear of the bridge, respectively. And, although the bridge pins would have a tendency to pull, or at least hold, the string to the bridge, the condition would be tenuous and unreliable. The function of angled and staggered bridge pins is to "clamp" and steady the strings on the bridge, not to create or maintain downbearing.

But under what physical circumstances would the conditions in the drawings actually exist in a piano? Considering a few possibilities will keep this real for us. Remember, the downbearing angle is correct and identical in each case. The condition at drawing *a* would exist if a too-tall bridge were installed, or if the plate were positioned too low at the front or too high at the rear. Condition *b* suggests a too-high plate at the pinblock or a plate lowered in part or all around in an attempt to obtain downbearing. The relationship at *c* in a new or old piano might be due to improper bridge top planing or a rolled bridge with the accompanying distorted soundboard. The condition at *d* exists when the top of the bridge is purposely planed higher at the front than rear (which is to spec in many old and new pianos), only too much wood was taken off the rear. A rolled bridge in this direction is rare. There are doubtless other causes for the four conditions but one thing is certain: of the four, the conditions at *a* and *d*, although not ideal, will work infinitely better than those at *b* and *c*.

So, is there downbearing in each case? Yes. Is the relationship of the string to the bridge top conducive to best tone in each case? No. Downbearing exists but the component bearings vary. Does this tell us that it is possible to have adequate downbearing but negative front bearing? Absolutely. Look again.

Measuring and interpreting the downbearing and component bearings continues to challenge even experienced technicians — it is easy to be fooled — and it matters not what technique or gauge is used. But, as always, a systematic approach is the key. Let's assume a strung piano, old or new. The first thing we want to know is if downbearing exists at all — is there an angle of deflection with its consequent pressure on the soundboard? The bridge top and bridge pins may be laying an ambush here, the former because it could present innumerable faces or cants to the string, and the latter because the gripping effects of bridge pins can easily mislead.

Still, these bug-a-boos can be outsmarted. A test string (carpet thread), although limited to the capo bar sections, can be used and is still the surest way to know if the bridge, or any part of it, stands taller than the plane which exists between capo bearing and the rear string rest. If while keeping the string straight and taut, it cannot touch the rear string rest without first touching the bridge, there is downbearing. It is even possible to tell if the thread is touching the front of the bridge only or the rear only, or whether it touches the whole bridge top at once. But these are component bearing considerations and will come up again momentarily. (A common mistake is to assume that because there is apparent downbearing there must also be crown in the soundboard. Although probably true in an old, un-rebuilt piano, anything is possible where you see signs of reconditioning, rebuilding, etc.)

The carpet thread can't be used where agraffes exist so another approach is necessary — which brings us to gauges. Readings from gauges, all gauges, can be misleading. The gauge itself may be fine: it's just that we ask more of our gauges than they can realistically tell. The reason was mentioned earlier. The cant of the bridge top and gripping effect of the bridge pins can hold the string in such a fashion that our gauge may indicate, for example, that there is downbearing when, in fact, downbearing has not been measured at all. Some condition of component bearing was measured, however, and was mistaken for downbearing. This will become clearer as we continue in this series. A gauge which looks for downbearing must show what the carpet thread shows — that the bridge blocks the way of a straight line from agraffe to rear string rest.

In order for a handy gauge (and not a bulky contraption) to do this it should take in a longer measuring span than most do. The simplest gauge I use here is a multi-purpose action regulating gauge which makes for a surprisingly handy bearing gauge. It looks like the drawing in Figure 2 and you probably have one. The designations marked *A* and *B* exist in the same plane — or should. To be sure, take the tool as shown, place it on a metal file, press down and rub to and fro until planes *A* and *B* are rubbing simultaneously. To use as a bearing gauge see Figure 3. The gap, if there is one, may be small and hard to see so work the gap end of the tool like an old fashioned telegraph and listen for little pinging sounds. In lieu of this action tool make something from wood or aluminum.

Is this foolproof? No — but close. The relatively long length of the gauge makes it less prone to erroneous findings due to varying bridge top orientations. In fact, the slender rear part of the tool often extends far enough to reach many rear string rests and even beyond (so back it up if necessary). And an important point: since bridges almost always roll forward (if rolled at all) remember to place the gauge on the rear string and look for a gap at the front string. It makes no difference from which string segment the downbearing angle is indicated. If a gap can be found, regardless of the side of the bridge it is measured from, downbearing, as pressure — which is all we're looking for right now — probably exists.

If no pressure on the soundboard assembly seems apparent, there may be a serious problem with the instrument. A collapsed soundboard, or at least a partially sunken one, is the most obvious cause. The remedies won't be discussed here. But if downbearing is apparent, the next thing we want to know is its character or how the pressure makes itself felt at the bridge top. It is this information, along with the previously ascertained downbearing findings, which gives a much more complete idea of the whole downbearing picture. We now want to know what the component bearings have to say.

The place where string and bridge come together, although a small place in the whole of a piano's terrain, is a no-man's-land.

Any quick conclusions drawn about downbearing in its complete sense, if gotten by a narrow look at component bearings only, can be quickly shot down. So excercise care, not haste. These components of interest are the ever together triplets called the front string segment, the bridge top segment, and the rear string segment. And, as shown earlier, they can exist in innumerable combinations. Some encourage good piano tone while others serve to sabotage an otherwise correct angle of deflection. By far, the first thing we want to know about component bearings is whether the front string segment is making firm contact at the front notch. This is called positive front bearing (not to be confused with positive downbearing which indicates pressure on the bridge). I can think of no better gauge than the bubble gauge to prove the conditions of the component bearings. Use of this gauge and technique here is not the only available approach, but it is the surest and fastest. We'll pick up here next time. ■

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Money And Its Real Value

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Have you ever wondered if the annuity, or single-pay life insurance policy your insurance agent has been trying to sell you is worthwhile? How much money should you set aside in a pension account for a comfortable retirement? How quickly will your money double in your IRA?

Everyday we are confronted with situations involving the exchange of money. Money paid for work completed or commodities purchased in the present are worth the face value of the transaction. Confusion arises when "time" enters the financial transaction. Time means interest is involved. Interest is the amount of money earned when you forego using the money yourself and "rent" its use to another party, or when someone else "rents" the use of their money to you. Unless you have the information to systematically calculate how much the "rent" on the transaction should be, you'll always be at the mercy of someone who is more informed. This article will clear up the confusion by giving you the mathematical capability to make those financial decisions.

There are four major areas involving present and future value of money. This article will look at and solve typical problems in each of those areas. These typical problems and solutions will require the use of tables which appear throughout this article. All you'll need is a simple calculator, pencil, and paper if you wish to try the problems yourself.

First we must have an understanding of the terminology:

Principal— amount of money borrowed or invested.

Term— number of periods the borrower has use of the principal.

Rate of Interest — percentage rate of the principal the borrower pays the lender per time period for use of the money, or simply put — price charged for using money over time.

Simple Interest— Principal x Interest Rate x Number of Time Periods. Simple interest is a return on principal for one time period, so it generally involves short term transactions of one year or less. A typical simple interest scenario is as follows:

Problem #1: What is the amount of interest you can expect to receive in one year on a $5000 Certificate of Deposit? Interest is paid yearly and the interest rate is 10% per annum.

Using our formula for simple interest:

$$I = P \times i \times n$$
$$I = \$5000 \times 10\% \times 1$$

Interest = $500

Compound interest— is a bit more complicated. Compound interest is interest paid on principal, and any interest earned but not withdrawn from earlier periods. So, in the first period you calculate interest on the principal just as you did for simple interest. For the second period calculations add the interest just earned to the initial principal amount. Now figure interest for the second period on this new combined amount. This process continues for each period compound interest is earned. Let's look at an example:

Problem #2: A competitive bank offers a 12 month Certificate of Deposit in the amount of $5000 that compounds quarterly at a 10% rate of return. What would be the total amount of interest earned in one year?

