Fundamentals of Piano Practice

Third Edition

Mlle. Yvonne Combe

by Chuan C. Chang

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To my wife Merry
who worked tirelessly so I could write this book
and our daughters Eileen and Sue-Lynn
who were my witnesses to Combe's teachings

The material of Chapter One originated from my notes on how the late Mlle. Yvonne Combe taught our daughters. Combe was Debussy's disciple and helped transcribe his new compositions as he played them out on the piano. She performed that incredible Second Piano Concerto by Saint-Saëns with the composer conducting. She dedicated her life to teaching piano and all who attended recitals by her students were mesmerized. This book had to be written: without it, her passing would have deprived us of a world heritage.

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ABBREVIATIONS

AP = Absolute Pitch, (17) Absolute Pitch, Relative Pitch
ET = Equal Temperament, (77) Circle of Fifths, Temperaments
FFP = Flat Finger Position, (4) Curled and Flat Finger Positions, Curl Paralysis
FI = Fantaisie Impromptu by Chopin, Op. 66, (48) Chopin's Fantaisie Impromptu, Op. 66, Polyrhythms
FOPP = Fundamentals of Piano Practice (this book)
FPD = Fast Play Degradation, (27) Fast Play Degradation, Eliminating Bad Habits
FR = Forearm Rotation, (21) Forearm Rotation
HS = Hands Separate, (6) Hands Separate (HS) Practice
HT = Hands Together, (37) Hands Together
K-II = Kirnberger II Temperament, (80) Kirnberger II, Equal Temperaments
LH = Left Hand
MP = Mental Play, (15) Mental Play (MP)
NG = Nucleation Growth, (56) Origin and Control of Nervousness
PBE = Play by Ear, (18) Play by Ear (PBE), Composing
PPI = Post Practice Improvement, (23) Post Practice Improvement, Sleep, Fast/Slow Muscles
PS = Parallel Sets, (9) Parallel Sets (PSs), Conjunctions, Cycling
RH = Right Hand
RP = Relative Pitch, (17) Absolute Pitch, Relative Pitch
SW = Speed Wall, (12) Speed Walls
TO = Thumb Over, (30) Thumb Under, Thumb Over, Glissando Motion, Pivoting
TU = Thumb Under, (30) Thumb Under, Thumb Over, Glissando Motion, Pivoting
WT = Well Temperament, (77) Circle of Fifths, Temperaments

Foreword

I took piano lessons for over seven years from age ten, practicing up to eight hours on weekends. My successes in life and lifelong dedication to the piano [see (84) About the Author] gave me every reason to believe that I should be successful in piano. Although I became a choir accompanist and church organist, I was struggling with the Beethoven sonatas — difficult passages remained insurmountable no matter how long I practiced. This made no sense because there have been thousands of proficient pianists in the world — **how did they all learn?** I was told that musical talents and perseverance were the only ways, but I suspected that there are teachers who know how to teach. They must have written books. So I read books and they all taught the same things: practice scales, arpeggios, exercises, start with easy lesson pieces, etc., which I was already doing. Even published interviews with famous pianists gave no clue as to how they learned, except to endlessly tout their exceptional talents, an obviously self-serving device with no pedagogical value. Was lifelong, daily, total dedication to piano, at the exclusion of everything else, the only way? These facts made no sense; I needed to investigate.

This book (FOPP) originated in 1978 when I took our daughter to her piano lesson with Mlle. Yvonne Combe. After a few years of lessons, our two daughters were progressing at unbelievable speed, which we attributed to their "exceptional musical talents". During this lesson, the teacher took out a book with lesson pieces arranged according to difficulty, for choosing a new piece to study. Combe said "Choose whatever you want!!!" and my daughter looked all over the book, as Combe played excerpts from various pieces. I couldn't help interfering to ask "Shouldn't she stay within her level of difficulty?" Combe smiled knowingly with our daughter and answered **"Difficulty isn't our problem, is it?"** I was so flabbergasted by the implications of what she said that I decided to investigate her teaching method. It took 15 more years of research for me to realize that efficient practice methods were the key to success, not talent!!, and additional 10+ years to gather the material for FOPP.

I read over fifty of the most popular piano books and have reviewed them here and they demonstrate that practically every piano learning method consists of showing students what to practice, and what kinds of techniques (runs, arpeggios, legato, staccato, trills, etc.) are needed. There are few instructions on how to practice in order to be able to play them, which is mostly left to the student and endless repetitions. These books show how teachers taught, because they were written by respected teachers.

Most of the known methods of how to practice for technique acquisition have been assembled in FOPP, see [(58) Summary of Method (One Page)]. New pieces are quickly learned in this way because there are solutions to every technical problem, and previously "impossible" pieces come within reach. The difference in learning rate between approaches based on efficient practice methods and others can be the difference between a rewarding musical experience within months and a *lifetime* of exercises, lesson pieces,

little progress and nothing to perform. I also researched an additional 50+ references, and **included any insights on practice methods from all these sources into FOPP**. Finding material for FOPP was my main motivation for reading them. Books with significant useful information have been labeled "must read" in the reviews [(83) Book Reviews: General Comments].

As a scientist, I knew that organizing the material into a logical, scientifically sound, structure was the only way to write a useful textbook that did not contain fatal flaws such as false assumptions. The methods were subjected to scientific scrutiny, with theories of why things work or not, providing a better understanding of the underlying principles. My career as a research scientist was critical to the creation of FOPP and, together with the most complete treatment of practice methods, distinguishes it from every other book on piano; see (64) Why the Greatest Pianists Could Not Teach, (66) Scientific Approach to Piano Practice and (83) Book Reviews: General Comments. Eliminating some widely accepted practice methods based on incorrect assumptions frees up enough time to not only learn piano, but also pursue the education needed to navigate in today's world, or even have a separate career. The higher education is *necessary* for understanding basic piano principles! I became convinced of FOPP's potential to help students and teachers and, since 1999, have made it downloadable free on the internet

I did not originate most of the basic ideas in FOPP. They were re-invented umpteen times in the 200 years since Bach, by every successful pianist; otherwise, they would not have had such success. The basic framework for FOPP was constructed using the teachings of Combe, the teacher of our two daughters who became accomplished pianists (they have won many first prizes in piano competitions and averaged about 10 recitals a year each for ten years; both have absolute pitch, enjoy composing music, and have careers in the computer field). Other parts of FOPP were assembled from the literature by reading most of the books recommended by fellow pianists and my research using the internet. My main contribution was to provide some understanding of why these methods work and why some widely taught methods do not. This understanding is crucial, not only because it is the only way for the reader to apply them correctly, but also to identify the ineffective methods based on wrong assumptions.

It is well known in science that more discoveries are often made while writing the research reports, than when conducting the research. Writing FOPP was no exception. One important discovery was that the efficient practice methods that students needed most were never adequately documented, and this could be remedied by more rigorous research and documentation. Other discoveries [(73) New Discoveries of this Book, Research]: Hanon pulled most of his exercises from Bach's works [(43) Problems with Hanon Exercises], Bach based his Inventions on Parallel Sets [(46) Bach Used Parallel Sets to Compose His Inventions], [(9) Parallel Sets (PSs), Conjunctions, Cycling], Beethoven invented group theory before mathematicians did [(67) Mozart's Formula, Beethoven and Group Theory], the first movement of the Appassionata is a piano version

of Beethoven's Fifth Symphony [(51) Beethoven's Appassionata, Op. 57, First Movement], etc..

Too many students spend 100% of their time learning new compositions and, because this process takes so long under the old teaching systems, there was no time left to practice the art of making music and to get a needed education. The objective of FOPP is to make the learning process so fast that we can allocate 10% of practice time to technical work and 90% to making music, an objective first enunciated to me by Combe.

The Age of Exercises (1900-2000), epitomized by Hanon's exercises and Cortot's book (Cortot, Alfred,), is finally ending because we know much better methods for technical development. The age of "you can't play this for ten years because it is too difficult" is also over; we can all start making music from day one of piano lessons and aspire to acquire significant repertoires of memorized, performable music within a fixed schedule of time.

I did not realize how effective the methods of FOPP were until after I finished my First Edition book in 1995. These methods were better than what I had been using previously and, for years, I had been applying them with good results. I experienced my first awakening after finishing that book, when I read my own book and followed the methods systematically -- and experienced their incredible efficiency! So, what was the difference between knowing parts of the method and reading a book? In writing FOPP, I had to take the various parts and arrange them into an organized structure that served a specific purpose and that had no missing essential components or fatal errors. It was as if I had most of the parts of a car but, without a mechanic to assemble it, find any missing parts, and tune it up, those parts weren't much good for transportation. That is a major advantage of books: everything can be carefully thought out and organized; nothing is forgotten. A teacher teaching a student in real time doesn't have that luxury; I always remembered important things that I should have taught (in science, piano, etc.) *after* the lessons were over. Without a good textbook, it is impossible to convey the information in a good book in lessons lasting several hours a week.

Teachers are better than books because they can adapt their teachings to fit each student, but good books can provide more information than any one super teacher can hope to know, are always available to anyone, and cost less. Everyone agrees that the best system is a good teacher with good books, as practiced at all schools and universities. Can you imagine your school or university teaching without textbooks? Piano teaching got away without genuine textbooks for so long because it was based on talent instead of knowledge. Where would our civilization be today, if all institutions of learning were based on student talent instead of knowledge, where each student had to rediscover algebra, science, history, etc., on his own, without books and with only the professor's memory as the source of information?

FOPP is not a dogmatic set of practice rules; it is a collection of tools for solving technical problems. It empowers students to create their *own* practice routines because

each individual is different. It is about growth into independent, self-sufficient, mature individuals and musicians (by allowing pianists to control their own futures), instead of career students waiting for instructions.

Music, the ability to memorize a large repertoire, and IQ are linked. This book discusses the physical basis of this linkage, see (65) Creating Geniuses. Learning piano can lower the IQ (with mindless repetitions of exercises and cultivating a lazy brain) or raise the IQ by learning how to memorize, conversing with the greatest geniuses that ever lived through their music, increasing brain stamina and speed, and learning the four **"genius skills"**: **efficient practice methods** (FOPP), **mental play** [(15) Mental Play (MP)], **absolute pitch** [(17) Absolute Pitch, Relative Pitch], and **play by ear** [(18) Play by Ear (PBE), Composing], **that we can all learn**. It is astonishing that a majority of teachers never taught these genius skills -- little wonder that genius was such a rarity.

In order to understand music theory and to learn piano, it is helpful to understand the (76) Chromatic Scale and piano tuning [Chapter Three Tuning Your Piano]. Pianists need these types of knowledge to communicate intelligently with the piano tuner. Every tuner is familiar with these subjects, but they run into impossible problems when the pianists are not informed, so that the tuners decide what is best for the pianist. Bach and Beethoven used specific temperaments and some temperaments are problematic with Chopin's music. Today, you can change temperaments with the flick of a digital piano switch and experience the unbelievable sonority of Beethoven's Waldstein or hear key color with Bach's Well Tempered Clavier, that are impossible with even the most expensive concert grand tuned to today's standard (Equal) Temperament.

FOPP is only a beginning; future research will reveal better practice methods with limitless possibilities. Today, babies are tested for hearing as soon as they are born; tomorrow, parents who want musical children will teach them Absolute Pitch before they learn the alphabet, see (17) Absolute Pitch, Relative Pitch, (65) Creating Geniuses.

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Here are eye-opening Testimonials; how teachers evaluated FOPP and how it affected each pianist. What *readers* say, matters.

CHAPTER ONE
Basic Practice Methods

(1) Practice Routines, the Intuitive Method

Many students use the following **practice routine**:

1. Practice scales or technical exercises until the fingers are limbered up. Continue this for 30 minutes or longer if you have time, to improve technique especially by using exercises such as the Hanon series. This is when you can really work hard to strengthen the fingers.

2. Then take a new piece of music and slowly read it for a page or two, carefully playing both hands together, starting from the beginning. This slow play is repeated until it can be performed reasonably well and then it is gradually speeded up until the final speed is attained. A metronome might be used for this gradual ramp-up.

3. At the end of a two hour practice, the fingers are flying, so the students can play as fast as they want and enjoy the experience before quitting. After all, they are tired of practicing so that they can relax, play their hearts out at full speed; this is the time to enjoy the music!

4. Once the new piece can be played satisfactorily, memorize it and keep practicing "until the music is in the hands"; this is how you make sure that it is memorized.

5. On the day of the recital or lesson, practice the piece at correct speed (or faster!) as many times as possible in order to make sure it is in top condition. This is the last chance; obviously, the more practice, the better.

Every step of this procedure creates problems, is based on false beliefs and will limit progress to about the intermediate level even if the students practice several hours daily. This method tells the students nothing about what to do when they hit an impossible passage except to keep repeating, sometimes for a lifetime, with no idea of when or how the necessary technique will be acquired. A teacher who can't even play the piano can teach this method! It leaves the task of acquiring technique to the student — the method teaches nothing. Moreover, the music will come out flat during the recital and unexpected flubs will be almost unavoidable, as explained in this book. All these problems are solved using **"efficient practice methods"**.

The above practice routine seems so intuitively logical. Although human intuition helps us solve simple problems, when it comes to highly developed fields such as learning piano, intuition can not compete with **learning tricks** that past geniuses have discovered. Without these learning tricks, students are stuck with what we shall call **"intuitive methods"**, that are not based on the most efficient practice methods**.** "Talented" students, it turns out, have teachers, such as Combe, who know some of the

efficient practice methods, or have discovered them through a lifetime of dedication to piano, and can learn unbelievably quickly. Any student can progress equally quickly if there is a textbook containing all the known efficient practice methods. Though "intuition" generally denotes something good, I have chosen "intuitive methods" to denote the old, discredited teaching methods because the best methods are usually counter-intuitive, as we shall see.

There are numerous books on piano [(83) Book Reviews: General Comments]; they all teach what you should play, such as scales, trills, a Mozart sonata, etc., but they seldom teach how to acquire technique so you can play them. This book is a compilation of practice methods for acquiring technique with explanations of why certain methods work while others don't. Without the explanations, there is no way to know if a method works or not. Just because a teacher used the method for 30 years is not a valid explanation because so many of them have turned out to be wrong. Textbooks will free teachers from having to teach the mechanics of practicing and allow them to concentrate on music where the teachers are needed.

Piano teachers know that students must practice musically in order to acquire technique. Both musicality and technique require accuracy and control. Practically any technical flaw can be detected in the music. Nonetheless, many students tend to practice neglecting the music, preferring to "work" when no one is around to listen. Their reasoning is, "I'll practice non-musically (which is easier because you can shut off the brain) until I can play it well, then I'll add the music." This never works because learning piano is all about training the brain, not finger calisthenics. Such practice methods produce "closet pianists" who love to play but can't perform [(42) Musicality, Touch, Tone, Color].

Using efficient practice methods, you can learn in less than five years, what you *might* achieve in fifty diligent years using the "practice, practice, practice" (intuitive) approach. This book is not claiming that it will transform you into Mozarts, Beethovens or Chopins, although that can't be ruled out. It only claims that you can learn to play their music with ease.

(2) Bench Height, Distance from Piano, Posture

The **bench height** should be set so that the elbows are slightly below the level of the keys when the upper arms are hanging straight down with the hands on the keyboard in playing position. Sit on the front half of the bench, not in the center, and at a **distance from the piano** such that the body does not interfere with the elbows when they move towards each other in front of the chest. For beginners, benches with fixed height will not be problematic because they can adapt to a range of heights.

Low bench height has the advantage that it makes it easier to lift the fingers, especially the 4th, and it may allow a straighter wrist, thus reducing the chances of contracting carpal tunnel syndrome. The shoulders will be closer to the keys, providing a

wider reach and the head will be closer to the keys, providing a more intimate feel of the keys. It also makes it easier to sit with a straight spine and to sit farther away from the piano, which provides more elbow space. Sitting lower is more compatible with many techniques such as (21) Forearm Rotation, using the Power Thumb [(31) Thumb, Most Versatile Finger, Power Thumb] or the flat finger positions [(4) Curled and Flat Finger Positions, Curl Paralysis], etc. It also allows the use of forearm rotation to rotate the wrist rapidly.

Posture is important: a high position can cause the players to hunch their backs, so that a conscious effort must be made to sit straight up. Massage therapists know that a crooked spine, head leaning forward, can cause long-term problems from stress.

The high position makes it easier to lean forward and exert downward pressure with the shoulders for loud passages. It may also make it easier to prevent "hand collapse" (HC), which is a controversial subject because the different types of HC have not been clearly defined, although HC is prominently discussed in several books.

Whatever advantages/disadvantages there are to different bench heights, they can be compensated by an adjustment in wrist position. In addition, each person has different ratios of the lengths of the spine, upper arm , etc., so that bench height alone does not determine the optimum position.

Bench height becomes important for advanced pianists; thus the best time to test for optimum height is at the advanced level. More factors favor the lower position, so that the optimum position is probably one with the elbow one to two inches below the keyboard. This will make most commercial non-adjustable benches too high by several inches. Adjustable benches are highly recommended.

A majority of teachers and books recommend sitting with the elbow at the level of the keys and a few, especially the older ones, recommend higher positions. Many concert pianists sit high, probably because they had teachers who preferred the high position, and became accustomed to it. The lower position is recommended here because it has more advantages.

(3) Starting a Piece

Learn only music that you can perform. The days of "years of exercises and lesson pieces for technical development" are over. Start assembling a repertoire immediately; the list of great music containing technical lessons is effectively infinite, so you don't need anything else! It is never too early to practice performances; it is never too early to make music. One of the most harmful comments I have heard is that youngsters are too young for Chopin. Then there is kiddie music for the youngest: kiddie music exists only in the minds of adults. Children of any age can appreciate good music and perform them; there isn't a single reason why children should be held back.

Of course, beginners need Beginner books,, (Humphries, Beyer, Thompson, Faber & Faber, etc.) to learn the necessary conventions and basic music theory. There is no need

to go through every page, just pick up those elements that are new to you. With the practice methods of this book, the student can start with performable music that may present challenges, but such challenges are just what is needed to learn how to use these methods. Exercise/lesson books such Hanon, Czerny, Cramer-Bulow, Dohnanyi Exercises, Cortot, etc., are obsolete. There are pianists who were raised on such exercises that still teach them and they are certainly not worthless, but there are better methods. There is plenty of easy starter music that are performable, such as Magdalena's Easy Bach,. Most importantly, choose the music that you like. We shall choose Beethoven's **Für Elise** (Sheet Music,) to illustrate the practice methods because it can be learned very quickly using these methods.

Listen to recordings of pieces you decide to learn. This is the fastest way to learn musicality and improve technique. It is a great way to gather musical ideas, and explore new material. Listen to several recordings of the same piece. Your teacher should be able to play and demonstrate for you; it is better to have teachers who can play your pieces.

Next, analyze the structure of the piece and estimate how long it will take to learn it — these are necessary components of (59) Project Management; advanced pianists become experts in project management. If you can not estimate the completion time, it means that you do not know all the practice methods needed to learn the piece. Of course, the estimate will be wrong, but the exercise of estimating teaches you what practice methods are needed. Without the estimate, there is a chance that you will never finish the piece; however, no music is ever finished, so how do you know you finished it? The performance! Once it is performed successfully, it is finished.

Start analysis by numbering all the bars. There are two versions of Für Elise sheet music differing in the way the repeats are indicated, which changes the bar numbers. I am using the long version with 124 full bars. The short version has (105) bars; the ( ) indicates the bars for the shorter version. The first 4 bars are repeated 15 times, so that by learning 4 bars, you can play 50% of the piece! Another 6 bars are repeated 4 times, so by learning 10 bars, you can play 70% of the piece. This 70% can be memorized in less than 30 minutes because these 10 bars are simple. There are two interruptions among these repetitions that are more difficult for a total of 50 distinct bars to learn. Each of the difficult sections can be memorized in one day, so you can memorize the entire piece in three days. Give yourself two more days to practice (additional instructions are given below), and you should be able to play the piece (with questionable quality) in a week. How long it will take you to polish this piece so that it is performable will depend on your skill level and knowledge of practice methods.

(4) Curled and Flat Finger Positions, Curl Paralysis

The **curled position** has been defined in the literature as the "relaxed" natural position of the fingers when you hang the hands down your sides. This works for pianists who have been playing for years, but how a two-year-old, or a golfer, or swimmer, who

had never played piano, would hang the hands can be any position. To properly define the curled position, place both hands on a tabletop, about a foot apart, palm side down. Form domes with the hand and fingers as if you are holding softballs, with finger tips touching the table. The right and left thumb nails should point towards the left and right shoulders, respectively. This is the starting position for the fingers and is called the curled position because the fingers are curled over the imaginary ball.

The advantages of the curled position are that it: provides firm control of each finger, facilitates playing between black keys, and aligns the fingers close to a straight line so that all keys are played at about the same distance from their pivots [balance rail, see (81) Grand Piano Action Diagram]. Those with long fingers find it necessary to curl fingers 2-4 more in order to play the thumb. The disadvantages are: (1) you play with the fingertips that are easy to injure and do not provide sufficient padding for better control of touch or playing FFF and PPP; two types of finger tip injuries can occur with the curled position, see (60) Injury, Health, (2) the downstroke requires precise control of complex sets of muscles, (3) it is easy to miss black keys because the finger tip area is small, and (4) it suffers from **curl paralysis**.

To demonstrate curl paralysis, stretch any finger (except the thumb) straight out and wiggle it up and down as if depressing a piano key. Then gradually curl the finger, keeping the same wiggle motion as before. Note that the maximum wiggle decreases with increasing curl: paralysis increases with curl.

One unusual position is the **"collapsed" position** in which the last phalange (nail phalange) is bent outwards, instead of the "normal" straight or slightly curled. There is no evidence that this position is harmful, and it has the advantage of playing more with the front pad of the finger. Furthermore, the muscle to this phalange can be relaxed because tendons naturally limit the outward motion, thus simplifying finger motions and increasing (8) Relaxation. Although some teachers abhor this position because it looks unnatural, there is no known reason why it is bad and has advantages. Trying to "correct" this position can create terrible problems.

The curled position must be taught, especially to beginners, but there are many other positions that must be studied. Each pianist has his own natural position so that forcing every student to adopt a single "standard" curled position is a common mistake of older teaching methods that can significantly slow down a student's progress.

When both black and white keys are played, the black keys should be played with less curl because they are higher. We shall call the family of non-curl positions the **Flat Finger Positions (FFP)** - see Prokop, P.13-15 for FFP photos.

(1) The most extreme FFP is the straight flat position: all fingers are stretched straight out. It is the way V. Horowitz played and has the advantages that: the keys are played with the front pads of the fingers which reduces the probability of injuries from long practice sessions, and the keystroke motion is the simplest of all positions, requiring use of the smallest number of muscles. This facilitates relaxation. The finger contact areas

with the keys are maximized, reducing the probability of missed notes, and you can feel the keys with the most sensitive front pads of the fingers. The sensitivity gives more tone control whereas, with the curled position, you are restricted to one tone which tends to be harsher. Because it is simpler, and does not suffer curl paralysis, you can play faster; however, the fastest position is one in which you play the black keys FFP and the white keys curled because this places every finger closest to its key. FFP increases the reach and reduces interference from the fingernails.

Proponents of the curled position argue that it is the strongest position because of the arch shape; this is false because athletes who do hand stands use the front pads, not the fingertips; thus the FFP is the stronger position.

Nomenclature: **Phalange** (also called phalanx; plural is always phalanges) is the name for the finger bones beyond the knuckle; they are numbered 1-3 (thumb has only 1 and 3), and the 3rd phalange is the "nail phalange" (see Prokop, P. 101).

With FFP, the **tendons** under the finger bones hold the fingers straight when playing. Unlike the curled position, no effort is needed to keep the fingers straight because tendons limit the amount of backwards bending. There are pianists whose nail phalange naturally bends backwards (collapsed position). There is nothing wrong with this and it does not interfere with FFPs. Learn to use these tendons to help with relaxation. The nail phalange should always be relaxed. The relaxed 3rd phalange also acts as a shock absorber. When playing fortissimo with curled fingers, both the extensor and flexor muscles must be controlled in order to hold the curled position. In FFP, the extensors are relaxed and only the flexors are needed, reducing stress and simplifying the motion. Thus the curled position is complex and requires a good fraction of a lifetime to learn properly, whereas the FFP is more natural. That is why self taught pianists tend to use more FFP.

The best way to practice FFP is to play the B major scale, in which fingers 2,3,4 play the black keys and 1,5 play the white for both hands. Since 1 & 5 should not generally play the black keys in runs (a fingering rule), this is exactly what you want for practicing FFP.

Play FFP with the palm of the hand almost touching the keys. This increases accuracy because you know exactly where the keys are. FFP legato is easier and different from legato using the curled position because the curled position produces a harsher tone. It is easier to play two notes with one finger FFP because the finger can be turned at an angle to the keys so that the large area under the finger can play two keys. Because Chopin was known for his legato, was good at playing several notes with one finger, and recommended practicing the B major scale, he probably used FFP. Combe taught FFP and noted that it was particularly useful for playing Chopin. One legato trick she taught was to start with FFP and then curl the finger so that the hand can move from white to black keys without lifting the finger off the key. Parts of the Bach Inventions are good for practicing FFPs, suggesting that he composed them with both FFP and curl in mind.

The freedom to play with any amount of curl is a necessary technique. One

disadvantage of the curled position is that the extensor muscles are not sufficiently exercised, causing the flexor muscles to strengthen and even overpower the extensors. In FFP, the unused flexor muscles are relaxed; in fact, the associated tendons are stretched, which makes the fingers more flexible. There are numerous accounts of the extraordinary flexibility of Liszt's fingers. Liszt used FFP to improve tone (Boissier, Fay, Bertrand). Because of the tradition of teaching mostly the curled position, many older concert pianists under-use the FFPs and had to work unnecessarily hard to acquire technique.

(2) Another FFP is the pyramid position in which all the fingers are straight, but are bent down at the knuckles. This has the advantage that the downstroke action is simpler than for the curled position. Some pianists feel naturally relaxed with this position. If you are not naturally comfortable with this position, there is no need to learn it.

(3) The spider position is similar to the pyramid, except that the bend occurs mostly at the first joint after the knuckle. As with the pyramid position, the main reason for using this position is that it is a natural position for that pianist. Many pianists are unable to use this position, so don't be concerned if you can not. Of all the FFPs, the spider position may be the most versatile. The insect kingdom adopted this position after hundreds of millions of years of evolution.

Chopin's legato is documented to be particularly special, as was his staccato. Is his staccato related to the FFP? Note that all the FFPs take advantage of the spring effect of the relaxed third phalange, which might be useful in playing staccato.

It is easier to play FFP when the bench is lowered. There are numerous accounts of pianists discovering that they can play better with a lower bench height (Horowitz and Glenn Gould). They claim to get better control, especially for pianissimo and speed.

Don't worry if you can't use all these positions. Use those that are comfortable, natural positions for you. The purpose of these discussions is to caution teachers against forcing every student to use one idealized curled position because that can create problems. Each hand is different and each position has advantages and disadvantages that depend more on the person than on the position.

In summary, Horowitz had good reasons to play with flat fingers and the above discussions suggest that part of his higher technical level may have been achieved by using more FFPs than others, and sitting low. Although the curled position is necessary, the statement "you need the curled position to play technically difficult material" is misleading – what we need is flexible fingers. Playing with FFPs liberates us to use many useful and versatile finger positions. We now know how to play all those black keys, especially arpeggios, and not miss a single note. Thank you, Johann, Frederic, Franz, Vladimir, Yvonne (Combe)!

(5) Reading, Fingering

Beginners who know nothing about reading, fingering, or how to start learning

piano, should use the Beginner books, where they can find the beginner information including fingerings (Beyer does not tell you that thumb is finger #1 and pinky is #5!). Here are the fingerings for scales and arpeggios: (29) Scales: Nomenclature and Fingerings; they should be practiced until they become automatic habits. Thumb is rarely asked to play the black keys because that places the other fingers too close to the fallboard.

The **time signature** at the beginning of each composition looks like a fraction, consisting of a numerator and a denominator. The numerator indicates the number of beats per measure (bar) and the denominator indicates the note per beat. For example, 3/4 means there are three beats per measure and each beat is a quarter note. Knowing the time signature is critical when accompanying or playing in a group because the moment that the accompanist starts is determined by the starting beat which the conductor indicates with the baton. This beat is indicated in the sheet music — it is frequently not the first beat of a measure! The **key signature** indicates the key in which the music is written and appears before the time signature. It indicates the locations of the sharps and flats.

Do not take extended reading lessons just to learn all the music notations because you won't remember them months later when you need them. Learn to read music notations as they are encountered in new compositions you learn, or when practicing scales and arpeggios. Teachers must balance the students' abilities to read and to memorize, which is treated in (14) Memorizing, Close Your Eyes and Play.

The most important rule for fingering is that, for the same or similar passages, always use the same fingering. Changing the fingering after you have partially learned a section is a major decision because getting rid of old habits and establishing new ones takes a lot of work. During a performance, the old habits can suddenly pop up and result in a flub.

The standard fingerings are generally not indicated in the sheet music and they do not always work depending on what comes before and after, in which case you need non-standard fingerings; these are generally indicated in most sheet music. Although some indicated fingerings may seem awkward at first, you will find that they are needed when you get up to speed and play hands together.

For the **Für Elise**, look for editions that have the non-standard fingerings indicated. Bar 52 (31 short version) RH, can be played 2321231 where the 3212 is the turn, or 3432131.

(6) Hands Separate (HS) Practice

Technique is acquired most quickly using **hands separately (HS) practice** for music that is difficult and require technical development. If it can be played **hands together (HT)** at final speed, skip HS work, and you are done. Beginning students should practice everything HS just to learn the methodology. Easy sections that don't require HS

work will be completed very quickly, so little time is wasted. For difficult material, separating the hands speeds up the learning process by allowing the application of a myriad of learning tricks that are major topics throughout this book.

To practice HS, choose two sections to practice, one for each hand. Practice one hand and switch hands as soon as the working hand gets tired. In this way, you can work hard 100% of the time without fatigue because one hand is always resting. When a hand that had been working hard is rested, it is initially tired and sluggish. As it rests, it recovers and becomes re-energized and eager to play — this is the best time to switch hands because it can perform miracles. Rest it longer, and it will cool off and become sluggish again. Thus you must learn from experience, the best time to switch hands; the shortest times are about 10 seconds. Depending on the conditioning of the hands, the degree of difficulty, etc., this rest time can be longer. The best switching time is the shorter of the optimum rest time of the resting hand and the "tiring time" of the working hand.

HS practice is simpler than HT because most of the learning is confined to one hemisphere of the brain for each hand. HT practice involves both hemispheres which is more complex and takes longer to learn. HT is a separate skill [(37) Hands Together] that must be practiced after all HS work is done. It is best to learn one skill at a time because, if two skills are practiced simultaneously, difficulties in one skill can prevent progress in the other.

A critically important HS skill is **experimentation**. This ability is what separates the mature musician from the perpetual student. It is impossibly difficult to experiment with new hand motions when practicing HT. Experimentation consists of two phases: diagnosing the problem and then solving it, as demonstrated throughout this book.

HS practice is used to increase your **brain speed**. Beginners can't play fast because every brain has its speed limit: it has never been asked to work faster. This limit is different from (12) Speed Walls that are limited by lack of technique. Just because you have heard music at high speeds doesn't mean that your brain/fingers can execute them. Playing fast will actually alter the brain and its connections to the hand. When playing fast for the first time beyond the brain's old speed limit, you should feel a strange new sensation like the first time you learned how to ride a bicycle. At the highest speeds, this feeling can only be described as "exhilarating".

Technique can be pushed much further HS than HT, and is a lot of fun! It is superior to anything Hanon or any other exercise can provide. This is the time to figure out "incredible ways" to play that piece. **The amount of time spent, working on pieces that have been completely mastered, is what separates concert pianists from amateurs**, because this is when you really develop advanced techniques.

For beginners, HS is mainly for acquiring technique and getting up to speed for learning new music quickly. For advanced players it has a myriad uses limited only by human imagination. Some pianists not brought up with HS methods consider HS to be

trivial and unimportant because it is so easy to learn. In practice, 80% of this book discusses what magic you can perform when the hands are separated. HS is trivial only for the uninformed.

Pianists who never practice HS will always have a **technically weaker LH**. The LH plays passages that require more strength (the lower hammers and strings are heavier), but it often lags in speed and technique because the melodic material in the RH tend to be technically more demanding (which is the clearest demonstration that technique is not finger strength). The HS method will balance the hands because you can give the weaker hand more work.

For passages that one hand can play better than the other, the better hand is often your best teacher. To **let one hand teach the other**, select a short segment and play it rapidly with the better hand, then repeat immediately with the weaker hand, one octave apart to prevent collisions. You will discover that the weaker hand can often "catch on" or "get the idea" of how the better hand is doing it. The fingering should be similar but does not need to be identical, because the LH is a mirror image of the RH and it is usually impossible to use the same fingering. An interesting alternative is to use mirror notes and identical fingering, but then the music from the two hands will not be the same. Once the weaker hand "gets the idea", gradually wean it off by playing the weaker hand twice and the stronger hand once, then three against one, etc., until the stronger hand is not needed anymore.

In the intuitive method, both hands are played together, hoping that the weaker hand will catch up to the stronger one. In reality, the opposite happens because at low speed, nothing happens to both hands and at high speed, the weaker hand is playing stressed, forming (12) Speed Walls while the stronger hand keeps improving.

This ability of one hand to teach the other is more important than most people realize. It works with practically anything you practice HS. The reason for this broad applicability is that one hand always plays something better than the other.

(7) Difficult Sections First, Segmental Practice, Continuity Rule

Practice the most **difficult sections** first because you must spend the most time there. If the easy sections are practiced first, the difficult sections will never be learned sufficiently well because time will run out; that's not just human nature, but also a time management flaw. Technique acquisition also suffers because practicing the difficult sections is what advances technique. Practice the easy sections first only if that simplifies the learning of other sections, as we shall see for Chopin [(48) Chopin's Fantaisie Impromptu, Op. 66, Polyrhythms].

Segmental practice: Choose two short segments to practice, one each for the right (RH) and left hand (LH). The segments can be any length, down to just one or two notes, but are generally about one bar. The shorter the segment, the easier it is to play, the more times you can practice it in a given time, and the faster you can play it without forming

bad habits. Segmental practice, combined with HS practice, enables experimentation with new hand motions, etc., that results in a powerful method for acquiring technique.