Period	Principal	x	Rate	x	Time	= Compound Interest	Accumulated Amount
Quarter 1	$5000.00	x	10%	x	.25	$125.00	$2125.00
Quarter 2	5125.00	x	10%	x	.25	128.13	5253.13
Quarter 3	5253.13	x	10%	x	.25	131.33	5384.46
Quarter 4	5384.46	x	10%	x	.25	134.61	5519.07

As you can see from comparing this example to the previous simple interest example, compound interest does yield a higher amount of interest earned. The "future (compound) value" of the Certificate of Deposit at the end of Year 1 is $5519.07. An additional note: the .25 under the column "Time" reflects compounding quarterly, which is 3/12 of a year, or 1/4, or .25.

Now with an understanding of the basics, we can discuss present and future value, and the four basic areas of interest which are:

1) Future value of a lump sum at compound interest.

2) Present value of a lump sum at compound interest.

3) Future value of an annuity at compound interest.

4) Present value of an annuity at compound interest.

Present and Future Value: As previously stated, whenever "time" is involved in a monetary transaction so is interest, unless you are an unusually kind-hearted person who does not mind having debts paid back without an interest charge. Since we are assuming there is a price, or "rent," on use of funds, we can make the statement that "a dollar today is worth more than the promise of receiving a dollar in the future." The passage of time erodes the value of a dollar and means that you cannot add together inflows of dollars received at various future dates unless you make an allowance for this deterioration of net worth of a dollar. For example, a dollar received two years from now is worth more than a dollar received five years from now. A dollar received ten years from now is worth substantially less than a dollar received five years from now. These future inflows of dollars must be discounted to their present values before they are added together. The same applies to outflows of dollars.

Future value involves compound interest, covered in Problem #2. In order to have the same buying power per dollar in the future as you have today, interest must be paid and compounded on the dollars. Let's move on to some examples.

Future Value of a Lump Sum at Compound Interest: Problem #3: A 50-year-old self-employed piano technician decides to set aside $10,000 into a Keogh pension account. The account pays 12% compounded quarterly. How much money will be in the account when he retires in 15 years?

Recall Problem #2 — Future value = Principal x Rate x Time. The principal amount initially is $10,000 but will change each quarter since the interest earned must be added to the principal. The interest rate is 3%, which is 12% divided by quarterly compounding. Periods of time, or "n" (as you will see in the tables) is 60 (15 years x 4 quarters per year of compounding). Solving this problem as we did in Problem #2 would be extremely cumbersome since we are dealing with 60 periods. There is, however, a short cut. At the bottom of this page you will see Table #1. This table solves for the future value of a lump sum at compound interest. The formula we will use to plug in our numbers is:

$$FV_n = PV_o\,(CVIF_{i,n})$$

This means the Future Value at the end of year (n) (FV_n) equals the Principal amount (which is $10,000 in our example) times Compound Value Interest Factors (CVIF), at a particular interest rate (i), for a set number of periods (n). You can see this formula as line four at the top of Table #1. This formula gives you the same answer as doing the calculations long hand. The CVIF are simply factors in the body of the table which will help us to solve this problem.

Our problem states that the number of periods are 60, so look down the far left column labeled "Period" and go to 60. Now look at the top horizontal column. Our interest rate is 3%. Find that rate in the column. Now find the intersection of both the horizontal and vertical columns for 60 periods at 3%. The number at the intersection is 5.892. This number is our CVIF. Let's now plug the numbers into our formula.

$$\begin{aligned} FV_n &= PV_o\,(CVIF_{i,n}) \\ &= \$10{,}000\,(CVIF_{.03,60}) \\ &= \$10{,}000\,(5.892) \\ &= \$58{,}920 \end{aligned}$$

For those of you who have never done these kinds of computations, the result ($58,920) must look rather amazing. It is, however, correct. Compound interest over a long period of time does have a profound effect on the amount of money you can amass. I must at this time mention that inflation is not taken into account, which means that the buying power of a dollar in the future will be substantially less than it is today, which is more the reason for frequent compounding.

Our piano technician, in this example, invested his $10,000 into a Keogh plan. Many insurance salesmen are presently selling tax deferred single-pay life insurance policies, which really are the same thing as our lump sum investment example. You should compare the return you could get on your own with what is offered by an insurance policy. Many single-pay life insurance policies, and also annuities, pay a set high interest rate for a limited time, and then revert to market yield. Check the base rate guarantee on the policy and also check the surrender value on the policy. If for some reason an emergency arises, and you need to access the funds in advance, you don't want to find out that there are steep penalties for early withdrawal, or a minimal return of principal.

Keep in mind that the funds kept in an insurance policy are only as good as the company's net worth. If the insurance company goes "belly up," you're just one of thousands trying to squeeze your retirement funds out of a bankrupt company. Before investing, check the financial standing of the insurance company. Go to your local library and look for a copy of *Rating and Analysis* by A.M. Best Co., which rates insurance companies finances. If you don't feel the company will be in business when you retire, which will be in 20 to 40 years for many of you, then don't sink your hard-earned money into the company.

Let's get back to future value and our problem solving. Besides solving for future or present value, we can also use the tables to solve for "number of years," or "interest rates" by manipulating the formulas. Let's first look at a problem solving for number of years.

Problem #4: Our piano technician needs $20,000 down so he can take out a bank loan to buy a storefront/shop. He presently has $10,000. How long would it take for $10,000,

Table 1

Compound Value Interest Factor (CVIF)
($1 at *i*% for *n* years)
$CVIF = (1 + i)^n$
$FV_n = PV_0(CVIF_{i,n})$

Period, *n*	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	1.010	1.020	1.030	1.040	1.050	1.060	1.070	1.080	1.090	1.100	1.110	1.120
2	1.020	1.040	1.061	1.082	1.102	1.124	1.145	1.166	1.186	1.210	1.232	1.254
3	1.030	1.061	1.093	1.125	1.158	1.191	1.225	1.260	1.295	1.331	1.368	1.405
4	1.041	1.082	1.126	1.170	1.216	1.262	1.311	1.360	1.412	1.464	1.518	1.574
5	1.051	1.104	1.159	1.217	1.276	1.338	1.403	1.469	1.539	1.611	1.685	1.762
6	1.062	1.126	1.194	1.265	1.340	1.419	1.501	1.587	1.677	1.772	1.870	1.974
7	1.072	1.149	1.230	1.316	1.407	1.504	1.606	1.714	1.828	1.949	2.076	2.211
8	1.083	1.172	1.267	1.369	1.477	1.594	1.718	1.851	1.993	2.144	2.305	2.476
9	1.094	1.195	1.305	1.423	1.551	1.689	1.838	1.999	2.172	2.358	2.558	2.773
10	1.105	1.219	1.344	1.480	1.629	1.791	1.967	2.159	2.367	2.594	2.839	3.106
11	1.116	1.243	1.384	1.539	1.710	1.898	2.105	2.332	2.580	2.853	3.152	3.479
12	1.127	1.268	1.426	1.601	1.796	2.012	2.252	2.518	2.813	3.138	3.498	3.896
13	1.138	1.294	1.469	1.665	1.886	2.133	2.410	2.720	3.066	3.452	3.883	4.363
14	1.149	1.319	1.513	1.732	1.980	2.261	2.579	2.937	3.342	3.797	4.310	4.887
15	1.161	1.346	1.558	1.801	2.079	2.397	2.759	3.172	3.642	4.177	4.785	5.474
16	1.173	1.373	1.605	1.873	2.183	2.540	2.952	3.426	3.970	4.595	5.311	6.130
17	1.184	1.400	1.653	1.948	2.292	2.693	3.159	3.700	4.328	5.054	5.895	6.866
18	1.196	1.428	1.702	2.026	2.407	2.854	3.380	3.996	4.717	5.560	6.544	7.690
19	1.208	1.457	1.754	2.107	2.527	3.026	3.617	4.316	5.142	6.116	7.263	8.613
20	1.220	1.486	1.806	2.191	2.653	3.207	3.870	4.661	5.604	6.728	8.062	9.646
24	1.270	1.608	2.033	2.563	3.225	4.049	5.072	6.341	7.911	9.850	12.239	15.179
25	1.282	1.641	2.094	2.666	3.386	4.292	5.427	6.848	8.623	10.835	13.585	17.000
30	1.348	1.811	2.427	3.243	4.322	5.743	7.612	10.063	13.268	17.449	22.892	29.960
40	1.489	2.208	3.262	4.801	7.040	10.286	14.974	21.725	31.409	45.259	65.001	93.051
50	1.645	2.692	4.384	7.107	11.467	18.420	29.457	46.902	74.358	117.391	184.565	289.002
60	1.817	3.281	5.892	10.520	18.679	32.988	57.946	101.257	176.031	304.482	524.057	897.597

Period, *n*	13%	14%	15%	16%	17%	18%	19%	20%	24%
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	1.130	1.140	1.150	1.160	1.170	1.180	1.190	1.200	1.240
2	1.277	1.300	1.322	1.346	1.369	1.392	1.416	1.440	1.538
3	1.443	1.482	1.521	1.561	1.602	1.643	1.685	1.728	1.907
4	1.630	1.689	1.749	1.811	1.874	1.939	2.005	2.074	2.364
5	1.842	1.925	2.011	2.100	2.192	2.288	2.386	2.488	2.932
6	2.082	2.195	2.313	2.436	2.565	2.700	2.840	2.986	3.635
7	2.353	2.502	2.660	2.826	3.001	3.185	3.379	3.583	4.508
8	2.658	2.853	3.059	3.278	3.511	3.759	4.021	4.300	5.590
9	3.004	3.252	3.518	3.803	4.108	4.435	4.785	5.160	6.931
10	3.395	3.707	4.046	4.411	4.807	5.234	5.695	6.192	8.594
11	3.836	4.226	4.652	5.117	5.624	6.176	6.777	7.430	10.657
12	4.335	4.818	5.350	5.926	6.580	7.288	8.064	8.916	13.215
13	4.898	5.492	6.153	6.886	7.699	8.599	9.596	10.699	16.386
14	5.535	6.261	7.076	7.988	9.007	10.147	11.420	12.839	20.319
15	6.254	7.138	8.137	9.266	10.539	11.974	13.590	15.407	25.196
16	7.067	8.137	9.358	10.748	12.330	14.129	16.172	18.488	31.243
17	7.986	9.276	10.761	12.468	14.426	16.672	19.244	22.186	38.741
18	9.024	10.575	12.375	14.463	16.879	19.673	22.901	26.623	48.039
19	10.197	12.056	14.232	16.777	19.748	23.214	27.252	31.948	59.568
20	11.523	13.743	16.367	19.461	23.106	27.393	32.429	38.338	73.864
24	18.790	23.212	28.625	35.236	43.297	53.109	65.032	79.497	174.631
25	21.231	26.462	32.919	40.874	50.658	62.669	77.388	95.396	216.542
30	39.116	50.950	66.212	85.850	111.065	143.371	184.675	237.376	634.820
40	132.782	188.884	267.864	378.721	533.869	750.378	1,051.67	1,469.77	5,455.91
50	450.736	700.233	1,083.66	1,670.70	2,566.22	3,927.36	5,988.91	9,100.44	46,890.4
60	1,530.05	2,595.92	4,384.00	7,370.20	12,335.4	20,555.1	34,105.0	56,347.5	402,996

invested at 12% per annum, and compounded quarterly to double to the $20,000 he needs?

We use the same formula as we did in the previous problem: $FV_n = PV_0\,(CVIF_{i,n})$. Since we know that PV (present value) is $10,000, and FV (future value) is $20,000, we are solving for CVIF at 3% per quarter but we do not know the number of years. First of all let's move the formula around so it will work for us, and plug in the numbers we know.

$$(CVIF_{i,n}) = \frac{FV}{PV} = \frac{\$20{,}000}{\$10{,}000} = 2.000$$

The answer of 2.000 is the CVIF which can be found in the body of our table. Turn to Table #1. We know our interest rate is 3%. Look down the 3% column until you come to the number closest to 2.000. That number is 2.033. Follow 2.033 horizontally to the left most column labeled "Period," and notice that it took about 24 periods for the money to double to $20,000. If you want a more exact result than our table provides, you can use interpolation, or any of the financial software packages presently available.

A shortcut solution that you can easily commit to memory which also tells you how long it would take money to double is the "Rule of 72." Simply divide 72 by the interest rate to determine the number of periods it would take for money to double: 72 divided by 3 = 24 periods. Using this quick method you can also calculate the interest rate needed for a sum of money to double in a given number of periods: 72 divided by 24 = 3%. Remember, our example is compounded quarterly, which means that 24 periods is six years. Also, keep in mind that the "Rule of 72" is an approximation, not an exact formula.

Present Value of a Lump Sum at Compound Interest: Another type of problem we may be confronted with is — given a future value (FV_n) of some number, what is its equivalent value today.

Problem #5: Two piano technicians have been in business as equal partners for the past seven years. They have now decided to divide their business and go their separate ways. Net value of tools and equipment in the shop is estimated to be $12,000. Technician A would like to buy out Technician B's half of the business, keep all the used equipment and offers Technician B $2200 now, $2200 in one year, and $2200 in two years. This amounts to a total of $6,600 in payments, $600 more than present net worth of Technician B's half share of the business. Should Technician B accept the offer?

The present market interest rate in a high growth mutual fund, which is the method Technician A chooses to invest extra cash is 12% per annum. We will use quarterly compounding in this problem.

We must use Table #2 to solve this problem, and the following formula:

$PV_o = FV_n\,(PVIF_{i,n})$. PV means present value, FV is future value, PVIF is the present value interest factor at a given interest rate for a given number of periods. This problem has three sections, the initial $2200 payment, the year 1 payment of $2200, and the year 2 payment of $2200. The year 1 payment is 3% for 4 periods, while the year 2 payment is 3% for 8 periods.

The present value of the initial payment of $2200 is $2200, since the payment is current and no "time" is involved. The present value of the year 1 payment is as follows:

$$PV_o = FV_n\,(PVIF_{i,n}) = \$2200(PVIF_{.03,4}) = \$2200(.889) = \$1955.80$$

The present value of the year 2 payment is as follows:

$$PV_o = FV_n\,(PVIF_{i,n}) = \$2200(PVIF_{.03,8}) = \$2200\,(.789) = \$1735.80$$

Add all three payments: $2200 + $1955.80 + $1735.80 = $5891.60. The answer of $5891.60 is less than Technicians B's initial net worth of $6000 for his half of the business so Technician B should not accept Technician A's offer.