Continuity Rule: When choosing a segment, include the beginning of the next segment. This overlap of segments, called a **conjunction** [(9) Parallel Sets (PSs), Conjunctions, Cycling], facilitates the joining of segments later on. The continuity rule applies to segments of any length; for example, at the end of the first movement, include the beginning of the second movement. A related rule is the

Contiguity Rule: finish each project before moving on to the next, and finish related projects first. This means do not start on a second Beethoven Sonata until the first one is completely finished; otherwise, you may never complete either of them.

Our **Für Elise** example has two sections that are more difficult than the rest. They are bars 45 (24, short version) to 56 (35), and 82 (61) to 105 (84). The first section might be more difficult, so start with that: bar 53: practice the RH, including the first four notes of bar 54 (continuity rule); similarly, practice the LH, including the first chord of bar 54. The RH fingering is 251515151525,1254. Repeat this procedure with bar 54. When satisfactory, connect the two (bars 53, 54), HS only.

HS and segmental practice are the most efficient practice methods for acquiring technique quickly.

(8) Relaxation

The human brain can be quite wasteful. In conducting any activity, the untrained brain activates many more muscles than is necessary, often activating opposing muscles that fight each other, or neglecting to relax the muscles after their work is done. This waste gets worse in difficult or complex situations. For simple activities, such waste does not matter. In piano, it can make the difference between success and failure because we are using the brain and hands at tasks beyond their evolutionary capabilities.

Relaxation in piano is not relaxing all muscles, but relaxing all *unnecessary* muscles so that the necessary ones can do their job; the necessary ones are frequently asked to work extremely hard. We also need to quickly relax the working muscles as soon as their work is done in order to reduce fatigue and to prevent interference with subsequent movements. This is called **rapid relaxation**; the relaxation speeds must match the keystroke speeds for the system to work. This requires conscious practice, because it is not normally required.

All pianists have experienced the phenomenon in which there is no progress for extended periods of practicing difficult material until suddenly, you can play it. What happened? There are various causes such as discovery of [(36) Hand Motions], but the most common cause is relaxation which produces a positive feedback loop: you have become good enough to relax; the more you relax, the better you can play, and the better you can play, the more you can relax, etc. Incorporating relaxation from the beginning immediately starts this positive feedback, greatly accelerating technique acquisition.

The realization that relaxation is important has spawned various schools of teaching, such as the arm weight method. Getting bogged down in such methods is not a good idea because they mostly emphasize what you shouldn't do over what you should do because the material is not sufficiently understood. Instead, understanding the basic principles is better. The arm weight is important in piano because humans evolved with muscle strengths that match gravity exactly. Accordingly, the piano was designed with all required forces as close to gravity as possible. Students not taught relaxation can press down on the piano constantly or tense their muscles most of the time, especially when practicing difficult material. Gravity provides a constant reference force of exactly the correct magnitude against which to measure the level of relaxation. This answers the question "how do I know if I am relaxed?" You are relaxed when you can feel gravity pulling on your body and hands.

This has led to the concept of the **gravity drop**. Raise your hand four to ten inches above the keyboard and drop it on one key with one finger, letting gravity pull the hand down, as if the hand is going to fall right through the keyboard. At the bottom of the keydrop, stiffen the finger so that the keyboard stops the hand and the finger is supporting the hand; then immediately relax the hand. If sufficiently relaxed, you will feel gravity pulling the hand down. If done correctly, you were relaxed during the fall and the finger accelerates through the keydrop, which is the process of "playing deeply into the keys" to produce a deep tone [(42) Musicality, Touch, Tone, Color].

The gravity drop is not the way to play the piano, but is useful for illustrating relaxation, and everybody should practice it. A rising elbow is often an indication of stress; when this happens, relax by allowing gravity to pull the elbow (and shoulder) down.

(9) Parallel Sets (PSs), Conjunctions, Cycling

Parallel Set (PS) practice, also called chord attack, provides the fastest way to increase finger speed. PSs are groups of notes that can be played simultaneously with one hand, such as 12345 or 1324 and every note appears only once. They are played in order from left to right.

Let's play a two-note PS, 23. Play middle C and D with RH fingers 2 and 3, one after the other. You can speed up this PS by playing them like grace notes. It can be played even faster by dropping the hand onto the keys, but letting 2 land slightly ahead of 3. You can increase the speed even more by letting 3 land closer and closer to 2. At the limit when they land together, you are playing at a mathematically infinite* speed!

*In mathematics, infinity is defined as inf. = 1/n, $n \to 0$; "infinity is one divided by n, as n approaches zero". With PSs, you are conducting this mathematical operation on the piano using a two-note PS. Speed = 1/delta where delta is the time difference between the two fingers. As speed increases delta decreases, until it becomes zero when the two

notes are played as an interval.

In practice, nobody can play infinitely fast because no one has such accuracy — the accuracy in playing intervals determines the fastest speed that the pianist can play, so it is necessary to practice playing accurate intervals in order to achieve hyper-speeds using PSs.

Let's apply PSs to speeding up the **Alberti** construct CGEG. The objective is to to play any number of CGEG in succession, at any desired speed, such as in the 3rd movement of Beethoven's Moonlight. LH: start with 5 on C3 and play 5131. Play it as fast as you can. Remember this speed and we will compare it to the final speed after applying the PS method. Since we need something for the RH so that we can switch hands, let's do the same with the RH: with 1 on C4, play CGEG,1535, as fast as you can play accurately, and again, remember this speed (measure it with a metronome).

LH: start with the simplest PS, two notes, 51. Practice in units of four PS repeats called a **quad**: 51,51,51,51. When this is satisfactory, practice four quads in succession: quad,quad,quad,quad, until the hand tires or stress starts to build up (perhaps 10 seconds), then switch hands and repeat a similar procedure for the RH. "Satisfactory" means final speed of about a quad per second (slower for beginners), *relaxed and easy*.

For increasing speed quickly, practice "chords" instead of PSs. Play both 51 notes simultaneously as an interval or chord, and practice rapid **chord quads**. Play each quad in one down movement of the hand, keeping all fingers close to the keys. Then raise the hand to play the next quad.

As you increase speed (chord quads), stress should start to build up. Then stop speeding up (or even slow down slightly) and relax the whole body (and hand) as you play, breathing comfortably. As you add relaxation, you should feel the stress draining out of the hand as you keep on playing. This is how relaxation is practiced! Switch hands as soon as it starts to feel tired and begins to slow down. The rested hand should be eager to play and it can now play faster than before.

To transition from quad chords to fast PSs, substitute the last chord of a chord quad with a fast PS:

(chord,chord,chord,chord) → (chord,chord,chord,PS),

keeping the repeat rate the same within each quad. Once this is satisfactory, substitute two PSs, etc., until the entire quad is PSs. This method enables you to transition immediately to fast PSs, because the chord and fast PS are similar.

Next let's try three-note PSs. LH: 513, RH: 153, and repeat the above procedure. Play all three notes in one down movement of the hand and practice the PSs in quads. Start with 513 chord quads if you have difficulties with the PSs. Complete this practice for both hands.

Conjunction: the final note in the CGEG is a repeat note and cannot be practiced as a PS (see definition of PSs at the beginning of this section). This G connects the PS,

CGE, to the notes that follow, so it is called a conjunction. Conjunctions are what slow you down — you cannot play conjunctions infinitely fast. In order to practice fast conjunctions, we introduce the concept of:

Cycling, also called looping, is a procedure in which the same short segment is cycled over and over continuously: CGEG,CGEG,CGEG, ... In this case, we can cycle without adding new notes. We say that CGEG is **self-cycling** because it has a built-in conjunction G.

To enable rapid cycling, you may need to practice the PS EG and then GEG. Now cycle the CGEG twice: CGEG,CGEG with no pause in between. This step is facilitated by using the continuity rule [(7) Difficult Sections First, Segmental Practice, Continuity Rule]: when practicing CGEG, include the first note of the next cycle and practice CGEGC. So practice CGEGC quads. Then practice cycling CGEG twice CGEG,CGEGC, then three times, etc. Play one CGEGC with one down motion of the hand. Finally practice cycling quads - now you are playing a quad of quads. Why always quads? In general, if you can do a quad comfortably, relaxed, you can play an indefinite number.

You are done! Now compare your new speed with what you did before applying the PS methods. A person who is experienced with these methods would start with CGE chord quads, then CGE PS quads, then CGEGC quads, then CGEG cycling, and finish the process in minutes. This is repeated several days in a row, until the final speed is faster than needed.

Cycling is pure repetition, but it is a device to minimize repetitive practicing. Use cycling to acquire technique so rapidly that it eliminates unnecessary repetitions. In order to avoid picking up bad habits, change speed and experiment with different (36) Hand Motions for optimum play and always practice relaxation. Do not cycle the exact same thing too many times because that's how you pick up bad habits. Over 90% of cycling time should be at speeds that you can handle comfortably and accurately, for reasons to be explained in (23) Post Practice Improvement, Sleep, Fast/Slow Muscles. You are done when you can play at any speed for any length of time, completely relaxed, and with full control. Then cycle down to slow speeds because you might find that certain intermediate speeds give trouble. Practice those speeds because they may be needed when you start HT.

If a technique requires 10,000 repetitions (typical for really difficult material), cycling allows you to get them done in the shortest possible time. Representative cycle times are about 1 sec., so 10,000 cycles is less than 4 hours. If you cycle this segment for 10 min. per day, 5 days a week, 10,000 cycles will take almost a month. Clearly, very difficult material will take many weeks to learn even when using the best methods. This explains why students without proper guidance can practice for years without significant improvement.

Cycling is potentially the most injurious piano practice procedure. Don't over-do it the first day, and see what happens the next day. If nothing is sore, or you don't detect bad

habits or non-musical tendencies the next day, you can increase the cycling practice time.

The general rule for applying PSs is to break up each difficult passage into as large PSs as possible, e.g., 513 for practicing 5131. If this is too difficult, then break it up into smaller PSs, e.g., 51, 13, and 31.

PSs accomplish two objectives: (1) train the brain to handle high speeds (untrained brains are totally lost at new high speeds), and (2) increase speed as quickly as possible. For those brains that had never experienced such high speeds, you should briefly experience a strange sensation as the brain digests the implications of the higher speeds and adapts to the new capabilities, just like the feeling you get when you first learn to ride a bicycle, ski parallel, or swim on your own. Playing fast PSs necessarily positions the hands and fingers for high speed. The "Parallel" in PSs means that all the playing fingers move simultaneously (in parallel). The higher brain speed means that, when performing, you must be aware that the brain speed of the average audience is slower, and adjust your speed accordingly.

PSs are generally not how you play classical piano (they have been used in jazz, blues, etc.). They only bring you closer to the final technique quickly. The rest of this book provides the remaining steps for converting PSs to actual technique.

PS exercises are not mindless repetitions; they are still part of music and must be practiced musically, which means that anyone hearing you practicing PSs will admire that gorgeous piano sound. It means practicing softly, with attention to musicality. This is possible because you never spend too much time on any one PS exercise; it solves your problems quickly, so that you can move on.

For the Für Elise, you might cycle bars 1-6, then cycle 6-10 (9 short version). Then 17-20 (10-13) including the first note of 21 (14), then 21-22 (14-15), etc.; try to figure out the rest by yourself.

For bar 53 (32), practice the RH PSs 25 and 15, then 52 and 51, then 251, 152, and 151. Bar 54 (33) RH contains three PSs; don't forget the continuity rule. Similarly, bar 100 (79) has three PSs, 123, 135, and 432. To practice the chromatic scale of bar 103 (82), practice PSs 31, 13, 131, 313. The rest should be obvious, and you now have all the preliminary technique to play the whole piece.

(10) Parallel Sets Catalogue

A unique property of **Parallel Sets (PSs)** is that they are both **diagnostic tests** for discovering weaknesses and **methods for correcting** them. A beginner should fail all the tests! Even for advanced players, PSs are used only when they fail the test. They are not exercises in the conventional sense to be practiced repeatedly, wasting time. They are used only when necessary to solve problems. Once solved, you have gained a technique for life — you never have to repeat that procedure again, unlike the Hanon type exercises that are repeated all your life with little assurance that they will solve your problems. Below are the major PSs listed in order of complexity with explanations of their

properties and how to use them. They are listed using a representative member, such as 1111 (four repeats, a **"quad"**, of the thumb), representing all repeats.

There is no need to practice all the PSs because you create just the PS you need depending on the problem, and there are too many of them. Study a few until you understand the concept.

PS #1: 1111, the repetition. This "PS" is somewhat of a misnomer because it contains no PS, but is a necessary member of the family of PS exercises.

It is the simplest, but is the most important. Because of its simplicity, it is too often ignored, and therefore not understood. It is used at the beginning of practically every PS session to separate out the motions of the large members (arms, hands, body, etc.) from the smaller motions of the fingers. It is practiced as quads of quads: 1111,1111,1111,1111, four quads in rapid succession (no rest between quads) followed by a brief pause. Difficult material requires a series of PS sessions such that each session prepares you for the next, and this is the starting PS.

Diagnostic test: increase speed to more than one quad (1111) per second, playing comfortably, relaxed. Then two quads in a row without any pause between them: **1**111,**1**111, accenting the first of each quad, then three, etc., until you can do four quads. Next, do two 4-quads in a row with a pause between them, then three, and finally four (16 quads in all, or about 16 seconds). If you fail, practice it. The passing criteria depend on the individual and degree of difficulty. Thus beginners playing slower pieces may pass at one quad per two seconds; set the test speed according to the required final speed.

Example: use PS #1 to start a two-note PS session with PS 23 of RH (fingers 2 and 3). For actual applications, see (35) Trills and Tremolos.

Test using PS #1: play this: 2.3,2.3,2.3,2.3; the 2.3 notation means that 2 and 3 are played simultaneously, as an interval, not a PS. Play one quad at faster than one per second. Then four quads in rapid succession in four seconds. Then, up to four 4-quads in 16 seconds. There is a tendency to play louder with increasing speed, but they must be played softly. If you fail any of these, practice them. One might think that once you practice PS #1 for, say, one finger, you have acquired the repetition skill so that you will never need PS #1 again. This turns out to be false. There is a large number of PSs, as we shall soon see, and the different fingers required for each PS necessitates that you start with PS #1 all over again, especially at the higher speeds. And, you will be increasing that maximum speed all your life! If you fail, how do you practice?

Solution: Shorten PS #1 to just two units: 2.3,2.3. If satisfied, do three, then a quad. Then two quads, etc., until you can play 4-quads, comfortably, softly, relaxed. To increase speed, keep the fingertips close to the keys and play each quad with one down motion of the hand, and a flexible wrist. As you increase speed, stress will build up and the quads will start to slow down; the slowing down is a sign of fatigue – it is time to switch hands. The motions must originate in the body, near the diaphragm, with small contributions from every connecting member up to the fingers. You fail unless you can

play relaxed, see (8) Relaxation. For advanced material, you may need weeks of work — you need to build stamina, etc. Without relaxation, this can create (12) Speed Walls.

As the repetition speed increases, the fingers/hands/arms will automatically go into positions that are ideal; PSs will make sure of that; otherwise, you will not attain the required speeds. These positions will resemble those of concert pianists -- after all, that is why they can play it. Bring your opera glass and watch the motions of advanced pianists after you have read this book. To the untrained observer, a concert pianist may seem to be doing nothing unusual, but if you know the hand motions as explained here, you will see them executed beautifully. If you pass the 4-quad test, you should be able to play the quads as long and as fast as you want, with control and without fatigue.

This exercise is important for practicing accurate intervals and chords, and this accuracy determines the fastest PS speed you can play. Since you can always increase the speed no matter what your skill level, PS #1 can be useful to everyone at all times.

PS #2: 123, linear sets.

There are many of these, such as 234, 543, 135, 1354, 12345. When practicing one PS, practice its reverse also. To practice 123, practice 321; otherwise, you tend to develop unbalanced technique; that is, the inability to play 123 well may be due to the fact that you cannot play 321 well. A right handed golfer should also practice lefty swings. Otherwise, the body will become unbalanced, the left hip bone will weaken while the right will be stronger than normal, which can result in osteoporosis of the left hip or bone fractures and other injuries. Massage therapists know that unbalanced bodies can cause numerous problems such as pain and injuries.

PS #3: 1324, alternating sets.

These are practiced by breaking them down into smaller PSs; eg, 1324 is practiced as 13, 32, and 24, or as 132, then 324.

PS #4: 1.3,2.4, compound sets, where 1.3 is an interval.

These are very difficult. To practice them, simplify them to 1.3,4, then 1.3,2, then 1,2.4 and 3,2.4.

PS #5: HT PSs

PSs can be used to practice HT and to synchronize the two hands. See how this is used to practice the end of (50) Beethoven's Pathetique, Op. 13, First Movement. In this application, the RH plays normally because it is easier, but the more difficult LH is simplified into PSs. Note the importance of PS #1 in this example. Thus PSs can be used as part of an outlining program [(38) Outlining, Beethoven's Sonata #1, Op. 2-1].

PSs #1 to #5 are just samples of the most common ones. There is an indefinite number of them and, within each type, there are many subtypes. This shows how inadequate older exercises such as Hanon and Cortot are, in addition to the fact that they do not apply directly to the music you are practicing. By contrast, the relevant PSs are generated directly from the music you are learning.

(11) Basic Key Stroke; Legato, Staccato

The **basic keystroke** consists of 3 main components, the downstroke, hold, and lift. This might sound like a trivially simple thing to learn, but it is not because each component has a method and a purpose, and the pianist must know how to use the keys to manipulate the jack, backcheck, and hammer shank flex (Askenfelt, Anders, Ed.,). The fact is, few beginners do it correctly.