Table 2

Present Value Interest Factor (PVIF)
($1 at *i*% for *n* years)

$$PVIF = \frac{1}{(1+i)^n}$$

$$PV_0 = FV_n(PVIF_{i,n})$$

Period, *n*	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	24%
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.806
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694	0.650
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579	0.524
4	0.961	0.924	0.889	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482	0.423
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402	0.341
6	0.942	0.888	0.838	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335	0.275
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279	0.222
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233	0.179
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194	0.144
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162	0.116
11	0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135	0.094
12	0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112	0.076
13	0.879	0.773	0.681	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093	0.061
14	0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078	0.049
15	0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065	0.040
16	0.853	0.728	0.623	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054	0.032
17	0.844	0.714	0.605	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045	0.026
18	0.836	0.700	0.587	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038	0.021
19	0.828	0.686	0.570	0.475	0.396	0.331	0.276	0.232	0.194	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031	0.017
20	0.820	0.673	0.554	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026	0.014
24	0.788	0.622	0.492	0.390	0.310	0.247	0.197	0.158	0.126	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013	0.006
25	0.780	0.610	0.478	0.375	0.295	0.233	0.184	0.146	0.116	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010	0.005
30	0.742	0.552	0.412	0.308	0.231	0.174	0.131	0.099	0.075	0.057	0.044	0.033	0.026	0.020	0.015	0.012	0.009	0.007	0.005	0.004	0.002
40	0.672	0.453	0.307	0.208	0.142	0.097	0.067	0.046	0.032	0.022	0.015	0.011	0.008	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000
50	0.608	0.372	0.228	0.141	0.087	0.054	0.034	0.021	0.013	0.009	0.005	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
60	0.550	0.305	0.170	0.095	0.054	0.030	0.017	0.010	0.006	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

offer.

Present and Future Value of Annuities: An annuity is the payment or receipt of equal payments over a specified number of periods, with compounding of interest. Some examples of annuities are: putting money into an IRA account, monthly mortgage payments on your home, a sinking fund — which is the annuity amount that must be invested regularly to produce a future determined value, a capital recovery situation — which is the annuity amount needed to recover some initial investment, or bond payments. Let's first look at one of my favorite present/future value problems — annuities and retirement savings.

Future Value of an Annuity at Compound Interest:

Problem #6: A married couple individually invests $2000 into an IRA for a total yearly investment of $4000. They will have been investing for 30 years before retirement, compounding semi-annually. What is the future value of their investment? They have decided that their yearly investments should yield an average of 10% per annum, which is 5% for 60 periods. The formula is CSAN = R($CVIFA_{i,n}$). CSAN means compound sum of an annuity, R stands for the annuity amount, and CVIFA is compound value interest factor at a given interest rate per given number of periods. We will now solve for future value of the investment using Table #3. Follow the same procedure as previously — find 5% on the horizontal top line of Table #3, follow it down until you locate its intersection with the vertical column of 60 periods to find the correct CVIFA.

CSAN = R($CVIFA_{i,n}$)
= $4000($CVIFA_{.05,60}$)
= $4000(353.584)
= $1,414,336.

Problem #7: What if our couple saves for only 15 years, compounding semi-annually at 10% per annum? This will be 30 periods at 5%.

CSAN = R($CVIFA_{i,n}$)
= $4000 ($CVIFA_{.05,30}$)
= $4000(66.439)
= $265,756.

Problem #8: Having calculated how much we can actually compound over time, let's look at a real-life proposal a hospitalization insurance agent recently offered my husband and me. The scenario is as follows: Along with your hospitalization coverage you can also sign up for a "great" plan called the "Return of Benefit Premium." The insured would pay $26 per month of additional payments on top of hospitalization payments until the primary insured reaches age 65. At that point the insured is entitled to receive all of their "paid-in" health insurance premiums, less any claims "paid-out" for the primary insured and dependents over the years. Let's assume that the primary insured has 25 years until age 65, and will pay an average of $175 a month or $1050 semiannually for hospitalization. We will also assume a semiannual "pay-in" of $156 ($26 a month) for the "Return of Benefit Premium," 50 periods at 5% per period, and total claims "paid-out" of $25,000 over the years. Is this a good deal?

Hospitalization Payments:
$1050 semiannually x 2 payments per year x 25 years = $52,500 paid in.

The future value compounding semiannually at 5% for 50 periods:

CSAN = R($CVIFA_{i,n}$)
= $1050($CVIFA_{.05,50}$)
= $1050 (209.348)
= $219,815.

Return of Benefit Premium:
$156 paid in semiannually x 2 payments/year x 25 years = $7800. The future value compounding semiannually at 5% for 50 periods:

CSAN = R($CVIFA_{i,n}$)
= $156 ($CVIFA_{.05,50}$)
= $156 (209.348)
= $32,658.

As you can see from these figures, hospitalization payments over time, without compounding = $52,500 less estimated claims paid out over 25 years = $25,000. This means that you would receive $27,500 in a "Return of Benefit Premium." From looking at these figures you can see that the insurance company is not paying the "Return of Benefit Premium" from your hospitalization payments but entirely from the additional $26 a month surcharge, and they will still make an additional $5158 ($32,658 - $27,500).

Our tables only go up to 60 periods. If this scenario was calculated on Lotus 123, which has the capability of calculating more than 60 periods, you would find that the result of the additional compounding would further accentuate the insurance company's net gain. This also applies to Problem #6. Most savings instruments compound on a monthly basis, so you can see that

Table 3

Compound Sum of an Annuity Interest Factor (CVIFA)
($1 per year at *i*% for *n* years)

$$CVIFA = \frac{(1+i)^n - 1}{i}$$

$$CSAN = R(CVIFA_{i,n})$$

Period, *n*	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.010	2.020	2.030	2.040	2.050	2.060	2.070	2.080	2.090	2.100	2.110
3	3.030	3.060	3.091	3.122	3.152	3.184	3.215	3.246	3.278	3.310	3.342
4	4.060	4.122	4.184	4.246	4.310	4.375	4.440	4.506	4.573	4.641	4.710
5	5.101	5.204	5.309	5.416	5.526	5.637	5.751	5.867	5.985	6.105	6.228
6	6.152	6.308	6.468	6.633	6.802	6.975	7.153	7.336	7.523	7.716	7.913
7	7.214	7.434	7.662	7.898	8.142	8.394	8.654	8.923	9.200	9.487	9.783
8	8.286	8.583	8.892	9.214	9.549	9.897	10.260	10.637	11.028	11.436	11.859
9	9.369	9.755	10.159	10.583	11.027	11.491	11.978	12.488	13.021	13.579	14.164
10	10.462	10.950	11.464	12.006	12.578	13.181	13.816	14.487	15.193	15.937	16.722
11	11.567	12.169	12.808	13.486	14.207	14.972	15.784	16.645	17.560	18.531	19.561
12	12.683	13.412	14.192	15.026	15.917	16.870	17.888	18.977	20.141	21.384	22.713
13	13.809	14.680	15.618	16.627	17.713	18.882	20.141	21.495	22.953	24.523	26.212
14	14.947	15.974	17.086	18.292	19.599	21.051	22.550	24.215	26.019	27.975	30.095
15	16.097	17.293	18.599	20.024	21.579	23.276	25.129	27.152	29.361	31.772	34.405
16	17.258	18.639	20.157	21.825	23.657	25.673	27.888	30.324	33.003	35.950	39.190
17	18.430	20.012	21.762	23.698	25.840	28.213	30.840	33.750	36.974	40.545	44.501
18	19.615	21.412	23.414	25.645	28.132	30.906	33.999	37.450	41.301	45.599	50.396
19	20.811	22.841	25.117	27.671	30.539	33.760	37.379	41.446	46.018	51.159	56.939
20	22.019	24.297	26.870	29.778	33.066	36.786	40.995	45.762	51.160	57.275	64.203
24	26.973	30.422	34.426	39.083	44.502	50.816	58.117	66.765	76.790	88.497	102.174
25	28.243	32.030	36.459	41.646	47.727	54.865	63.249	73.106	84.701	98.347	114.413
30	34.785	40.568	47.575	56.085	66.439	79.058	94.461	113.283	136.308	164.494	199.021
40	48.886	60.402	75.401	95.026	120.080	154.762	199.635	259.057	337.882	442.593	581.826
50	64.463	84.572	112.797	152.667	209.348	290.336	406.529	573.770	815.084	1,163.91	1,668.77
60	81.670	114.052	163.053	237.991	353.584	533.128	813.520	1,253.21	1,944.79	3,034.82	4,755.07

Period, *n*	12%	13%	14%	15%	16%	17%	18%	19%	20%	24%
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.120	2.130	2.140	2.150	2.160	2.170	2.180	2.190	2.200	2.240
3	3.374	3.407	3.440	3.473	3.506	3.539	3.572	3.606	3.640	3.778
4	4.779	4.850	4.921	4.993	5.066	5.141	5.215	5.291	5.368	5.684
5	6.353	6.480	6.610	6.742	6.877	7.014	7.154	7.297	7.442	8.048
6	8.115	8.323	8.536	8.754	8.977	9.207	9.442	9.683	9.930	10.980
7	10.089	10.405	10.730	11.067	11.414	11.772	12.142	12.523	12.916	14.615
8	12.300	12.757	13.233	13.727	14.240	14.773	15.327	15.902	16.499	19.123
9	14.776	15.416	16.085	16.786	17.518	18.285	19.086	19.923	20.799	24.712
10	17.549	18.420	19.337	20.304	21.321	22:393	23.521	24.709	25.959	31.643
11	20.655	21.814	23.044	24.349	25.733	27.200	28.755	30.404	32.150	40.238
12	24.133	25.650	27.271	29.002	30.850	32.824	34.931	37.180	39.580	50.985
13	28.029	29.985	32.089	34.352	36.786	39.404	42.219	45.244	48.497	64.110
14	32.393	34.883	37.581	40.505	43.672	47.103	50.818	54.841	59.196	80.496
15	37.280	40.417	43.842	47.580	51.660	56.110	60.965	66.261	72.035	100.815
16	42.753	46.672	50.980	55.717	60.925	66.649	72.939	79.850	87.442	126.011
17	48.884	53.739	59.118	65.075	71.673	78.979	87.068	96.022	105.931	157.253
18	55.750	61.725	68.394	75.836	84.141	93.406	103.740	115.266	128.117	195.994
19	63.440	70.749	78.969	88.212	98.603	110.285	123.414	138.166	154.740	244.033
20	72.052	80.947	91.025	102.444	115.380	130.033	146.628	165.418	186.688	303.601
24	118.155	136.831	158.659	184.168	213.978	248.808	289.494	337.010	392.484	723.461
25	133.334	155.620	181.871	212.793	249.214	292.105	342.603	402.042	471.981	898.092
30	241.333	293.199	356.787	434.745	530.321	647.439	790.948	966.712	1,181.88	2,640.92
40	767.091	1,013.70	1,342.03	1,779.09	2,360.76	3,134.52	4,163.21	5,529.83	7,343.86	22,728.8
50	2,400.02	3,459.51	4,994.52	7,217.72	10,435.6	15,089.5	21,813.1	31,515.3	45,497.2	195,373
60	7,471.64	11,761.9	18,535.1	29,220.0	46,057.5	72,555.0	114,190	179,495	281,733	*

all these calculations are quite conservative. My intention in writing this article was not to turn piano technicians into financial analysts. So, in the interest of space, the tables only extend to 60 periods. Those of you who have the desire, and financial spreadsheet software packages, can carry the calculations out to additional periods. Also keep in mind that the interest rate we are using in the calculations are approximations, since it is impossible to be sure of future interest rates over time.

Problem #9: How much money must be paid quarterly for 15 years (60 periods) at the rate of 12% per annum (3% per quarter) in order to have a $250,000 nest egg for retirement? We use Table #3 and the formula CSAN = R($CVIFA_{i,n}$). In this case we know the answer (CSAN = $250,000), and are solving for R. This type of a problem is called a "Sinking Fund Problem," and is awfully helpful in planning the payoff of a loan, or planning for retirement.

CSAN = R($CVIFA_{i,n}$)
$250,000 = R($CVIFA_{.03,60}$)
$250,000 = R(163.053)
$250,000/163.053 = R
$1533.24 = R

Present Value of an Annuity at Compound Interest: This is the fourth and final area we will cover. The present value of an ordinary annuity (PVAN) is the sum of the present value of the periodic payments.

Problem #10: Mr. Capstan has decided to sell his C Clef Piano Rebuilding Shop and retire. He and his accountant have figured that the business, including tools, parts, client file, tuning business, goodwill, and the building Mr. Capstan owns and uses as a shop is worth $100,000. He put the business up for sale. Ms. Hammer has decided to buy the business for the amount of $100,000 but only has cash of $30,000. She asks Mr. Capstan to extend a 10 year loan to her for the remaining $70,000. They arrive at a 12% per annum interest rate (3% per quarter). The payments are to be made quarterly over the next ten years (40 periods). What is the amount she must pay Mr. Capstan per quarter?

We will use Table #4. The formula is PVAN = R($PVIFA_{i,n}$). PVAN is the present value of an ordinary annuity, R is the actual payment due, PVIFA is the present value interest factor at the interest rate of 3% for 40 periods.

PVAN = R($PVIFA_{i,n}$)
$70,000 = R($PVIFA_{.03,40}$)
$70,000 = R(23.115)
R = $70,000/23.115
R = $3028 paid quarterly to Mr. Capstan for 10 years.

When you try solving these problems on your own, you must first ask yourself two questions: 1) Do we need a future value or a present value? 2) Are we dealing with a single amount (lump sum), or an annuity (which is a continuous stream of payments over time)? Table #1 and #2 are lump sums. Tables #3 and #4 are annuities. Table #1 and #3 are future value. Tables # 2 and #4 are present value.

If the problem you are to solve involves a lump sum and also a stream of payments: 1) divide the problem into its individual components, 2) solve the individual parts after answering the above two questions, 3) add together the component parts.

An example of this kind of a problem is a bond problem. A bond is comprised of a lump sum and also a stream of semi-annual interest payments.

I hope this article has been of some help to you. If you have successfully completed this article, you may be a candidate for a financial calculator. Texas Instruments, Hewlett-Packard and others have calculators ranging in price from $20 to $135. When your present calculator wears out, look for one with financial functions. You'll find that as time goes on, you'll find more and more uses for this type of information, not only to monitor your business, but to ward off slick salespeople looking to increase their retirement portfolio and diminish yours. ■

Table 4

Present Value of an Annuity Interest Factor (PVIFA)
($1 per year at i% for n years)

$$PVIFA = \frac{1 - \frac{1}{(1+i)^n}}{i}$$

$$PVAN = R(PVIFA_{i,n})$$

Period, n	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	24%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.806
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	1.457
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	1.981
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	2.404
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	2.745
6	5.795	5.601	5.417	5.242	5.076	4.917	4.766	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	3.020
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	3.242
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	3.421
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	3.566
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.193	3.682
11	10.368	9.787	9.253	8.760	6.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	3.776
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	3.851
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	3.912
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	3.962
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.060	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	4.001
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.312	7.824	7.379	6.974	6.604	6.265	5.954	5.669	5.405	5.162	4.938	4.730	4.033
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	5.373	6.047	5.749	5.475	5.222	4.990	4.775	4.059
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812	4.080
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.844	4.097
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.128	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870	4.110
24	21.243	18.914	16.936	15.247	13.799	12.550	11.469	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937	4.143
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948	4.147
30	25.808	22.397	19.600	17.292	15.373	13.765	12.409	11.258	10.274	9.427	8.694	8.055	7.496	7.003	6.566	6.177	5.829	5.517	5.235	4.979	4.160
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925	10.757	9.779	8.951	8.244	7.634	7.105	6.642	6.233	5.871	5.548	5.258	4.997	4.166
50	39.196	31.424	25.730	21.482	18.256	15.762	13.801	12.233	10.962	9.915	9.042	8.304	7.675	7.133	6.661	6.246	5.880	5.554	5.262	4.999	4.167
60	44.955	34.761	27.676	22.623	18.929	16.161	14.039	12.377	11.048	9.967	9.074	8.324	7.687	7.140	6.665	6.249	5.882	5.555	5.263	5.000	4.167