The **downstroke** is what creates the piano sound; in the correct motion, it must be a single *accelerating* motion, yet with control of the volume. The timing of this downstroke must be extremely accurate. The suggestion to "play deeply into the keys" means the downstroke must not slow down; it must accelerate all the way to the bottom so that control over the hammer is never lost. Practice this by starting the keystroke slowly rather than accelerating the end.

The Steinway "accelerated action" works because it adds acceleration to the hammer motion by use of a rounded pivot under the center key bushing [see item 5 in (81) Grand Piano Action Diagram, where it is just a felt bushing instead of a rounded pivot]. This causes the pivot point to move forward with the keydrop thus shortening the front side of the key and lengthening the back side and causing the capstan to accelerate for a constant keydrop. This illustrates the importance piano designers place on accelerating the keydrop in order to produce good tone. The effectiveness of the "accelerated action" is controversial because there are excellent pianos without this feature - in which case the acceleration is entirely controlled by the pianist. Obviously, it is more important for the pianist to control this acceleration than to depend on the piano. Nonetheless, this factor might explain the overwhelming preference of concert pianists for Steinways. Adding accelerator features to digitals should be trivial, but may be meaningless because there is no hammer shank flex effect. Fast flexor muscles must be developed for the downstroke, as well as rapid relaxation after the downstroke.

The **hold** component holds the hammer still using the backcheck [item 26 in (81) Grand Piano Action Diagram] to accurately control the note duration, which means that the pianist must maintain a downward force during the hold. Without the hold, the hammer can flop around and cause problems with repeated notes, trills, etc. Thus the hold is important in a trill. Beginners will have difficulty with making quick transitions from the downstroke to a relaxed hold. Do not push down on the key during the hold in an attempt to "push deeply into the piano", because this will result in stress, pain, and even injury. Although you may not press down firmly as a beginner, a student can end up pressing with incredible force after years of this bad habit. Gravity is sufficient to keep the key down and hold the hammer still with the backcheck. The length of the hold is what controls color and expression; therefore it is an important part of playing musically, and may be the most difficult component to control.

The **lift** causes the damper to fall onto the strings and terminates the sound. Together with the hold, it determines the note duration. The lift must be fast in order to control the

note duration accurately. If the damper is not returned rapidly, it will make a buzzing sound with the vibrating string. Therefore, the pianist must develop fast extensor muscles. Especially when playing fast, many students forget about the lift entirely, resulting in sloppy play.

In **normal play**, the lift of the previous note coincides with the downstroke. If you had never practiced these components before, start practice with fingers 1-5, C to G, C major scale, and apply the components to each finger. To exercise the extensor muscles, exaggerate the quick lift stroke; practice rapid lifts with immediate relaxation, not an isometric high lift and hold.

This basic keystroke practice is much more important than most students realize. It is obvious that you aren't going to play piano this way, so why practice it? With a minimum of practice, it quickly becomes an automatic part of how you play everything, because you will hear the difference in the music. The basic keystroke is another justification for the slow gradual approach to pianism used by many piano schools such as the arm weight, Alexander, and Feldenkrais schools.

Keep all the non-playing fingers on the keys, lightly. As you speed up the down and lift strokes, starting at about one note per second, stress may start to build up; practice until the stress can be eliminated. Then gradually speed up to some comfortable speed at which you can still practice each component. What is so magical is that if practiced diligently, the basic keystroke will be automatically incorporated into your play when playing at regular speed. There is no need to worry about losing these motions because the difference is clear: the music will deteriorate if they are not properly executed.

Now do the same with any slow music, such as the 1st movement of Beethoven's Moonlight, HS. If you had never done this before, HT will initially be awkward because so many components in both hands must be coordinated. However, with practice, the music will come out better, with more control over the expression and the music. The performances will be consistent from day to day, and technique will progress more rapidly. Without a good basic keystroke, different pianos, or pianos that are not in good regulation, can become impossible to play because the hammer will flop around uncontrollably.

In the old schools of teaching, students were taught to execute correctly by striving for good touch and tone, without worrying about jacks or backchecks. Today's better educated students must deal with the reality of what is happening in the piano because that provides more precise instructions on how to execute. For example, the implications of the basic keystroke change for digitals because they don't have jacks, backchecks, or hammers, which is one reason why advanced pianists prefer acoustic pianos. Still, the basic keystroke must be practiced with digitals because it is part of good technique and it is clearly audible.

Legato is smooth play. This is accomplished by connecting successive notes – do not lift the first note until the second one is played. Fraser recommends considerable

overlap of the two notes. The first moments of a note contain a lot of "noise" so that overlapping notes are not that noticeable. Since legato is a habit that must be built into your playing, experiment with different amounts of overlap to see how much overlap gives the best legato for you. If you have already developed your own habit, it may be difficult to change; be prepared to work on this over a long time. Then practice until the optimized motion becomes a new habit. Chopin considered legato as the most important skill to develop for a beginner. Chopin's music requires special types of legato and staccato (Ballade Op. 23); you should listen to recordings and practice them using this Ballade.

Staccato: Astonishingly, most books on learning piano discuss staccato, but never define it! In staccato, the hammer is bounced off the strings and the damper is returned immediately onto the strings so as to produce a brief sound with no sustain. Therefore, the "hold" component of the basic keystroke is missing and the hand is held above the keys after playing the note, not resting on the keys. There are two notations for staccato, the **normal (dot)** and **hard (filled triangle)**. In both, the jack [#1 in (81) Grand Piano Action Diagram] is not released. In normal staccato, the key drop is about half way down. In hard staccato, it is less than half way; in this way, the damper is returned to the strings faster, resulting in shorter note duration. The finger moves down and up rapidly. Because the backcheck is not engaged, the hammer can "bounce around", making staccato repetitions tricky at certain speeds. Thus if you have trouble with rapidly repeated staccatos, don't immediately blame yourself -- it may be the wrong frequency at which the hammer bounces the wrong way. By changing the speed, amount of key drop, etc., you should be able to eliminate the problem.

In normal staccato, gravity quickly returns the damper onto the strings (grand pianos; in uprights, springs are used). In hard staccato, the damper is bounced off the damper top rail [(81) Grand Piano Action Diagram, click on more detailed diagram link at bottom], so that it returns even more quickly. At string contact, the hammer shank flex can be negative, which makes the effective mass of the hammer lighter; thus a considerable variety of tones can be produced with staccato. Therefore, the motions of the hammer, backcheck, jack, and damper are all changed in staccato. Clearly, in order to play staccato well, it helps to understand how the piano works. Don't blame yourself when something unexpected happens because staccato is too complex to figure out; your only option is to try different things to see what works. Staccato is not just a very short note!

Staccato can be divided into three types depending on how it is played: (i) finger staccato, (ii) wrist (or hand) staccato, and (iii) arm staccato which includes both up-down motion and arm rotation. As you progress from (i) to (iii), more mass is added behind the fingers; therefore, (i) gives the lightest, fastest staccato and is useful for fast, soft notes, and (iii) gives the heaviest feeling and is useful for loud passages and chords with many notes, but is also the slowest. (ii) is in between. In practice, most of us probably combine

all three.

Since the wrist and arm are slower (heavier), their amplitudes must be correspondingly reduced in order to play faster staccato. Some teachers frown on the use of wrist staccato, preferring mostly finger staccato because of its speed or arm staccato for its power; however, it is better to have a choice (or combination) of all three. For example, you might be able to reduce fatigue by changing from one to the other, although the standard method of reducing fatigue is to change fingers. When practicing staccato, practice the three (finger, wrist, arm) staccatos separately before deciding on which one to use, or how to combine them.

(12) Speed Walls

All pianists have experienced **"speed walls" (SWs)**. What are they, how do they form, how many are there, and how do you eliminate them? Any piano piece can be played if slowed down sufficiently. The first order of business when learning a new piece is to bring it up to speed. That is when you can encounter SWs, conditions in which you can't go above a certain speed, no matter how hard you practice. SWs form when you practice incorrectly and create bad habits or build up stress. Therefore, it is the pianist who erects SWs. There are as many SWs as bad habits, basically an indefinite number.

HS practice is an effective weapon against SWs because most SWs are HT SWs. The next weapon is **segmental practice** because the shorter a segment, the faster you can play it without problems. **Parallel sets are the most useful weapons** against SWs because you can start at speeds above the speed wall. **Relaxation** is essential at all times, but especially for avoiding SWs because stress is a major cause. **Outlining** is another effective weapon because it allows the large motions to be correctly played at final speed, thus avoiding the SWs in these motions [(38) Outlining, Beethoven's Sonata #1, Op. 2-1]. **Quiet hands** is also helpful because you generally can not play quiet hands unless you have the technique [(24) Quiet Hands & Fingers]. Any method for increasing the efficiency of motion helps; thus mixing flat finger and curled positions, keeping the fingers on the keys, and the various hand motions such as glissando, cartwheel, arm rotation, wrist motion, etc., that are discussed below, are all needed to prevent SWs. Musical play is not possible at SWs because you lack control; thus in principle, if you always practice musically, you will never encounter a SW.

A few SWs built up over years may be difficult to eliminate in a short time. Early detection of SWs is the key to removing them quickly. The solution of last resort for a really stubborn SW is not to play it, or only playing it slowly, for weeks or months and learning something new during that time. Learning new things is a good way to erase old habits.

SWs form when you try the impossible. Many teaching methods have evolved to avoid this problem by slowing down the learning process. This defeats the original intent of learning as quickly as possible. The best solution is to use the learning tricks of this

book that achieve the objectives without doing anything impossible.

(13) Metronome

The **metronome** is one of your most reliable teachers -- once you start using it, you will be glad you did. Develop a habit of using the metronome and your playing will undoubtedly improve; all serious students must have a metronome. A student's idea of tempo is never constant; it can depend on what he is playing and how he feels at the moment. A metronome can show him exactly what these errors are. An advantage of HS practice is that you can count more accurately than HT. Use a metronome to check the speed and beat accuracy. I have been repeatedly surprised by the errors I discover, even after I "finish" a piece. For example, I tend to slow down at difficult sections and speed up at easy ones, although I think it is actually the opposite when playing without the metronome. Most teachers will check their students' tempi with it. As soon as the student gets the timing, *turn the metronome off*.

Metronomes must not be over used. Long practice sessions with the metronome accompanying you are the most common abuses. **Excessive use** of the metronome leads to non-musical playing. When the metronome is used for more than about 10 minutes continually, the mind will rebel against the enforced repetition and start to play mental tricks so that you lose the timing accuracy. For example, if the metronome emits clicks, after some time, your brain will create anti-clicks in your head that can cancel the metronome click so that you will either not hear the metronome, or hear it at the wrong time. This is why most modern electronic metronomes have a light pulse mode. The visual cue is less prone to mental tricks and also interferes less with playing musically. Another abuse of the metronome is to use it to ramp up speed; this abuses the metronome, the student, the music, and the technique, as explained in the section on (26) Speed, Rhythm, Dynamics. The metronome is for setting the tempo and for checking your accuracy; it can't teach you musicality. Once the tempo is set and checked, turn it off.

Electronic metronomes are better than mechanical ones although some people prefer the decorative value of the old models. Electronics are more accurate, can make different sounds or flash lights, have variable volume, are less expensive, are less bulky, have memory functions, etc. The mechanicals always seem to need rewinding at the worst possible times.

(14) Memorizing, Close Your Eyes and Play

Memorizing Procedure: Memorize every piece of music you learn *before* practicing it. While learning any segment when starting a piece, memorize it. Since a segment is typically 10 to 20 notes, memorizing it is trivial and takes very little time. Then you will need to repeat those segments many times, before you can play the piece -- that is many more repetitions than needed to memorize, and you have expended no extra

time. Don't waste such a priceless, one-time opportunity! Always memorize first, then practice only from memory, because this way of memorizing requires no extra expenditure of time.

The memorizing process is nearly identical to the learning process — you can accomplish two things in one process! Moreover, by memorizing and practicing at the same time, you actually learn the piece faster than if you didn't memorize it because you save time by not having to look for the sheet music. It also eliminates the slow process of reading the sheet music and mentally translating it to what you are playing, which slows down technique acquisition. **Memorizing saves time!**

The old school of memorizing taught students to learn to play a piece first and then memorize it. If you separate the learning and memorizing processes, you will have to go through the same procedure twice (HS, segmental, etc.). Nobody has the patience or time to go through such an ordeal; this explains why those who memorize after they have learned the piece *never* memorize as well as those who memorize first.

Memorizing HS will be useful during a performance for recovering from blackouts, etc. There are many more uses of HS memory that we shall discuss later. Once a short piece or a movement is memorized, break it up into logical smaller sections of about 10 bars each and start playing these sections randomly. Practice the art of starting play from anywhere in the piece. Starting randomly should be easy because you learned and memorized in small segments. It is really exhilarating to be able to play a piece from anywhere you want and this skill always amazes the audience.

Once a section is memorized, never use the sheet music again except for specific purposes, such as double checking the memory accuracy or checking the expression markings. Do not repeat the same segment too many times because memory is not reinforced proportionately to the number of repeats. It is better to wait 2 to 5 minutes and to re-memorize again.

Everything you memorize is in the head indefinitely; this is why savants can have such miraculous memory. Forgetting is not loss of memory but the inability to retrieve information. The most common cause of memory loss is confusion; instead of retrieving the right information, the brain goes to the wrong place and gets stuck. Memorizing HS is effective because you are dealing with only one hemisphere of the brain. HT memory involves both hemispheres and there are more chances for confusion. **Slow practice is a good test for memory** because there is more time for the mind to wander around and get lost. It is also a good way to memorize because there is time for the material to go back and forth from brain to hand many times, to strengthen the memory.

Many students become either good readers but poor memorizers, or vice versa. In almost all cases, this happens not because the students are born that way, but because of the way they practiced. Once they become good at reading, they have less need for memorizing, and can ignore memory practice. Vice versa for good memorizers. Teachers must carefully balance the reading/memorizing abilities of students at the beginner stage.

For practically all students (including those who consider themselves to be poor memorizers) the most difficult passages are played mostly from memory. Non-memorizers may need the sheet music for psychological support and small cues here and there but, in fact, they are playing difficult passages mostly from memory (if they can play them). Students who do not memorize never learn anything well, and this limits their technical development.

Pianists often **close their eyes** when they want to concentrate on playing music with high emotional content -- they need all the resources available to produce the high level of music. When the eyes are open, a tremendous amount of information comes into the brain because vision is a three-dimensional, multi-color, dynamic, source of high bandwidth video data that must be immediately interpreted in many complex ways. These data must be instantly processed because we must respond in real time to visual inputs. Thus a large portion of the brain is preoccupied with image processing at all times, not just when driving a car or playing tennis. Closing the eyes frees up this enormous amount of brain power for concentrating on music. Therefore, although most audiences admire that a pianist can play with eyes closed, it is actually easier. No concert pianist will intentionally make things more difficult for them during a difficult performance. They close their eyes because that makes it easier to play.

So, go ahead and play with your eyes closed and really impress the audience! Because it is simpler, it can be learned quickly. Besides, it is a skill any accomplished pianist should have. Learning to play with the eyes closed improves the ability to play with eyes open, because it requires skills such as feeling the keys [(28) Jumps, PP, FF, Feeling the Keys] and listening to your own playing.

Types of Memory: The best way to learn how to memorize is to study the best memorizers. Some savants have super-human memories, but we do not understand how their brains work, so they provide little help except to provide proof that human brains can perform incredible feats of memory. However, there are plenty of ordinary people who are terrific memorizers that routinely compete in memory contests. These memorizers have written articles/books on how to memorize that you can easily find on the internet. These accomplished memorizers always use memory **algorithms** [(16) Human Memory Function]. For example, to memorize a set of numbers, they map those numbers into a story or scenery that is easy to remember. The best memorizers have all been found to have evolved their own algorithms. Savants probably use algorithms also; unfortunately, no savant has been able to tell us what algorithm they are using; apparently theirs is something not readily describable in human languages.

It is instructive to study "intermediate" memory feats such as calendar calculations whereby a person can name the day of the week for every date, even thousands of years in the future or in the past. These are "modulo-A, B, . . ." problems and frequently have trivially simple solutions. For calendar calculations, A=leap year, B = month, and C =

week. Simple calculations show that you need to memorize only a few numbers to be able to calculate the day of the week for every date in seconds. Let's examine a simple modulo case, our number system (modulo-9) in which we need to memorize only ten numbers, 0 to 9, in order to write down and make calculations with numbers of *any size*, an amazing feat. Thus these modulo systems can be extremely powerful. The analog of the calendar calculation in the number system is the problem of predicting the last digit of a very large number, such as 5621. The answer (1) is trivial in this case, because of the modulo system. Pianists use the modulo-12 system (the octave) every time they play. The audience watches in wonderment as the pianist runs the entire span of the keyboard at top speed, because they don't know that we only need to know how to play one octave to be able to play all 88 keys.

There are numerous fascinating types of algorithms used by super memorizers, but that subject is outside the scope of this book. We don't need them for memorizing music because **music itself is an algorithm**! This is partly why all concert pianists can memorize such large repertoires - concert pianists are one type of super memorizer because piano practice provides them with *several* algorithms. Why music is such a good memory algorithm is not adequately understood; the answer certainly lies in the fact that music is a language [(68) Theory, Solfege]. An old man can tell stories for hours, much as a concert pianist can play for hours from memory. Thus memorizing hours of repertoire is nothing unusual for the *average human*, if you know how the brain memorizes.

Historically, music teachers have not taught memory methods, which explains why there is such a disparity between good and poor memorizers among pianists. The old school of music pedagogy had ascribed memory capabilities to talent because teachers did not know how to teach memory methods.

The first step in studying memory for piano is listing the ways in which we memorize: the pianists' algorithms. There are many types of memory such as emotional, temporal (when it occurred), personal (people associated with the music), spatial (where), historical, etc.; that is, too many, because memory is associative [(16) Human Memory Function]. Here we discuss five types that are particularly useful for piano with their algorithms enclosed in ( ):

1. music memory (algorithm: the music itself),
2. hand memory (combination of the tactile feel of the playing, auditory inputs from the piano, muscle reflexes built up during practice, etc.),
3. keyboard memory (visual location of the specific keys played),
4. photographic memory (photograph of sheet music), and
5. theoretical memory (music structure, theory).

(1) Music memory is based on melody, rhythm, harmony, expression, emotion, etc. The algorithm for music memory is mostly pre-wired in the brain; you don't need to be a music professor to enjoy music. Most of music memory is automatic, because it is

associated with inborn and learned processes already in the brain. It works best for artistic and musical types of persons who have strong feelings associated with their music. Those with absolute pitch will also do well because they can find the notes on the piano from the memory of the music. Composers use music memory all the time. The music algorithm is a major component of memory and therefore musicality is important for memory.

(2) Hand memory is a habituated reflex response to mental, auditory, tactile, etc., inputs acquired from repeated practice. A large component of any piano memory is hand memory, also called muscle memory — the hand goes on playing without having to consciously play each note. Before pianists understood the concept of associative memory [(16) Human Memory Function], hand memory was believed to be the only and best method of memory - "practice until the music is in your hands" we were told. We now know that this belief is wrong.

Everybody must practice common constructs, such as scales, arpeggios, Alberti bass, etc., so that the hands can play them automatically, without having to think about every note. Hand memory is a necessary component of memory; fortunately, it is automatically acquired as a byproduct of repeated practicing.

Hand memory is unreliable because it is prone to blackouts (whenever the normal stimuli change such as at a performance) and, if you get stuck in the middle of a piece, there is no way to restart because the stimuli have disappeared. Dependance on hand memory is the source of most piano memory problems because it relies on reflexes over which we have little control. Therefore, reliable memory can only be established by adding other memory methods, by adding more associations [see (16) Human Memory Function] such as the other memory methods discussed in this section.

(3) Keyboard memory: In keyboard memory, you remember the sequence of keys and hand motions as you play. There is a piano in your mind, and you can play it, as explained in (15) Mental Play (MP). Keyboard memory has most of the advantages of photographic memory but the memorized notes are the piano keys that you play instead of tadpoles on a sheet of paper. This bypasses the process of translating from tadpoles to keys. Keyboard memory is the easiest to use, because it can be acquired while practicing the piece and the memory is reinforced every time you play it. Since music and hand memory are also automatically acquired, the combination with keyboard memory will provide a sound memory foundation with little extra effort.

(4) Photographic memory needs to be cultivated if you aspire to become an advanced pianist, because it is necessary in advanced piano activities such as composing, sight reading, theoretical analyses and (15) Mental Play (MP), treated in the next section. At the very least, you should photographically memorize the first line or page of every piece you learn, especially the key and time signatures. If you do this with every piece you learn, you will automatically develop photographic capabilities so that, one day, you will suddenly discover yourself photographically memorizing a lot. The more you

practice photographic memory, the easier it becomes and there is no limit to the number of pages that the human brain can store, because memory is associative [(16) Human Memory Function].

Start photographic memory by memorizing one hand at a time. Memorize bar by bar; do not add bars unless all the preceding material is well memorized. Take a accurate photograph of the page, complete with its defects and extraneous marks; remember, the more associations the better. If you have difficulty memorizing certain bars, draw something unusual there, such as a smiley face or your own markings that will jolt your memory. Then, to recall this section, think of the smiley face.

Photographic memorization has many advantages; you can work on it without the piano, anytime, anywhere. You should read it in your mind, away from the piano, as often as possible until it is permanently memorized. If you get stuck in the middle of playing a piece, you can easily restart by reading that section of the music in your mind. It also allows you to read ahead while playing which helps you to think ahead. It will even improve your sight reading.

The main disadvantage is that most people cannot retain photographic memory for long periods of time and maintenance requires more work than other methods because of the high bandwidth of visual images. Another disadvantage is that reading the printed music in the mind is a slow process that can interfere with the playing. However, if you follow the methods discussed here, you may find photographic memory to be easier than you thought. In principle, once you have memorized a piece, you know every note and therefore should be able to map it back to the sheet music. Once you have acquired most of the types of memories discussed here, adding photographic memory requires very little additional work (once you become good at it), and you reap considerable rewards. Thus every pianist should use a certain minimum of photographic memory and gradually expand it with time.

For those who think that they do not have photographic memory, try the following. First memorize a **short** piece of music using keyboard memory. Once each section is memorized, map it back onto the score from which you learned the piece; that is, for each bar you play (from memory), try to picture the corresponding bar on the sheet music. Since you know every note, HS, mapping it back from the keyboard to the sheet music should be simple. Go back and forth, playing from photographic memory and mapping back from the keyboard to the sheet music until the entire (short) piece is memorized photographically. Then you can amaze your friends by writing down the score for the entire piece, starting from anywhere! Note that you will be able to write the whole music, forwards or backwards, or from anywhere in the middle, or even each hand separately. And they thought only Wolfgang could do it!

(5) Theoretical memory: use the knowledge of music theory to memorize. What is the key signature and how does that affect the whole composition? Where are the chord progressions? Theoretical memory also includes structural analysis. What is the main

theme and how is it developed? What are the relationships between the movements? How does the composer connect one bar or section to the next? How did the composer create a convincing ending? This is a difficult memory for beginners, but as you learn more music theory, its importance increases and becomes a major, indispensable element of memory for advanced pianists. Even with little knowledge of theory, anyone can conduct structural analysis, as we did by counting bars and repetitions in Für Elise in preceding sections.

Which of the above five memories to use? The answer is *all* of them, and even more (such as emotional, historical, etc.); it is unrealistic to think of using only one method, because memory is associative; the more you memorize, the more you can memorize, and the better you can recall the memory. Beginners should learn keyboard memory first because it is the easiest and most rewarding. More generally, start with whatever memory method that is easiest for you. However, in the end, you will be (and already are, to some extent) using all of them; that is why it is beneficial to study as many memory methods as possible because that is how you improve the memory. Each person has a main memory method and supplements it with all the others, some of which are necessary, such as hand memory, and others are partly inborn, such as music memory. More theoretical details of how to improve your memory are discussed in (16) Human Memory Function.

A useful memory device is the "forget 3 times" rule. If you can forget and re-memorize the same thing 3 times, you will usually remember it indefinitely. This rule works because it eliminates the frustration from forgetting and provides 3 chances to practice memory methods. Frustration with, and fear of, forgetting is the worst enemy of poor memorizers, and this method alleviates that frustration because instead of trying to memorize, you are trying to forget.

Concert pianists always play from memory; why?? One obvious reason is the high level of technical skill and "talent" that is expected — you won't have the time for reading the music, turning pages, etc. We discuss the *many* benefits of memorizing throughout this book, such as raising your IQ [(65) Creating Geniuses]; **these benefits make memorizing a necessity**, not a special talent or a luxury. That's why concert pianists always play from memory — there is no better way.

Memory maintenance: A memorized repertoire requires two investments of time: the first is the initial memorizing process, plus a second "maintenance" component for archiving the memory permanently and for repairing forgotten sections. During the lifetime of a pianist, the maintenance component is by far the larger one because the initial investment is zero or even negative as we have seen (you save time by memorizing). Maintenance is one reason why some give up memorizing: why memorize if I am going to forget it eventually? Maintenance can limit the size of a repertoire because after memorizing, say, five to ten hours of music, the maintenance requirements may preclude memorizing any more pieces. There are several ways to extend your

repertoire beyond any maintenance limit. An obvious one is to abandon the memorized pieces and to re-memorize later as needed. Pieces that were *well memorized* can be re-polished quickly, even if they haven't been played for years. If not well memorized the first time, you may have to go through the entire memorizing procedure all over again. So what does "well memorized" mean?

If you memorized before practicing the pieces and practiced only from memory, the results generally qualify as well memorized.

Memorize as many pieces as possible before the age of 20. Pieces learned in those early years are practically never forgotten and, even if forgotten, are easily re-memorized. This is why youngsters must memorize all their repertoire pieces. Material memorized after age 40 require more memorizing *and* maintenance efforts. Although many people have little trouble memorizing new material past age 70 using the above memory methods, they must know that the newly memorized material may need constant maintenance to preserve them.

A most effective maintenance procedure is to use Mental Play (MP, playing it in the head, away from the piano, discussed in the next section). MP is also a good test of whether you memorized sufficiently well.

Maintenance time is a good time to revisit the score and check your accuracy for the individual notes and the expression marks. Since you used the same score to learn the piece, there is a good chance that if you made a mistake reading the score the first time, you will make the same mistake again later on, and never catch that mistake. One way around this problem is to listen to recordings. Any major difference between your playing and the recording will stand out as a jarring experience and is easy to catch.

Now memorize the Für Elise in its entirety (HS) as you practice each segment. For more step-by-step examples of how to do this, see (45) Practice Routines: Bach Inventions, Sinfonia.

(15) Mental Play (MP)

Music in the mind is what we shall call **Mental Play (MP)**. MP is the process of playing the music in your mind, or on an imaginary piano [Richard, Francois L.,]. We shall see that MP controls practically everything we do in music, from the learning process (technique) to memorization, absolute pitch, composition, music theory, interpretation, controlling nervousness, performance, etc. It is so all-encompassing that it is not possible to devote one section to explaining it; rather, it permeates practically every section of this book. In fact, MP permeates everything you do, even outside music!

All accomplished pianists use MP although it is seldom taught by piano teachers; they had to learn it on their own, out of necessity. This contrasts with today's advanced athletes, such as skiers and golfers, for whom MP is a necessity and has been taught and developed for decades. This doesn't imply that MP is not necessary for piano — it is *absolutely necessary*; however, it was not taught because it was considered a talent, and

therefore, not teachable. That belief is wrong because *everybody* conducts MP every day without even recognizing it as MP. When a mother gets up in the morning and, in just a few seconds, plans the day's activities for her five children (what clothes they should wear, their meals, which schools they attend, etc., etc.) she is conducting MP just as complex as playing a Bach Invention in the mind, yet she is not considered "talented".

Thus MP permeates everything we do in life, yet was not taught for piano because it was swept under the "talent" rug. This is why the concept of talent has been so harmful to piano pedagogy — it absolves the teacher from teaching even necessary skills such as MP. That mother was so good at her daily MP because she had practiced it all her life. If a mother can learn MP automatically, out of necessity, why can't pianists do the same, especially because it is just as necessary in music? Why teach MP at all?

MP must be taught because (1) if not taught, there will be a wide range of use of MP among pianists, from almost none at all, to experts. (2) Because it is so necessary, teachers need to develop MP teaching into a fully developed expertise so as to make full use of it, to accelerate the development of musicianship. (3) MP is so powerful, useful, and all-encompassing that, if not taught, students will never make full use of it; it's like the difference between self teaching piano without any help, and having a good teacher. We shall see time and again in this book how teaching MP can make a huge difference to students.

MP must be taught from the first year of piano lessons. If you are over 20 years old, and never practiced MP for piano, it may take a year of diligent practice to become comfortable with it. Learn it as a youngster, and it comes naturally, effortlessly. As with absolute pitch [(17) Absolute Pitch, Relative Pitch], MP can be learned effortlessly at a young age, and **the resulting MP is far more powerful than anything that can be learned later**.

We all conduct complex MP every day without even thinking about it as MP, because we have been using it since childhood for our daily activities out of necessity. Can you imagine what disasters would happen if we never had a mental plan for the day? But that is exactly what we do if we walk onto a stage and play a recital without MP training. No wonder performers get so nervous! MP is the best antidote against stage fright [(56) Origin and Control of Nervousness] – it certainly worked for Mozart.

Since everybody already knows how to MP, it is easy to learn how to apply it to music. **Start teaching MP** together with memorizing. Teach the student to MP every memorizing method, such as keyboard memory, photographic memory, music memory, etc., especially away from the piano. We will discuss more uses of MP as we encounter them later.

MP and Memorizing cannot be separated because one can't function fully without the other; this is why teaching only hand memory without teaching MP is so inadequate. MP gives you the ability to start anywhere within a composition -- something that is difficult to learn in any other way. MP provides a clearer understanding of the structure of

the composition, etc., because you can now analyze them in your head. You can even "practice" without a piano, at speeds that the fingers cannot manage. There are numerous accounts of pianists who can play a composition without practicing on the piano, by just reading the sheet music and using MP to practice. **No student should ever be asked to perform without first learning MP.**

In order to memorize well, it is necessary to practice memory away from the piano using MP. This saves time because you can practice even when no piano is available, and greatly strengthens the memory because you don't have the piano and hand memory as "crutches". For those who wish to learn sight singing [(53) Sight Reading, Sight Singing, Composing] and acquire absolute pitch [(17) Absolute Pitch, Relative Pitch], MP is used to develop both skills.

Away from the piano, if you MP keyboard memory, you tend to make the same mistakes, and get stuck at the same places, as when playing at the piano! This supports the concept that all mistakes originate in the brain. Test your memory with MP and it will reveal how much you still depend on hand memory even after you had acquired keyboard, etc., memory. MP is one of the best tests of memory.

The next item to teach using MP is **absolute pitch** [AP, (17) Absolute Pitch, Relative Pitch]; without it, the MP will be handicapped because anybody with MP will start composing and improvising. The inability to compose or improvise is a major handicap for an advanced pianist. Those without MP can compose by using the piano, but it is much more efficient (and powerful) if you can figure out the scales and chord progressions in your head and write down the music without the piano.

Many pianists have the misconception that the expensive, huge, concert grand produces its wondrous sound, creating music, and therefore we must train our *fingers* for learning to play the piano. The human brain is far more complex than, and superior to, any mechanical contraption; the mind doesn't have the limitations of wood, felt, and metal. Therefore, it is more important to train the brain than the fingers, especially because any finger movement must originate in the brain: music and technique cannot be learned separately. As a musician, it is essential to develop MP to such an extent that the music in your mind is superior to that coming from the piano. A quality grand will certainly be inspirational, but a musician's mind should have no upper limit and MP is how those heights are attained. Don't be passive and wait for the music to come out of the piano, but actively anticipate the music you want to produce – which is the ultimate MP and the best way to execute a convincing performance.

MP is how the great geniuses accomplished what they did [see (65) Creating Geniuses]; if students are not taught MP, the achievements of the great pianists appear unattainable. Many of those reportedly "amazing feats" performed by Mozart, such as speaking sentences backwards, are simple MP tricks that anyone can learn. In order to speak sentences backwards, all you do is to write it on an imaginary blackboard and read it backwards. Try it yourself: write "dog" on that mental blackboard and read it

backwards; when that becomes easy, try two words, "mad dog", etc., keep adding words and practice until you can do longer sentences. Easy!

We can now explain why famous geniuses, such as Beethoven, Einstein, "professors", etc., are known for their **absentmindedness** — they are all good at MP and get completely absorbed in their mental world.

As you memorize the Für Elise example, start practicing MP with it.

Conclusion: it is possible to practice the piano using only MP! Every pianist must cultivate MP; you will not only learn a useful skill, but it will enable you to make fuller use of all the other piano skills.

(16) Human Memory Function

Memory consists of two functions, **storage** and **recall**.

Storage: everything we experience is stored in temporary memory and then transferred to permanent memory, an automatic process that takes about 5 minutes, where it is stored practically for life. Savants that can remember everything indefinitely provide the best proof that memory is permanent. The approximately 5 minute transfer time has been verified innumerable times from records of head trauma victims: they can remember only up to about 5 minutes before the trauma incident; we saw an example of this from the survivor of Princess Diana's fatal accident – Trevor Rees-Jones, could not remember the accident or the few minutes prior to it.

My hypothesis for human memory is that information is stored in a **"memory field"** in various areas of the brain. The memory is not at any specific location, but is distributed in many areas of the brain, like a holograph. In computer memory, each memory has an address, so we know how computers recall memory. Brain memories do not have addresses, so how does the brain recall memories?

Recall: When we memorize, storing the information is not a problem because it is automatic and basically permanent — *recalling* is the problem because, unlike a computer in which all data have addresses, human memory is retrieved by a complex process that is not yet understood. My hypothesis is that the recall process is an **association** process, and the most obvious associative process is an overlap of memory fields. That is, when two related memories are stored, their memory fields overlap; the closer the relationship, the greater the overlap and the easier the recall. With time, however, more such overlaps will be stored so that the brain must search through more overlaps. The probability of confusion increases with time because the probability that the brain will choose the wrong overlap increases as the number of overlaps increases. Therefore, our inability to recall is caused by **confusion**, not by loss of memory.

Memory is most easily recalled if the memory is associated with something easy to remember, such as outrageous, funny, familiar, etc., associations, because the brain is attracted to them. This is the most common trick used by good memorizers.

The system of memory fields is complex because it is continually modified by the

brain. One modification is the creation of **abstractions called abstracts** here. The abstract "airplane" does not exist outside the brain, but is created in memory and includes everything from toy paper planes to the largest jumbo jets. This creates an additional, artificial, association among objects. Abstracts are generalized objects and they enable thought processes and languages. Thus we are generally dealing with memory fields of abstracts, not the original memory fields from external inputs such as visual, auditory, touch, smell, taste, etc., because the external inputs are like continuous movies with too much information. Abstracts simplify them into manageable objects. Thus the human memory is not a passive memory like the computer disk, but is an active processor of incoming information into simpler abstracts that are more manageable. However, because there are savants that can recall all the original data, those data are apparently also stored in the brain.