Calendar Of Coming Events

Date	*Event*
July 18-22, 1988	**31st Annual Piano Technician Guild Convention & Institute** Adams Mark Hotel, St. Louis, MO Home Office: 9140 Ward Parkway, Kansas City, MO 64114, (816) 444-3500.
Sept. 30-Oct. 2, 1988	**Florida State Seminar** The Jacksonville Hotel, Jacksonville, FL John Pelick Jr.; 1567 Townsend Blvd; Jacksonville, FL 32211-4944; (904) 724-4795
October 14-16, 1988	**Texas State Seminar** Tropicana, San Antonio Leonard Childs; 7867 Lark Ridge; San Antonio, TX 78250; (512) 647-3648
October 20-23, 1988	**New York State Seminar** Holiday Inn Arthur Nick Smith; 730 Park Avenue; New York, NY 13204; (315) 478-1669
October 28-30, 1988	**Central East Regional Conference** Sheraton Inn Robert Morris; 1729 D Valley Road; Champaign, IL 61820; (217) 356-9781
November 4-6, 1988	**North Carolina State Seminar** Comfort Inn Sam Corbett; Rt. 3, Box 115; Grifton, NC 28530; (919) 254-5016

Upgrading to RTT

Ron Berry
Vice President

In the past I have discussed the difference between Associate and RTT membership. This month I want to discuss the process of upgrading membership from Associate to RTT. Associate membership is now defined to include anyone with a professional or avocational interest in piano technology, a grand definition that includes both a hobbyist who wants to learn to tune his own piano as well as a well qualified technician. Since dues are $114, people who are not really serious about becoming professional technicians tend to be weeded out. All new members are processed as Associate members, which allows us to make someone part of the organization before tests have been arranged. Once a member, the Associate may take tests whenever ready.

The first test is a written exam with questions concerning tuning, repair, regulation, piano history and piano design. This test should be administered by the chapter and must be taken before the other tests. Because the test is simple to administer and is free, it can help you know when you're ready for additional tests. Experience has shown that unless you do fairly well on the written test, you are probably not ready for the technical test.

The technical test covers grand and vertical regulation and in-field repairs. It does not cover large scale shop repairs such as pinblock or soundboard replacement, but does cover repairing strings and broken action parts, rebushing keys, and other in-the-home repairs. The test takes about four hours and costs $60. If you fail to correctly complete the required 80 percent on one or two sections of the test, you may retake these sections once within a period of one year for $20 each. After the one-year period, you must retake the entire exam. Most chapters are set up to give the technical test but if you experience any difficulty in arranging a technical test, contact Examinations and Test Standards Committee Chairman Wayne Mately, 28610 SE Mud Mountain Road, Enumcalw, WA 98022.

The tuning test involves tuning single strings on a piano that is muted off. Measurements are then taken of your tuning and compared to a master tuning done on the piano by a group of examiners. Any notes found to deviate are verified aurally before they count against your score.

After all the single strings have been measured, each note in octaves 3 and 4 is measured before and after a standard test blow to see if there is any movement in pitch. Any note that moves more than one cent counts against your score. You are then asked to tune unisons in octaves 3 and 4. Each note is checked aurally and any questionable note is measured. A difference of one cent or more between any two strings is counted against your score. You must score 80 percent or better in each section of the exam. The test is scored for Pitch, Temperament, Midrange, Bass, Treble, High Treble, Stability, and Unisons. Those who use electronic instruments to tune may use these instruments on the test but will be asked to tune octaves 3 and 4 again aurally and must score at least 70 percent on Pitch, Temperament, and Midrange. The tuning test costs $60 and a score below 80 percent on any section means that the entire test must be repeated. One exception is that those who tuned electronically and failed only the aural retest of octaves 3 and 4 may repeat the aural test only at half the current exam fee. Tuning exams are available at many chapters, at most regional seminars, and at all annual conventions. Check your *Journal* for dates and places of special test sessions. For tuning tests, after checking with your chapter about where tests are available, contact the Examinations and Test Standards Committee for further help. The three tests (written, technical, and tuning) must all be completed within a four-year period. Otherwise, the test that is outside that time limit will have to be repeated. Reclassifying will involve some effort on your part but will provide a great educational opportunity. Good luck. ■

New Members During April 1988

REGION 1

Rhode Island, RI — 029

Robert T. Case
24 Sunnyfield Drive, #1
Westport, MA 02790

Vermont, VT — 054

Lowell D. Wakker
Rd #2, Box 650
West Rutland, VT 05777

New Jersey, NJ — 078

Lewis A. Hoyt
311 South Boulevard
Spring Lake, NJ 07762

Kurt E. Weissman
28 East Palisades Blvd., #17
Palisades Park, NJ 07650

New York City, NY — 101

Carl A. Viggiani
229 West 109 Street, Apt 3
New York, NY 10025

Philadelphia, PA — 191

David J. Bender
132 Crestview Avenue
Langhorne, PA 19047

Gretchen Kinsey
430 Rutgers Avenue
Swarthmore, PA 19081

Reading-Lancaster, PA — 195

Lance P. Runk
14 Horse Shoe Drive
Annville, PA 17003

REGION 2

Northern Virginia, VA — 223

Ted W. Lewis
7605 Locris Drive
Upper Marlboro, MD 20772

Research Triangle, NC — 275

Fred A. Koehler
6809 Glendower Road
Raleigh, NC 27612

Charlotte, NC — 282

James H. Baker
1314 Richland Drive
Charlotte, NC 28211

Timothy M. Boles
2730 Normandy Road
Charlotte, NC 28209

Atlanta, GA — 301

Clay P. Lavender
112 Park Place
Dublin, GA 31021

Southwest Florida, FL — 337

Starr Taylor
P.O. Box 33021, #278
St. Petersburg, FL 33733

Memphis, TN — 381

Michael D. Carroll
1013 Tucker
Dyersburg, TN 38024

Howard L. Dunn
Rt. 1, Box 293
Imboden, AR 72434

REGION 3

San Antonio, TX — 782

Ted W. Dickerson
8814 Angel Valley
San Antonio, TX 78227

Austin, TX — 787

Emily R. Kaitz
1502 East 34th Street
Austin, TX 78722

Northwest Texas, TX — 791

Bob R. Waltrip
908 Tenth Street
Levelland, TX 79336

REGION 4

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Stewart A. Highland
85 N. Highland Street
Akron, OH 44303

Chicago, IL — 601

Gordon H. Johnson
2415 Commonwealth
Joliet, IL 60435

Bernard P. Ricca
1231 East 53rd Street, #2
Chicago, IL 60615

REGION 5

Twin Cities, MN — 553

Ronald R. Lindquist
6039 River Road
Eagle River, WI 54521

Kansas City, MO — 641

Paul K. Morales
1304 SE Seventh Street
Lee's Summit, MO 64063

REGION 6

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Ladislav Prcik
505 S. Roosevelt, #H9r
Mesa AZ, 85202

Los Angeles, CA — 901

Mathew S. Schreiber
14818 Sylvan Street
Van Nuys, CA 91411

South Bay, CA — 905

Sharon E. Webber
3132 Kerckhoff
San Pedro, CA 90731

Orange County, CA — 905

John D. Barry
9142 Kapaa Drive
Huntington Beach, CA
92646

Emil J. Economou
5510 Via Vallarta
Yorba Linda, CA 92686

Bruce A. Preston
1913 Spahn Lane
Placentia, CA 92670

Eugene, OR — 974

John W. Polese
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Florence OR, 97439