This memory-field-overlap recall process is similar to a basic phenomenon in quantum mechanics. The probability of an electron emitting a photon is given by the overlap of the electron and photon wave functions mediated by the emission function. Therefore the human memory recall process may be mimicking a basic process in nature. This mimicking is common: electrons orbit atom nuclei, planets orbit the sun, and stars orbit black holes in galaxies. The most advanced theory of cosmology posits that the universe is made up of strings so small that nobody can see them; thus the piano strings making music emulates string theory that creates the universe.

There is little question that **memory is associative**. We memorize music by associating it with things we already know. If you ask a musician to memorize a full page of random music notes, he will have great difficulty memorizing even a single page because he has nothing with which to associate random notes. This musician will have no trouble memorizing a 20 page sonata quickly because the sonata has melodies, rhythm, etc., that are familiar. This is why there is no better way to memorize music than by using music theory. All you have to do is to associate the music with the theory and you have it memorized. Although music theory memory is the best, it is not equally helpful to everybody because most students do not know enough theory.

The strongest evidence for the associative nature of human memory comes from tests on good memorizers who can perform incredible feats such as memorizing hundreds of telephone numbers from a phone book. These good memorizers all use **associative algorithms** for memorizing. The algorithms are different for each person, but they are all devices for associating the objects to be memorized with something that have patterns that are already in memory.

For example, for remembering hundreds of numbers, one algorithm is to associate a sound with each number. The sounds are chosen such that they form "words" when strung together, not in English, but in a new "language" (algorithm) that is created for that purpose. Japanese is a language with such a property. For example, the square root of 2 is 1.41421356 which can be read as a phrase that translates roughly to, "good people, good

people are worth looking at" (hitoyo-hitoyoni-hitomigoro), and the Japanese routinely use such algorithms to remember such things as telephone numbers. To 7 decimals, the square root of 3 reads "Treat the entire world!" and the root of 5 reads "On the 6th station of Mt. Fuji, an owl is crying"; I learned these 60 years ago and still remember them.

The amazing thing is the speed with which good memorizers can map the object to be memorized onto their algorithms. Super memorizers develop after much hard work in perfecting their algorithms and practicing every day, just like pianists. This "hard work" comes effortlessly because they enjoy it.

Let's try one sample algorithm. Suppose that you want to memorize the sequence of 14 numbers 53031791389634. One way to do it is to use something like the following story: "I woke up at 5:30 AM with my 3 brothers and 1 grandmother; the ages of my brothers are 7, 9, and 13, and my grandma is 89 years old, and we went to bed at 6:34 PM." This is an algorithm based on life's experience, which makes the random numbers "meaningful". What is so intriguing is that the algorithm contains 132 letters, yet it is much easier to remember than the 14 numbers because of familiar associations. You can easily test this for yourself. First memorize both the 14 numbers (if you can -- it is not easy for me) and the above algorithm. Then 24 hours later, try to write down the numbers from memory and from the algorithm; you will find the algorithm to be much better. There are even better algorithms that you can readily find on the internet.

Because of the huge information processing power of the brain, the retrieval process is more efficient if there are more relevant associations and the number of these associations quickly increases in size as more items are memorized because they can be cross-associated. Therefore the human memory is almost diametrically opposite to the computer memory: the more you memorize, the easier it becomes to memorize because you can create more associations; each new association provides numerous new possible routes for recall. Thus everything we know about memory tells us that exercising our memory will strengthen it.

Memory is an important component of **consciousness**, which might be defined as a series of looping brain functions: inputs → memory → conclusions → action → inputs, etc., that form a perpetual loop.

Newborn babies have few items in memory and therefore cannot form associations. Their consciousness increases as the brain develops. As a result, they can not think or communicate initially except to make noises in response to their needs. In just a few years, they have enough associations to learn languages and to think. At this stage, they learn very quickly because the brain is developing rapidly, but for the same reason, they also forget quickly. Their intelligence may appear to be low because they can have difficulties memorizing from a lack of associations; however, they are capable of understanding complex concepts quickly. If the memory is maintained into the teen years, myelin sheaths begin to form around axons, thus locking the memory permanently. Thus repertoire memorized and maintained before the twenties is almost never forgotten.

Even the youngest youngsters can appreciate and memorize music. Practically any pianist can easily memorize several Beethoven sonatas or an equivalent length of music they love. From the point of view of data bits, each sonata represents over 1,000 telephone numbers. Thus practically all pianists can memorize the equivalent of over 10 pages of phone numbers – something that would be considered miraculous if they were phone numbers.

Therefore, what concert pianists achieve is not that different from what those "genius memorizers" do. Proper instructions on how to memorize makes this "miracle" achievable for everyone.

(17) Absolute Pitch, Relative Pitch

Relative pitch (RP) is the ability to identify a note, given a reference note. **Absolute pitch (AP)**, is the ability to identify a note without a reference. AP and Perfect Pitch (PP) are synonymous, but AP is used here to avoid confusion with pianissimo. **A person with AP automatically has RP.** The test for AP uses 2 pianos; the tester sits at one and the student at the other, and the student tries to repeat the note played by the tester. If there is only one piano, the student names the note played by the tester (do, re, mi . . . . or C, D, E, ...).

Nobody is born with AP; it is a learned skill, because the chromatic scale is a human invention - there is no physical relationship between the pitches of the chromatic scale and nature, and no natural law that says middle A should be 440 Hz; most orchestras tune to 442 Hz, and before it was standardized, there was a larger range of frequencies for A. Because of the logarithmic nature of the chromatic scale and the human auditory system, everybody can learn RP effortlessly [(76) Chromatic Scale].

The human ear is not calibrated to an absolute scale. By contrast, the eye responds to color on an absolute scale (everyone sees red as red from birth without any training, and this perception never changes with age), because color detection is achieved using quantum mechanical reactions that respond to specific quanta (wavelengths) of light. Some people who can identify certain pitches with specific colors can acquire AP by the color that the sound evokes. They are calibrating the ear to an absolute reference.

Babies can hear at birth and are routinely tested for hearing at most maternity wards. AP and RP are best learned in early youth, before the age of five; the earlier, the better. The best way for toddlers to acquire AP is to be exposed almost daily to well tuned pianos from birth. Therefore, every parent who has a piano should keep it tuned and play it with the baby nearby. Don't worry about awakening babies; they will sleep soundly while you flail away at a Beethoven Sonata. Then parents should test the child from time to time for AP. This test can be performed by playing a note (when the child is not looking) and then asking him to find that note on the piano. If you want the child to name the note, you have to teach the child the piano scale. If the child can find it after several tries, he has RP; if he can find it the first time every time, he has AP. We don't know how

quickly babies learn AP, but, unlike adults, it is effortless and automatic, and very fast; we don't know how fast, but it could be days. Parents should test toddlers as soon as possible; the earliest age may be one to two years.

The particular temperament to which the piano is tuned [(77) Circle of Fifths, Temperaments] is not important; in fact many people with AP know nothing about temperaments and when notes on pianos tuned to different temperaments are played, they have no difficulty in identifying the notes because different temperaments change most frequencies by less than 5%, and no one has AP with that kind of accuracy.

AP can be acquired later in life but becomes more difficult after age 30. In fact, even those with AP will slowly lose it starting around age 20, if it is not maintained. Many piano schools routinely teach AP to all their students, some with over 90% success.

Having AP is clearly an advantage. It is a great help for memorizing, mental play, sight reading, recovering from blackouts, "play by ear" and composing/improvising music. AP helps with MP because it helps in so many ways such as in keyboard memory and photographic memory because you know the exact notes. You can be the pitch pipe for your choir, and easily tune string or wind instruments without a tuning fork. It is a lot of fun because you can tell how fast a car is going by listening to the tires whine, you can tell the differences between car horns and locomotive whistles, especially by noting whether they use thirds or fifths. You can remember telephone numbers by their tones. Most importantly, AP gives you the confidence that you are a complete musician, and the recognition from others, especially fellow musicians.

There are a few minor **disadvantages of having AP**. Music played off tune can be annoying. If a lot of music is played off tune, this can present quite a problem. The person can sometimes react adversely to such music; physical reactions such as teary eyes or clammy skin can occur and out-of-tune pianos will be difficult to play. Transposed music is fine because every note is in tune. Listening to off-tune music can cause you to lose AP, which is probably why the mind reacts so negatively to off-tune sounds.

Learning AP is not as difficult as many people believe. We saw that the objective of memorizing is to be able to MP. By paying attention to RP and AP while practicing MP, you can acquire AP! MP should be conducted in AP because, without playing at the correct pitch, you lose so many of the benefits of MP listed above, such as the ability to write the notes down on paper or immediately play it out on the piano even if you had never practiced that music before. For most students, memorizing one short composition in AP is sufficient for acquiring AP to within a semitone [(76) Chromatic Scale]. Younger students under age 10 will learn much faster than older ones over 30.

Procedure for learning RP and AP. We need to learn only AP, because if you have AP, you already know RP.

To learn AP quickly, guess A4 (A440), test it at the piano, to see if you have AP. If you do, you are done; just keep practicing to improve your AP, as discussed below. You

may have AP for A4 because you had heard the orchestra tuning to it before every concert. If you do not have AP, learn C4 first, not A4, because our initial objective is to learn AP for the C major scale, and A4 is not the tonic and is not as useful. Every time you walk by the piano, guess the C4 and test it.

When creating notes in the mind, do not try to hum or sing them because the dynamic range of the piano is larger than the singing range and you will need to train the brain to deal with those higher and lower notes. Also, practicing AP is a process of practicing MP, and singing or humming defeats this purpose because that limits what the brain can do. Unless you are a singer who can sing on pitch (in which case you should have at least RP), you will not be able to accurately sing the pitch; the resultant incorrect sound will confuse the brain and erase any AP that you may have acquired.

For learning AP, the memory of each note for AP must initially include everything -- the harmonics, timbre, etc., of the piano -- as many memory associations as possible. Therefore, use the same piano until you acquire AP. Unless you have an electronic piano, make sure that the piano is in tune. Once you acquire a strong AP, it will work with any source of sound. Not singing or humming is not a strict rule, because it can be quite useful, but it is important to MP the notes as much as possible and not get into the habit of humming everything.

So guess the C4 and test it at the piano. Everyone has a maximum and minimum note he can hum. For memorizing C4, hum from C4 (referenced to the piano) to the lowest note you can hum. This may be F3. Now, every time you guess C4, you can check it by humming down to the lowest note you can hum to see if it is F3. If it is E3, your guess was too low; raise it a semitone. You can create another test by humming to your highest note; use whichever works better. Practice until your C4 is correct to within a semitone; this may take days, or it might take months, depending on the person.

When the C4 is fairly correct, start testing other notes within the C4 octave (white keys only), starting with the major intervals (octave, fifths, fourths, major and minor thirds), and then the entire C major scale. Now practice learning the octaves. In this way, the task of memorizing 88 notes on the keyboard is reduced to just 11 notes and one interval (the octave). For now, we ignore the black keys and learn AP for just 8 white notes. Acquaint yourself with all the notes on the piano by playing them in octaves and training the mind to recognize octaves. At first, octave notes may sound like two totally different notes, but with practice, all octave notes will begin to sound "similar".

Until you learn some rudimentary absolute pitch, practice AP only at the piano so that you can correct yourself as soon as you wander off tune. Do not practice mentally away from the piano with the wrong pitch; this will only erase your AP. Start practicing away from the piano after your AP is at least within a semitone.

Progress may seem slow at first, but your guesses should get closer with practice. At first, identifying notes takes time because you need to check your C4 by humming to your lowest or highest notes, or you may have to guess the other notes by comparing to C4

using relative pitch. **Then suddenly, one day, you should experience that magical moment when you are able to identify any note directly, without any intermediate steps.** You have acquired true AP! Therefore you should actively seek and anticipate this transformation so that you won't miss it. Students who are not aware of it will miss it the first few times it happens, wasting a lot of time.

This initial AP is fragile and you will lose it and regain it several times before it becomes permanent. The next step is to strengthen the AP by practicing to identify the notes as *rapidly* as you can. Then start practicing with two-note intervals, then any three notes played simultaneously, etc. Any AP that can identify five or more notes played simultaneously is considered excellent. The ability to identify many notes is important when composing music because complex chords can often contain more than five notes. Once you have a strong AP, practice humming the notes and singing on pitch, and sight reading on pitch. Congratulations, you have done it!

The quality of AP is determined by

(1) how quickly you can identify a note,

(2) how many notes you can identify when they are played simultaneously, and

(3) how accurately you can reproduce a pitch; this test is difficult to apply and is rarely used.

People with excellent AP will identify a note in less than a second, and identify a maximum of about 10 notes played simultaneously, in about five seconds.

The biological mechanism underlying AP is not understood. It appears to be entirely a memory function. The ability to acquire AP automatically at the baby stage suggests that it may be related to bonding to the parents via their voices. Many species, such as penguins, bond in this way, which is critical for the baby's survival. This hypothesis also explains why AP is lost after childhood, and difficult to learn for adults.

People with MP and AP tend to continually make music mentally; music keeps running around in their heads, whether it is their own compositions or music they had heard. This is why most musicians with AP will automatically start to compose music. The brain always returns to music when it has nothing else to do.

Most beginners will MP intervals narrow because the brain automatically tries to "increase the singing range". Thus ascending notes will be sung flat and descending notes sharp. In addition, notes higher than your mid-range will be sung flat and those below will be sung sharp.

The "standard" way to learn AP in music classes is via **solfege** [(68) Theory, Solfege]. AP is taught as an adjunct to these exercises by learning to sing everything at the correct pitch. There are no specific methods for acquiring AP in solfege; you simply take AP tests at every lesson until the correct pitch is implanted in memory. Because AP is learned together with many other things, progress is slow, typically years.

AP must be maintained. After age 20, AP starts to deteriorate unless it is maintained by checking with the piano periodically. Without maintenance, you can totally lose AP in

about ten years.

(18) Play by Ear (PBE), Composing

Most piano teachers today don't know how to teach "play by ear" (PBE), so few students learn it, even when they have AP. Just as babies learn to speak before they learn to read or write, musicians must be taught to PBE, which is part of learning MP. Without learning to PBE, they are throwing away a large part of what they can do with MP. Youngsters will quickly learn to PBE, just as they pick up AP and MP effortlessly at sufficiently young ages. It will take progressively longer to learn PBE as they get older. Start teaching it by letting students play melodies they already know, such as the *ABC Song* (same melody as *Twinkel, Twinkle, Little Star*), *Happy Birthday, Auld Lang Syne,* etc., in different keys at different lessons. Then let them add their own accompaniments. Of course, this will dovetail nicely with learning theory, such as chords, chord progressions, and dictation, etc., in later lessons. Now every student can play Happy Birthday in any key at every birthday party if there is a piano!

Learning PBE will kick start the process of **composing music**. Thus MP, AP, PBE, composing, and improvisation are all part of a single package of skills that every pianist must learn; these are the musicians' magic, the genius skills. **Every known great pianist could PBE**, so it makes no sense not to teach it -- it is a necessary part of becoming a musician; it is the fourth genius skill [(65) Creating Geniuses]. Those who learn improvisation are effectively practicing PBE, so methods for teaching PBE are known [(52) Fake Books, Jazz, Improvisation].

(19) Breathing, Swallowing

An important part of relaxation is maintaining the normal body functions, such as breathing, swallowing and proper posture. When stressed, these are the first functions to change, so that they are good indications of the level of stress. In addition, most people are unaware of the proper ways to breathe.

Not **swallowing** can result in dry throat or mouth and this change in condition can affect hand memory that we rely on for smooth performances. It is a good idea to bring a bottle of water to your performance.

Performing at the piano requires a lot of energy, especially in the brain, so that **breathing** and posture, which affect the oxygen supply, is important. Yet, when we concentrate hard or become nervous, we often forget about breathing and swallowing, or even hold our breath. This is one reason why meditation, with emphasis on proper breathing, is helpful.

Most students think of breathing as pumping the chest, but the diaphragm plays a major role in breathing see Mark, Thomas,, P. 121. Chest pumping can interfere with rhythm and the playing actions, so that diaphragm breathing is especially important for piano. Breathing efficiency is maximized by using *both* chest pumping and the

diaphragm, and maintaining good posture which increases the maximum volume of the lung.

Breathing exercises are beneficial, not only for piano, but for general well-being. Sit upright with a straight spine, expand your chest, push your diaphragm down (this will make your lower abdomen bulge out), raise the shoulders and towards your back, and take a deep breath; then exhale completely by reversing the process. When taking deep breaths, complete exhalation is more important than a fuller intake because the objective is to exchange the carbon dioxide in the lungs for oxygen in the air; if you don't expel the carbon dioxide, the process is less efficient. Breathe through your throat, not through the nose (the mouth can be open or closed). Most people will constrict the nasal air passage if they try to suck air through the nose, which is normally the procedure for preventing nose drips. Dripping is prevented by narrowing the nasal passage so that air flows more rapidly up the smaller opening. To breathe, relax your nose muscles and suck air through the throat region close to the vocal chords -- even with the mouth closed, this procedure will relax the nose muscles, allowing more air to pass through the nose.