Affiliate

Marian Franken
Casilla 6374 cci
Ecuador

Reclassifications

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Orleans, ON K1C 4M8
Canada

Toronto, ON — 062

Paul D. Gilchrist
8 Kitsilano Crescent
Richmond Hill, ON L4C 5R8
Canada

New York City, NY — 101

Daniel Levitan
230 West 16th Street, Apt. 3a
New York, NY 10011

S C. Pennsylvania, PA — 170

Keith A. Bowman
210 Hamilton St
Harrisburg PA 17102

REGION 2

Washington, DC — 201

Carol Beigel
8230 Chestnut Ave
Bowie, MD 20715

Memphis, TN — 381

Monica S. Hern
954 Tatum Road
Memphis, TN 38122

REGION 3

Austin, TX — 787

Jimmy L. Currey
8509 Millway Drive
Austin, TX 78758

REGION 4

Chicago, IL — 601

Paul Gunty
704 West Elm
Arlington Heights, IL 60004

REGION 5

St. Louis, MO — 631

Skip Becker
16301 Manchester
Glencoe, MO 63038

Reinstatements

L.I. Cristofori, NY — 118

Robert Linton
164 - 23rd Street, #4r
Brooklyn NY 11232

The Auxiliary Exchange

President's Message

Time — Use It Or Loose It

The Complete Schedule of Events can be found elsewhere on this page. This gives you ample opportunity to pick and choose those things you wish to attend. We would like to see each and every one of you enjoy all of them. Through your requests, via last year's questionnaire, we have selected classes, fun times and kept open some free time. We have assembled some excellent instructors who are giving their time to prepare their own class for you and then giving up PTG class time to present them to you. If you have never had your handwriting analyzed, this is your chance. You will learn many things about yourself. You will also learn the rudiments of analyzing the handwriting of others. "Do they really mean what they say in that letter you receive?" "Or are they just being polite?" You can often tell by the way they cross a "t", dot an "i" or slant their letters. At the Opening Assembly, the history and background of St. Louis will unfold for you. Each time you leave the hotel, across the street you will observe the Court House where Dred Scott was tried and remember the city's storied history.

The PTGA Council Meeting, where the membership have their opportunity to change the rules and by-laws, and elect the officers for the coming year is of importance to all, not just the delegates, for you can speak through the delegate from your Chapter or Region.

The Tea and the Annual Installation Luncheon are always high points. At the Tea you will hear both of our PTGA Scholarship winners perform. See and hear, first hand, the first results from this worthy program. A fine pianist is also scheduled for the luncheon.

The newly built hotel, located in the reconstructed area of St. Louis, immediately across from their famous Arch, is ideal for easy access to shops, restaurants, fast food outlets and points of interest. A great time should be had by all!

Ginger Bryant

Food, Glorious Food...

Lionel Bart, composer of the book, music and lyrics of the Broadway show "Oliver" and later an Academy Award-winning motion picture, comes to mind when this writer thinks of the efforts being made by Nita Kadwell to compile and launch a new cook book from the Auxiliary of the Piano Technicians Guild. Recipes are accepted from RTTs and nonRTTs. Just send them to Nita. "Is it worth waiting for? If we live 'til eighty-four, all we ever get is gruel!" Recall the logo on the H-O Oatmeal box with Oliver Twist saying: "Please Sir, I want more." Well, we want and need some more-recipes!

Nita writes: I am disappointed that to date I have heard from only fifteen members with recipes. This is only 5 percent of the membership. Are you all thinking that the OTHER MEMBERS are going to fill up our cookbook? There is not as much time as one might think to get them to me, as I will need to begin compiling the manuscript for the printing company just a few weeks after the Convention in St. Louis, in order to have the books ready for sale in 1989. So I need to hear from you and SOON!

1988 Auxiliary Schedule — July 18-22 — Rose Garden Room

Sunday, July 17

	Auxiliary Room open.

Monday, July 18

9:00 a.m.	Board Meeting
9:00 a.m.	Walking Tour conducted by St. Louis Auxiliary of four-block radius of hotel. Meet in Auxiliary Room.
3:00 p.m.	Class — Gary Green, Sohmer Piano Co. — "All You Should And Would Ever Want To Know About Ivories."

Tuesday, July 19th

8:30 a.m.	Auxiliary Opening Assembly Welcome to St. Louis Memorial: Pauline Miller, Los Angeles, CA.
9:00 a.m.	"History of St. Louis" — presentation by Dr. Raymond Breun of the Jefferson National Historical Association.
10:00 a.m.	Get-acquainted coffee.
10:45 a.m.	Council Meeting. Member-At-Large Meeting
3:00 p.m.	Tea — Program: Auxiliary Scholarship Recipients.

Please see Auxiliary Membership Booth for child-care information

Wednesday, July 20

9:00 a.m.	Optional tour, including Lafayette Square, Missouri Botanical Gardens, Jefferson Memorial Museum, lunch on the Robert E. Lee Riverboat, and drive through Forest Park. There is a separate fee for this tour.
3:00 p.m.	Return to hotel. Auxiliary Suite open all day for those not going on tour ("Auxiliary Room In Use" sign posted outside indicating suite number).

Thursday, July 21

8:30 a.m.	Master Graphoanalyst, Sue Mathias.
10:00 a.m.	Class — Sharla Kistler, RTT, Lehigh Valley, PA, Chapter — "What It Is, Where It Goes, And How Not To Do It."
12:30 p.m.	Installation Luncheon — Program: graduate student, the St. Louis Conservatory and Schools of the Arts. Installing officer: Christine Monroe, California, At-Large.
4:00 p.m.	Post Board Meeting

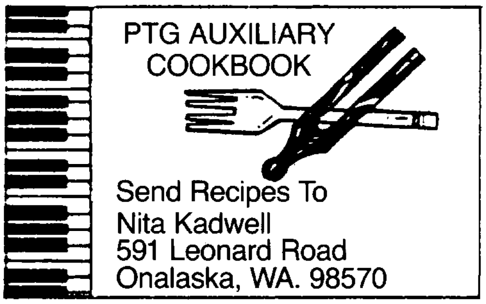
Friday, July 22

8:30 a.m.	Organizational Forum — Moderator: Julie Berry.
10:00 a.m.	Business Class — Chris Monroe, Paul Monroe, RTT — "How To Build, Increase And Maintain Your Business."

"There's not a crust, not a crumb can we find, can we beg, can we borrow or cadge. But there's nothing to stop us from getting a thrill when we all close our eyes and imagine: Food glorious food..." Now how about those recipes??? Nita has graciously proposed, if it is easier for you, take the recipes with you to the Convention and they will be collected in the Hospitality Room. She adds, "Let's make this a 100 percent effort BY ALL MEMBERS.

To those of you who wish to save Nita from lugging home all the recipes, prepare yours now and send to: 591 Leonard Road, Onalaska, WA 98570.

Editor



"You have a friend in Pennsylvania"...so the promotional says on bumper stickers, highway billboards and the like, and they're right! We had more than "a friend." We had many at the Pennsylvania State Conference, April 15-17, held in Altoona, PA, the great railroad complex for freight and passenger service. Word has it that the classes for Guild members were well attended and greatly appreciated. This writer very much enjoyed the spouse program which opened with a lecture on Social Security and what we ought to know about it. General interest was evident by the number of attendees and the questions that were asked of the representative from the regional Social Security office.