If you had not taken this type of deep breaths for a long time, it should cause hyper-ventilation -- you will feel dizzy after two or three such exercises. Stop if you hyper-ventilate. Then repeat this exercise several minutes later; you should find that you can take more breaths without hyper-ventilating. Repeat until you can take at least 5 full breaths in succession without hyper-ventilating; this may take several days. Now, if you go to the doctor's office and he checks you out with his stethoscope and asks you to take a deep breath, you can do it without feeling dizzy! Perform this exercise at least once every several months and incorporate it into your normal breathing habit, especially when playing the piano.

(20) Endurance, Brain Stamina

Piano playing requires control, not muscle power. Many students and even some teachers, believe that technique requires finger strength, which is wrong. One day, Combe grabbed my hand, squeezed it, and said, "See, my hands are strong because I am a pianist." That squeeze was no stronger than an average handshake. I have an unusually strong handshake, probably strong enough to break her hand, but that has nothing to do with piano skills.

Obviously, you can't play loud, grandiose passages without expending energy. Big, strong, pianists can play louder and manage "demanding pieces" more easily than weaker pianists. All pianists have enough physical stamina to play pieces at their levels, simply because of the practice that was required to get there. Yet we know that endurance can be a problem.

Playing demanding pieces requires about as much energy as a **slow jog**, at about three miles per hour for adults, with the brain requiring about half the total energy. Many youngsters cannot jog continuously for over one mile. Therefore, asking youngsters to

practice difficult passages continually for 20 minutes would strain their stamina because it would be equivalent to jogging about a mile. Teachers and parents must be careful when youngsters start their piano lessons, to limit practice times to under 20 minutes in the beginning until the students gain sufficient stamina.

Piano playing requires conditioning the brain for stamina. That is why mindless practicing of exercises for stamina doesn't work. The most efficient ways to gain piano stamina are to play finished pieces and make music, and practice difficult sections HS continuously. Again using the jogging comparison, it would be hard for most students to practice difficult material continuously for more than a few hours because two hours of intense practice would be equivalent to jogging six miles, which is a terrific workout. Therefore, play some easy pieces between the intense practice sessions. Concentrated practice sessions longer than a few hours are not that helpful until you are at an advanced level, after you have developed sufficient stamina. Clearly, hard piano practice is strenuous work and serious practicing can put the student in good physical shape.

Conditioning the brain is more important than conditioning the muscles for most students because evolution has programmed the brain to be lazy in order to conserve energy. This is why so many students prefer to separate music from technique and work for technique by using exercises and mindless repetitive practices. This is counter-productive because (1) the brain is not exercised, (2) you develop non-musical habits, and (3) you can waste a lot of time. Brain conditioning is especially important for performing because, without sufficient stamina, you can rapidly run out of energy during a performance. Strenuous conditioning of the muscles can lead to stress and cause the body to convert fast muscles to slow muscles that have more endurance, but this is exactly what you do not want.

For long practice sessions of over several hours, pianists get their second wind just as athletes do (such as marathoners, cyclists). Therefore, if you feel fatigue, don't immediately conclude that you lack stamina, but look for the **second wind** to kick in – awareness of the second wind can make it kick in more reliably, especially after you have experienced it and know what it feels like.

In order to control stamina, we need to study its biological basis. We need sufficient oxygen intake, efficient disposal of carbon dioxide, and adequate blood flow. The biggest factor influencing oxygen intake is lung efficiency, see (19) Breathing, Swallowing.

Another method of increasing stamina is to increase the **amount of blood** in the body. To achieve this, you must simultaneously exercise the muscles and the brain during practice. This will cause the body to manufacture more blood, in response to the higher demand for blood. For anemic people, their brains will rebel (they feel uncomfortable) when there is insufficient blood and the pianist will feel better just practicing mindless exercises, which is the main reason for the popularity of exercises and the tendency to separate music from technique. But they are not helpful because you can shut off the brain.

Practicing piano or exercising after a large meal also increases the blood supply and conversely, resting after every meal will reduce stamina. There is a well-known Japanese saying that you will turn into a cow if you sleep after a meal. Experience had taught them that you will become anemic and lazy if you sleep after a meal. With a full stomach, most people do not have enough blood to engage in strenuous activity, and the body will rebel initially by making you feel terrible, but this is an expected (evolutionary) reaction. Such activity must be conducted within safe medical limits; for example you may temporarily experience digestive problems or dizziness (which is the rationale behind the misguided belief that you should never exercise after a large meal). Once the body manufactures the necessary extra blood, the discomfort will disappear. You should stay as active as you can after a meal, in order to prevent anemia. Clearly, good health, exercise, and sports are helpful for gaining stamina in piano playing. That comfortable sofa may be the single worst cause of poor health in modern society.

The brain must be exercised all the time by making music, especially during practice. Play as if you are performing, so that anyone listening to you practice will enjoy the gorgeous piano sound. Without brain stamina, the brain will run out of energy during a performance and you will end up playing on auto-pilot — not what you want.

In summary, beginners who have never touched a piano will need to develop their stamina gradually because correct piano practice is strenuous work even when playing easy material, relaxed, because of the musical requirements of the brain. Parents must be careful about the practice time of very young beginners, limit their practice time to less than 20 min., and help them to develop the habit of always practicing musically. At any skill level, we all have more muscle than we need to play the piano pieces at our level. Even professional pianists who practice over 6 hours every day don't end up looking like Popeye. Franz Liszt, Chopin and Paganini were quite thin, not muscular.

(21) Forearm Rotation

One of the most important piano playing motions is **forearm rotation (FR)**, one of the fastest motions of the hand. It is the main motion used to play the thumb and pinky. The two bones in the forearm are the ulna and radius (see Mark P. 82). In FR, the larger radius, connected to the thumb, is rotated around the thinner ulna, connected to the pinky. FR is used in fast parallel sets, tremolos, Albertis, scales, arpeggios, etc. In the FR motion, the thumb is rigidly attached to the hand, which is moved by FR. A small thumb movement can be combined with FR because, although the thumb muscles are slower, smaller movements are faster. All established schools of piano, such as the Alexander technique, teach FR.

The wrist and arm motions evolved to be the fastest motions because their speed is needed for tree climbing, fighting/defense and throwing/catching objects. FR is fast and is needed in most fast passages; thus, when practicing fast passages, always check to see if FR might help.

Practice FR by contrasting it with quiet hands, as Bach did with his Inventions #8; – where you need both FR and quiet hands and can therefore demonstrate the differences between them. It is a mistake to think that, at sufficient speeds, you must always play with quiet hands. Other examples where FR is needed are the tremolos and Alberti motions in (50) Beethoven's Pathetique, Op. 13, First Movement. Many students struggle with speed in these passages, often developing stress and even suffering injuries because they were never taught to incorporate FR. With FR, speed, power, and endurance cease to be problems, allowing play with relaxation.

(22) Slow Play

Slow play can waste a lot of time; if you play twice as fast, you practice twice as often, so why practice something you don't need at full speed? To make slow play pay off, combine many objectives into each slow practice:

(1) Slow play is beneficial to good technique, especially for practicing relaxation and correct keystroke [(11) Basic Key Stroke; Legato, Staccato].

(2) It reinforces memory because there is time for the playing signals to travel from the fingers to the brain and back several times before succeeding notes are played. Always practicing at fast speed will only reinforce hand memory and will not help true memory: slow play is an insurance against blackouts.

(3) Practice thinking ahead of the music you are playing, which provides more control over the performance and can even enable you to anticipate impending flubs. Think at least one bar ahead of the music and practice feeling the keys before playing, to guarantee 100% accuracy [(28) Jumps, PP, FF, Feeling the Keys].

(4) It is one of the best ways to erase bad habits that were picked up during fast practice [(27) Fast Play Degradation, Eliminating Bad Habits].

(5) Practice the ability to detach yourself from the music, and mentally wander around and multi-task, such as looking around or talking to someone.

(6) Always end a practice session with slow play. Repeat: **the last run-through of any practice session should be slow**, especially when practicing for speed, memory, or performance preparation [(55) Performance Preparation, Videotaping]. Though one of the simplest, this is one of the most important rules of piano practice.

Suppose you are practicing a Parallel Set, speeding it up, having repeated it 20 times, and want to switch hands. Play it once or twice at slow speed before switching. If you just played one of your favorite pieces at full speed and you want to preserve it in perfect condition, play the entire piece slowly before going on to something else. Always play the recital pieces slowly after practicing them, especially during the week before the recital. After a recital, if you need to play the same pieces again soon, play them slowly at least once as soon as possible. Apply this rule all the time, not only before recitals, because its cumulative benefits over years are enormous.

Why this method is so unbelievably effective is not completely understood; some

reasons are:

(1) it is free of bad habits (but you must make sure to use the same motions as required at faster speed),

(2) this improves true memory, and reduces hand memory,

(3) it erases the bad habits developed during fast play,

(4) the last run-through during practice has an inordinately strong effect on technique compared to preceding run throughs possibly because each run-through partially erases preceding run-throughs. This means that you should pay special attention to the last run-through, and

(5) this effect is cumulative so that it can build up to enormous benefits after extended periods (years).

(23) Post Practice Improvement, Sleep, Fast/Slow Muscles

Technique is acquired in two major steps. The first is the application of new hand motions, parallel sets, relaxation, memory, etc., that can immediately improve technique during a practice session. The second is called **Post Practice Improvement (PPI)** that results from physiological (mostly nerve & muscle) changes that occur after you stop practicing, a process that takes weeks or months. During practice, monitor your progress and quit as soon as a point of diminishing returns is reached, which usually starts after about 10 minutes. Like magic, your technique will keep improving by PPI for at least several days after a good practice. The next day, you should be able to play better even if you made little progress during practice the previous day. PPI is the basis for claims by many respected teachers that, if done correctly, you do not need more than two hours of practice a day.

It is more profitable to practice several things at one sitting and let them all improve simultaneously by PPI (while you are not practicing!), than working too hard on one thing. Over-practicing can hurt technique if it leads to stress, bad habits or injury and beyond a certain number of repetitions, you enter a state of diminishing returns. A minimum number of repetitions is required, about a hundred repetitions, for PPI to take effect. But because we are talking about a few bars played at speed, practicing dozens or hundreds of times should take only a few minutes. Don't fret if you practice hard but don't see much improvement during a practice session. This might be normal for that particular passage and you just have to wait for PPI; often, the worst thing you can do is to keep practicing. If you don't make any progress after a few days (no PPI), it is time to stop and think of new things to do, such as new hand motions or practice methods — don't keep practicing, because if you don't make progress, you are doing something wrong — that is the basic principle of this book.

There are many types of PPI depending on what is holding you back. These types differ in the length of time over which PPI is effective, which varies from one day to many months. The shortest times may be associated with conditioning, such as the use of

motions or muscles you had not used before. Intermediate times of several weeks may be associated with new nerve connections, such as HT play. Longer times may be associated with actual growth of brain/nerve/muscle cells, and conversion of slow to fast muscle cell types, such as fast trills or tremolos.

The methods of this book are ideal for PPI because they emphasize practicing only those segments that you cannot play. If you play HT slowly and ramp up the speed for a long section, PPI is insufficiently conditioned because you don't have enough time to make the necessary number of repetitions of the difficult few notes or bars. In addition, the PPI becomes confused because you mix a large number of easy segments with the difficult ones. If you practice too many skills for PPI together, they tend to cancel each other. Therefore, practice one skill for a sufficient amount of time, play it slowly once, then move on to the next skill.

PPI is nothing new; let's look at three well-known examples: the body builder, marathoner, and golfer. These examples will teach you how to optimize PPI for piano. While lifting weights, the **body builder**'s muscles don't grow; he will in fact lose weight. But during the following weeks, the body will react to the stimulus and add muscle. All the muscle growth occurs after the exercise. Thus the body builder (and the pianist) must concentrate on whether the exercise produces the appropriate conditioning for PPI. Another example is the **marathon runner**. If you had never run a mile in your life, and tried it for the first time, you might be able to jog for a quarter mile before you need to slow down to a walk. After some rest, if you tried to run again, you will still tire out in a quarter mile or less. Thus the first run resulted in no discernible improvement. However, the next day, you may be able to run a third of a mile before tiring -- you have just experienced PPI. This is how marathoners condition themselves to be able to eventually run 26 miles. For pianists too, PPI is cumulative and, in the long run, can make the difference between success and failure. **Golfers** are familiar with the phenomenon in which they can hit the ball well one day, but terribly the next because they picked up a bad habit. Thus hitting the driver (the most difficult club) too many times tends to ruin your swing, whereas practicing with the #5 wood (one of the easiest clubs) can restore it; therefore it is important to practice with a easier club before quitting practice. The analogy in piano is that playing fast, full tilt, tends to ruin the PPI whereas practicing simpler material (short sections HS slowly) tends to improve it see [(27) Fast Play Degradation, Eliminating Bad Habits]. This is why the principles of this book apply to many disciplines, not only piano. For the golfer, this means that after practicing with the driver, he should hit a easy #5 several times before quitting.

PPI occurs mainly during **sleep**. A mechanic can not service a car while it is traveling on the highway; likewise, most of the growth and maintenance of the body cannot occur during the waking hours. Sleep is not only for resting, but also for growth and rebuilding the body; this is one reason why sleep is necessary. Babies need so much sleep because they are growing rapidly. This sleep must be the normal, over-night type

with all of its major components, especially REM sleep. You may not get good PPI if you did not sleep well that night. PPI is triggered by cell death and stress; hard practice causes stress and even cell death, and the body over-compensates for this. You might think that 100 repetitions can't possibly kill cells, but millions cells are replaced every day, and any extra work will increase this replacement rate. "Cell death" is an over-simplification because chemical, physical (stress), etc., factors also induce cell growth (*The Human Cells*, in Scientific American, October, 2014, P. 76.).

Muscle bundles consist mainly of either **fast or slow muscles**. The slow muscles provide strength and endurance. The fast muscles are for control and speed. Depending on how you practice, one set grows at the expense of the other. Obviously, when practicing for technique, we want to grow the fast muscles. Therefore, avoid isometric or strength type exercises that grow the slow muscles. Practice quick movements, and as soon as the work is done, rapidly relax those muscles. This is why any pianist can outrun a sumo wrestler on the keyboard, although the wrestler has a lot more muscle. Practicing **Hanon type exercises** for hours, "to strengthen the fingers" might grow more slow muscles.

Another major process that occurs during sleep is the removal of bad habits during the nightly flush of toxins, etc., out of the brain (Kang, etc., Brain Flush,). How does the body know what is a bad habit? It doesn't, of course. During practice, you acquire technique as well as bad habits. Most bad habits are random motions and small compared to the desired technical motions, that are repeated many times. One of the things that happens during sleep is the "flushing out" from the brain of "junk"- small, random excitations that are generally not useful. In this way, the brain rejuvenates itself, avoids expending resources on useless items, and concentrates on the important ones; i.e., it throws out most of the bad habits, leaving mostly useful technique.

What does "flushing bad habits out of the brain" mean in neurological terms? During waking hours, numerous chemicals accumulate or are depleted in specific locations in the brain, such as in the spaces between synapses. This is what happens during practice to condition the cells for PPI. During sleep, the accumulated chemicals are flushed out and the depleted ones are replenished as part of the brain's rejuvenation process. Since stimuli (for technique, etc.) are stored as chemical changes at specific locations in the brain, this flushing process removes most of the weak stimuli, leaving only the strong ones that are too large to flush out. Thus the weak bad habits are literally flushed out of the brain or muscle cell.

There is one type of bad habit that is not small and random - speed walls. If you play faster than what your skill level allows, you will repeat the same stressed motions so frequently that the body will acquire that bad habit. One way to get rid of speed walls is to stop practicing that piece and practice something else. Practicing new material weakens old material until it becomes small enough for the brain to flush it out. Since the speed wall is not reinforced, is becomes smaller every night, and is eventually flushed

out. Of course, the methods of this book for avoiding speed walls are better than not practicing, which may take a long time.

Memory also undergoes PPI for long term memory, during sleep. As with technique, it is important to play slowly at least once before quitting, and then get a good night's sleep. Memory PPI explains why cramming into the late night before an exam is counter productive. This robs you of the time to get a good night's sleep, the cramming only confuses the brain and erases the lessons learned previously, and whatever is learned is only in short term memory and, without good sleep, is lost by exam time. You will get much better test scores if you only review the main lessons from the text book (which is usually the least confusing source of information and from where the test questions will be taken) and then get a good night's sleep. You sleep better, and the body functions better when happy, so watching a movie or enjoying other fun activities before going to bed will also improve the test score.

(24) Quiet Hands & Fingers

Many teachers justifiably stress "**quiet hands**". In this mode, the fingers appear to do most of the playing, with the hands moving very little. However, this apparent lack of motion is misleading because the hand is still compensating for the momenta of the fast moving fingers and is actually moving. The motion is small because the mass of the hand is larger than that of a finger, and the muscles connecting the hand to the arm also steady the hand. Since the motions of the fingers are small at high speed, the hand motions are even smaller. Thus quiet hands occurs only at high speed when momenta of the movements become an issue and is a new mode of play compared to slower play when force, more than momentum, is important. Although the audience cannot see the transition, the pianist will unmistakably feel this new mode when it is attained. At slow speed, all momenta reduce to essentially zero, making quiet hands meaningless and the hands can be moved without affecting play.