Patricia Coleman, our hostess, had cookies ready to serve in the Auxiliary hospitality room following this event. Greetings were exchanged all around. In addition to the members from the Keystone State (Bert Sierota, Cele Bittinger, Kathryn Snyder, Shirlie Felton, Pearl Kreitz, Ruby Stiefel and Shirley Truax) there were members from neighboring states. Jewell Sprinkle arrived from Virginia, Ginny Russell from Ohio, Ruth Juhn from New York. It was while we were at luncheon at the Clavin House that we saw additional members Crystal Bowman, Barbara Zeiner, Sue Hoffheins and Rosanna Hess. Lunch was followed by a well received lecture on herbs presented by herbalist Ann Marie Wishard. There were questions from Ruth Juhn, Zee Hawkins and many others. The train ride and its feature of the Horseshoe Curve of the Old Pennsyline, now known as ConRail, brought out five younger and prospective members of PTGA: Charlie and Daniel Berry plus Mom, Chris and Michael Snyder plus Mom, Miriam, and Zee Hawkins and grandchild Marvin. The small fry enjoyed each other and could have done so anywhere. At our Friday evening banquet we saw Margaret Moonan, chatted too with Connie Cadle and Marge Meyermann. It was good to see all of them. Mentioning individuals is a "risky" business — we're sure to have left out the name of someone with whom we talked at length. Ah, yes, there was Eleanor Ford recounting her delightful trip to Budapest earlier this year.

In conclusion, a unanimous vote of thanks to Fred Fornwalt, RTT, for developing the program and to Pat Coleman for implementing it.

Agnes Huether, Ed.

Exchange Editor:
Agnes Huether
34 Jacklin Court
Clifton, NJ 07012

Auxiliary Convention Program Highlights

Noted Historian Keynote Speaker. The opening assembly will feature reknowned historian **Dr. Raymond Breun,** Executive Director of the National Historians Association. He currently also serves on the boards of directors of both the Lewis and Clark Historical Foundation and the Midwest Museum Conference. Prior to his present position, he was Executive Director of the Missouri Art Museum.

We are indeed fortunate to have a man of Dr. Breun's prominence opening our festivities and no one will want to miss this outstanding program.

Luncheon Entertainment. Pianist **Diane Ceccarini** will entertain us during the luncheon and then join **Jim Kalkbrenner** for a fun and entertaining program they are developing for us.

Diane has extensive credits as a rehearsal pianist, musical director and arranger for the Repertory Theater of St. Louis and the St. Louis Muny Opera Company. She was rehearsal pianist for the American Theater's production of "My Fair Lady," starring Rex Harrison. She also has been the orchestra pianist for the St. Louis Opera Orchestra since 1983.

Jim Kalkbrenner has had a diverse experience as a performing artist. Along with appearances with major symphonies and opera companies both in America and in Europe, Jim has "crossed over" into popular entertainment, with roles in musical comedy and work in recordings, radio and television.

He now makes his home in St. Louis where he is the Program Director for the St. Louis Chapter of Young Audiences, Inc., an organization that brings the performing arts into the schools of Missouri.

What Are You Looking For In The Auxiliary? — An open discussion.

Because of the success of last year's program on Auxiliary affairs, **Julie Berry** will again moderate a program designed to elicit your thoughts and desires for a bigger and better Auxiliary. Last year's session concerning the future of the Auxiliary was brimming with opinions, ideas and suggestions from a variety of viewpoints and this year's program will bring forth even more. YOUR Auxiliary board is INTERESTED in knowing YOUR thoughts. Come to talk or come to listen.

Program Notes. A full program is scheduled. Previously previewed in the May issue were: a program on handwriting analysis presented by **Sue Mathias,** master graphoanalyst...Our two scholarship recipients will play for us at the Tea and their teacher will be an honored guest...The three classes scheduled are **Gary Green**, Sohmer Piano Co., "Ivory — The Good, The Bad, and The Ugly." **Sharla Kistler, RTT,** "What It Is, Where It Goes and How Not To Use It." **Paul and Christine Monroe,** "How To Build, Increase And Maintain A Successful Business."

Ginger Bryant

Index Of Display Advertisers

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Ads appearing in this publication are not necessarily an endorsement of the services or products listed.

Send check or money order (U.S. funds, please) made payable to Piano Technicians Journal, 9140 Ward Parkway, Kansas City, MO 64114.

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KORG AT-12 AUTOCHROMATIC TUNER,Play instrument; tuner shows note, octave, cents sharp or flat for seven octaves: C = 32.70 Hz to B = 951.07 Hz.(On some pianos, listens best to middle five octaves). Plays four octaves: C = 65.41 Hz to B = 987.77 Hz. Calibrate A = 430-450 Hz. Batteries, AC adaptor, earphone, case, year warranty, 1lb. Introductory offer: $135 postpaid ($190 list).**Song of the Sea, 47 West Street, Bar Harbor, Maine 04609, (207) 288-5653.**

JOHN TRAVIS PUBLICATIONS going out of business. *"Let's Tune Up"* for sale by the book or by the dozen. Paperbacks each $17.50 postpaid, hardbacks each $20.00 postpaid. Order NOW. No COD. Make check or money order payable to: **John W. Travis, 8012 Carroll Ave., Takoma Park, MD 20912.** "A Guide To Restringing" still available. See this month's CLASSIFIED.

SIGHT-O-TUNER SERVICE: Repairs, calibration, & modifications. Fast, reliable service. **Richard J. Weinberger, 18818 142nd Dr., SunCity West, AZ 85375. (602)583-0083.**

Wanted

LEADING MUSIC CENTER located in Central Jersey is in need of an experienced tuner for work in shop and field. Salary on payroll $26,000 per year. Paid vacation and secretarial work provided. Call **Freehold Music Center at (201)462-4730.**

WANTED: STEINWAY GRAND PIANO any size or condition. Call: **Doug or Tim at (804)358-1929.**

WANTED!! DEAD OR ALIVE "Steinway Uprights" Call collect, **Ben Knauer (818)343-7744.**

Up To $1000.00 Finder's Fee will be paid for successful purchase of a Mason and Hamlin Ex-Player. I have mechanism to install. Pls call collect **(317) 259-4307 or evenings (317) 849-1469. Jim Brady 4609 Cranbrook Dr., Indpls., IN 46250.**

PIANO TECHNICIAN WANTED: RTT preferred, minimum 2-5 years experience in tuning, repair and rebuilding. Full-time permanent position with good salary and benefits. Call: **Evan Tublitz — Syracuse Artist Pianos, Ltd. (315)446-5660.**

PIANO TECHNICIAN/REFINISHER looking for tuner technician and/or person experienced in refinish and touch-up. Tired of driving around town in the snow, relocate in sunny S. Florida, company benefits, paid vacation and holidays. **BOBB'S PIANOS & ORGANS, Inc., 2512 S. 30th Avenue, Hallandale, FL 33009. (305)456-7800, 1-800-531-9927 in Fla. Watts.**

YOUNG MAN WITH 12 YRS. EXPERIENCE rebuilding and refinishing pianos seeks employment. Salary is neg. Will relocate anywhere in U.S. Call or write: **Thomas Hechesky, 2668 Eastman Ave., Columbus, OH 43207. (614)491-8819.**

THE UNIVERSITY OF NEVADA, is currently seeking applicants for the position of Piano Technician. This position is responsible for the care, maintenance, cleaning and rebuilding of approximately 75 pianos and 3 harpischords. The work week is 40 hours, but evening and weekend work may be necessary depending on concert schedules. Qualified individuals will have certification and current registrations with the National Piano Technicians Guild. Salary starts in the $20,000 range; DOE. For more information and a Neveda State Employment Application send a resume and 3 letters of recommendation to: **University of Nevada, Las Vegas, Department of Personnel, 4050 Maryland Parkway, Las Vegas, NV 89154.** The deadline for responses is June 30, 1988. UNLV is an equal opportunity/affirmative action employer. UNLV will employ only those individuals authorized to work in the United States.

TUNER TECHNICIAN WANTED, 35 hrs., low $20's, plus benefits, to work with 3 other tuners maintaining 300 pianos. Average number of pianos per full time tuner is 80. Working conditions are excellent. 1/3 time tuning, 2/3 time regulating. Looking for a self-directed, reliable person with concert tuning skills who would enjoy working in a highly professional academic setting. Contact **Joseph Balconi, Eastman Scool of Music, 26 Gibb Street, Rochester, NY 14604.** We are an equal opportunity employer. M-F

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