Momentum M is given by M = mv, where m is the mass, and v is the velocity. Thus light objects such as fingers have less momentum than the arm. M decreases at slow play because v decreases. Therefore momentum play is important only at fast speeds. In a mostly momentum mode of play, one member (finger) is moving one way while another (hand) is moving in the opposite direction so that the two momenta add to zero, resulting in a "quiet" hand; otherwise, the hand will fly off the keyboard.

Quiet hands is the litmus test for technique. The ability to control a new force called momentum and elimination of unnecessary motions not only allows faster play, but also increases control. Many of Bach's compositions were designed for practicing quiet hands.

Some teachers impose quiet hands play at all times, even for beginners at slow speeds, but that is counter-productive because you can't play quiet hands slowly since there is no momentum. The student feels nothing and justifiably wonders why it is any good. When playing slowly, or if the student does not have sufficient technique, hand

movements are appropriate. To force the hands to be motionless under those conditions would be unnatural and only makes it more difficult to play and creates stress.

Those who already have quiet hands technique can add a lot of motion without detriment when playing slowly or fast. Some teachers try to teach quiet hands by placing a coin on the hand to see if it is quiet enough so that the coin will not fall off. This method only demonstrates the teacher's recognition of the importance of quiet hands, but it harms the student by creating stress. If you are playing Bach at full speed using quiet hands, a coin placed on the hand will immediately fly off — quiet hands does not mean still hands; it means that you are playing in the momentum mode, something that you feel, but is almost invisible.

When you acquire quiet hands for the first time, the new feeling is absolutely unmistakable, so don't worry about missing it. Once you have it, the quiet hands motions are so economical that you will have more control and more free time between notes. Quiet hands, involving momentum, is difficult to describe; to the pianist, it is best described as a feeling of control and the near total absence of speed walls — playing fast becomes easier.

For Bach's Inventions, quiet hands becomes necessary at speeds close to final speed; without quiet hands, you will hit speed walls. Obviously, Bach chose the speeds with quiet hands in mind. HS practice is important for quiet hands because it is easier to acquire and feel quiet hands when played HS. It is best not to start HT until you can play in the quiet hands mode with both hands because this will reduce the chances of locking in bad HT habits — you can certainly play HT at slow speeds, but those are mostly wrong motions without quiet hands.

Those with insufficient technique may take too long to attain quiet hands because they can not play fast enough, so that such students may have to start HT without quiet hands; they can then gradually acquire quiet hands at a later time, by using more HS practice, parallel sets, etc. This is one reason for not learning pieces that are too difficult for you. Although some people claim that the Bach Inventions can be played "at any speed", that is true only for their musical content; these compositions need to be played at their recommended speeds in order to take full advantage of the technical lessons that Bach had in mind. This is why HT practice takes so much longer for learning new Bach pieces -- there is no way to get to quiet hands quickly (both hands simultaneously!), using HT. Any HT play that is practiced before acquiring quiet hands is worthless or worse, because the two hands will not be independent.

One aspect of quiet hands that is too often overlooked is **"quiet fingers"** which means that the non-playing fingers do not flail around in the air in useless extra motions. If quiet fingers is not taught at the beginner stage, the extra finger motions become ingrained habits and will create problems with playing musically at advanced levels. By then, these bad habits can be so ingrained that they are difficult to correct.

Quiet fingers is often overlooked because it is not necessary at the beginner stage so

that the need to quiet the fingers and the methods for practicing quiet fingers do not become an issue until the student is at an advanced stage. At today's level of advanced technical excellence, quiet fingers can make the difference between passing or failing an audition because judges look for such details, and lack of quiet fingers is audible to experienced judges.

Quiet fingers is practiced just like any other element of technique. Choose a short segment (HS or HT depending on your level, one bar or even less) and practice it, keeping all fingers close to the keys at all times, and eliminating all unnecessary movements. This does not mean that all extra finger motions are bad. The artist has the license to consciously make any motions that are expressions of art. What quiet fingers eliminates are those *unintended* motions that can interfere with control and musicality.

(25) Staccato Practice, Soft Practice

The literature lists numerous methods for improving technique such as the **rhythm method** (change the rhythm or accented note), tapping, etc. The biggest drawback with such methods is that they waste time because there are too many rhythms, etc., that you need to practice. **A particularly effective method for developing finger independence and accuracy, taught by Combe, is staccato practice (SP)** in which every note is played staccato. If initially, you feel awkward playing staccato, it is a diagnostic that there is a weakness in the technique. Thus, like parallel sets, SP is both a diagnostic tool for discovering weaknesses and for strengthening them. Difficulties with smooth runs or hitting notes accurately are remedied with SP. Parallel sets get you up to speed so quickly that you can start HT (hands together) before you have sufficient accuracy to synchronize the two hands accurately. SP is the best way to convert that speed to technique (HS) and to accurately synchronize the two hands (HT). SP should be practiced HT as well as HS.

Chopin taught staccato practice; his method was to practice staccato before practicing legato (Eigeldinger). This works because if you only practice legato, you are always pressing down on the keys, whereas you need the extensor muscles for finger independence and speed. There are three ways to play staccato: by using the fingers only, wrist only, or the arm. Chopin's staccato is different from Beethoven's. For SP, use mostly finger staccato at slow speed because you are practicing for finger independence, then you may need to add very small amounts of wrist and arm staccatos for higher speeds.

Because the finger is off the key after playing the note, you give up control over the hammer in SP. This is another reason why SP is important — for you to practice how to handle the hammer when you give up control over it. SP forces each finger to be responsible for its note, so that a weak finger or missed note is immediately audible. Most students have a weak finger 4, which shows up in SP every time, forcing you to practice it more.

SP helps with practicing **relaxation** because the fingers are not always resting against the piano and especially with rapid relaxation because of the rapid return of the

fingers to their rest positions. Bach understood the value of SP and incorporated it into eight of his fifteen Inventions. Although he did not indicate staccatos in his manuscripts, it is clear where it is needed, and most sheet music indicate it.

What is so surprising is that staccato play works at any speed, and with all technical motions such as quiet hands, relaxation, jumps, soft, loud, etc. It is especially effective for practicing fast, soft passages – the holy grail of pianists. Pianissimo technique is best practiced using staccato. SP creates a robust technique so that you can play on any piano, whether the action is light or heavy and strengthens your performance ability. Thus when practicing with staccato, do not change any playing motions – just add staccato.

Those who had never routinely practiced SP may initially find it difficult to play. This is normal; with continued practice, you will be able to play every note with clear staccato. Best of all, your technique will be transformed! By slowing down, you should be able to play every note staccato. Once the slow play is satisfactory, speed up gradually. As speed increases, maintaining staccato will become progressively harder. This is an indication that you need more SP. There is an unmistakeable sign that you have succeeded with SP: that sign is quiet hands [(24) Quiet Hands & Fingers].

SP is helpful for accuracy because you have less help from other fingers to locate the next note, as you do in legato play. It also helps with gaining speed because the staccato motion is inherently faster than legato motion. By practicing staccato at one speed, you are practicing the motions needed at a higher speed because of the faster finger speeds needed for staccato. Thus SP is another method for overcoming speed walls and for increasing speed. At the highest speeds, the staccato and normal motions tend to merge: this tells you something about how to play fast: the fastest plays are mostly staccato motions! The advantages of SP are so numerous and pervasive that they can not all be written down in a few paragraphs, and any accomplished pianist will find an endless number of ways to benefit from it.

SP will greatly improve **memorization** of the piece because this action is completely different from hand memory. You may find that you need to work on memorization all over again, which is a warning that you had not memorized adequately.

Staccato must be practiced HT to improve the left-right hand coordination. This is especially important for those who use HS practice and parallel sets, both of which reduce the time needed for HT practice, resulting in poor coordination between the two hands. HT-SP is how you compensate for this loss. **Repeat: the importance of SP cannot be over-emphasized.**

Practice softly: During most practice sessions and especially with SP, the benefits of practicing softly also cannot be over-emphasized. Soft practice minimizes fatigue and stress so that you can practice relaxation and concentrate on technique. Loud practice is easier because it provides crutches that hide technical flaws. You may be able to temporarily play faster by playing louder, but that doesn't teach you technique. With loud practice, you pick up more bad habits, play non-musically, and acquire technique more

slowly.

In most instances, listening to students practicing is unpleasant because they are practicing too loud. Beethoven's music teaches us a most important lesson — that music is mostly soft, so that the brief loud sections stand out. However, his music can be so exciting that we are all tempted to play them louder than they should be, which is not musical and bad for technique. Thus even loud sections should be practiced softly until the technique is acquired; otherwise, you may *never* acquire the technique.

The holy grail of technique is to play rapid passages softly and clearly, like a string of pearls. Soft SP, without pedal [(39) Damper (Sustain) Pedal, Physics of the piano sound], is the *only* way to get there.

(26) Speed, Rhythm, Dynamics

Technique for speed is acquired by discovering new hand motions, not by speeding up a slow motion, and certainly not by "increasing finger strength". The hand motions for playing slowly and fast are different. This is why trying to speed up a slow play by gradually ramping up the speed doesn't work. That just leads to speed walls -- because you are trying to do the impossible. Speeding up a slow play is like asking a horse to speed up a walk to the speed of a gallop -- it can't. A horse must change from walk to trot to canter and then to gallop. If you force a horse to walk at the speed of a canter, it will hit a speed wall and will most likely injure itself by kicking its own hoofs to shreds. A horse has only four hoofs and a far inferior brain than a human, who has ten very complex fingers with almost infinite possibilities. What students must learn is the almost endless ways in which these fingers can be manipulated, ways that the greatest piano geniuses before us discovered.

In a typical speed session, you pick a short section to practice HS, for the RH and LH. Use the practice methods of this book to increase speed quickly. Once the segments are satisfactory, play longer sections and gradually increase speed. Do not force the hands to play faster, but wait for the hands to *want* to go faster when you switch to the rested hand, and accelerate only to that maximum comfortable speed.

The most important rule is: never practice anything incorrectly or, equivalently, never try the impossible. This explains why using the **metronome** to gradually ramp up speed doesn't work [(13) Metronome]. If you follow the procedures given here, you may be making jumps in speed, speeding up rapidly or even slowing down (!) at times. For example, when fatigue sets in, the hand will automatically slow down; otherwise it will develop bad habits; that's when you switch hands. You can't make these speed changes back and forth with a metronome. Some users of the metronome know that you can't accelerate too fast, so they accelerate slowly, which not only wastes time, but habituates the hands to play the slow motions. There are good reasons for getting up to speed quickly in addition to saving time — so that you do not pick up slow play habits, etc. Instead of speeding up at a safe, slow, pace, let the *hands* determine the optimum practice

speeds.

It is necessary to increase speed beyond your skill level to find new motions, but keep that to a minimum for accomplishing your experimentation, then reduce speed and practice the new motions with accuracy. Note that you have to *find* new motions (many are listed in this book)— you generally don't know what they are until you get there; it is the teacher's job to show them to you during lessons. The need to get up to speed quickly in order to find the new motions and the need to avoid bad habits by not playing too fast are contradictory. Practice routines for speed must be designed to satisfy both requirements, a complex process, that must be developed over years of experience and experimentation.

Improving the musicality is important for increasing the speed. Very often, simply increasing the accuracy can enhance the musicality, especially for popular melodies like Für Elise, for which beginners often try to add extra expression; that is inappropriate for familiar melodies because people have heard better interpretations.

Getting up to speed is just the beginning. When you get close to final speed, you will be ramping down the speed! Using HS practice, when you switch hands, the rested hand is ready to go; therefore, this is the time when you can play at maximum speed with minimum fatigue and stress. But at such speeds, the hand will tire quickly. This is the time to slow down and practice for accuracy. In this way, you avoid erecting speed walls and avoid fast play degradation [(27) Fast Play Degradation, Eliminating Bad Habits]. As this ramping down, changing hands procedure is repeated, the maximum comfortable speed after switching hands should increase, because you have been practicing correctly for technique.

When you find a good new motion, you can make a quantum jump in speed at which the hand plays comfortably; in fact, at intermediate speeds, it is often more difficult to play than the faster speed, just as a horse has difficulty at speeds between a canter and gallop and will switch between them erratically. If you use a metronome and happen to set it at this intermediate speed, you might struggle at it for a long time and accomplish nothing except develop stress. Without the metronome, you can jump from one speed to another comfortable speed.

With a digital piano, acquire new technique using the lightest key weight setting. Once the technique is satisfactory, practice at the heaviest setting so as to be able to perform on acoustic pianos because, in general, they feel heavier than digitals. You may have heard that piano tuners can adjust the key weight of acoustics to any value. This is true only for the static weight. The dynamic weight, which becomes important at higher speeds, cannot be arbitrarily reduced, and reducing the static weight can actually increase the dynamic weight. Even in most digitals, "light" is an illusion because the keydrop force is not changed when you change the key weight settings. Lightness is achieved in software by making the piano sound louder and more brilliant. An old acoustic piano can feel light because its hammers are compacted, but such hammers cannot produce PP and

can be difficult to play fast. When the tuner voices that hammer correctly, the piano will feel heavier, although the key weight was not adjusted. The inexpensive keyboards with extremely light (non-weighted) keys are not helpful because they are not made for speed.

Rhythm consists of 2 parts: **timing** and **dynamics**, and both come in 2 flavors, formal and logical. The mysteries surrounding rhythm and the difficulties encountered in defining rhythm arise from the "logical" part, which is at once the key element and the most elusive. One important element of dynamics is the unexpected accents.

Formal Timing: The formal timing is given by the **time signature**, and is indicated at the beginning of the music score. The major time signatures are **waltz** (3/4), **common time** (4/4), **cut time** (2/2, also alla breve) and 2/4.

The waltz has 3 beats per bar (measure); the number of beats per bar is indicated by the numerator. 4/4 is most common and is often not even indicated, although it should be indicated by a "C" at the beginning (remember it as "C stands for common"). Cut time is indicated by the same "C", but with a vertical line down the center (cuts the "C" in half).

The note per beat is indicated by the denominator, so that the 3/4 waltz has three quarter-notes per bar. The meter is the number of beats in a measure, and almost every meter is constructed from duplets (tuples, duples, tuplets, also mean the same thing, two notes per beat) or triplets (three notes per beat), although rare exceptions have been used for special effects (5, 7, or 9 notes per beat). Generally the first note of each multiplet carries the accent, and the beat note carries the strongest accent.

Repetition is the most important element of rhythm for two main reasons. (1) Music works because of satisfaction which is provided by creating an anticipation or tension, and then resolving it. Repeating the rhythm satisfies these conditions; you know what is coming, and you get it every time. (2) We can't control time; no matter what we do, time marches on. By repeating the same rhythm, we can stop time! Nothing changes, the same thing happens over and over, as if time were standing still; we can even accelerate it or slow it down. Thus musicians can do what physicists can't — control time. Even music without rhythm can be considered music, in which case time becomes irrelevant.

How to practice rhythm: Rhythm must be treated as a separate subject of practice with a specific program of attack. Set aside some time for working on rhythm. A metronome can be helpful. Double check that your rhythm is consistent with the time signature. This can't be done in the mind even after you can play the piece -- you must revisit the sheet music and check every note. Too many students play a piece a certain way "because it sounds good"; you can't do that. Check with the score to see if the correct notes carry the correct accent strictly according to the time signature. Only then, can you decide which rhythmic interpretation is the best way to play and where the composer has inserted violations of the basic rules (very rare) for special effects; more often the rhythm indicated by the time signature is strictly correct but can sound counter-intuitive, an intentional construct by the composer. An example of this is the mysterious "arpeggio" at the beginning of Beethoven's Appassionata (Op. 57). A normal arpeggio (such as CEG)

starts with the first note (C), which should carry the beat. However, Beethoven starts each bar with the third note of the arpeggio (the first bar is incomplete and carries the first two notes); this places the accent on the third note, not the first, a most unusual arpeggio. We find out the reason for this odd "arpeggio" when the main theme is introduced in bar 35. This beginning "arpeggio" is an inverted, schematized form of the main theme. Beethoven had psychologically prepared us for the main theme by giving us only its rhythm! This is why he repeats it, after raising it by a curious interval -- he wanted to make sure that we recognized the unusual rhythm. He used the same device at the beginning of his 5th symphony, where he repeats the "fate motif" at a lower pitch. The reasons behind these strange rhythmic constructs in this sonata are explained in (51) Beethoven's Appassionata, Op. 57, First Movement. Another example is Chopin's Fantaisie Impromptu. The first note of the RH in bar 5 must be softer than the second. Can you find at least one reason why? Although this piece is in double time, it may be instructive to practice the RH as 4/4 to make sure that the wrong notes are not emphasized.

Having carefully checked the rhythm when practicing HS, check again when starting HT. When the rhythm is wrong, the music usually becomes impossible to play at speed. If you have unusual difficulty in getting up to speed, double-check the rhythm. Incorrect rhythmic interpretation is a common cause of speed walls and troubles with HT. If there is an rhythmic error, no amount of practice will get you up to speed! In such cases, outlining [(38) Outlining, Beethoven's Sonata #1, Op. 2-1] is an excellent way to find and correct errors in the rhythm. When starting HT practice, exaggerate the rhythm, which makes it easier to synchronize the two hands. Next, look for the special rhythmic markings, such as "sf" or accent marks, because they are the guides to the logic in the music.

Rhythm is intimately associated with speed. This is why most Beethoven compositions must be played above certain speeds; otherwise, the emotions associated with the rhythm and even the melodic lines can be lost. Rhythm is often referenced to speeds that exist in nature, such as the speed of the human brain or the heartbeat. It is important to stay just ahead of the brain, so that it has no time to be bored or distracted and has no choice but to follow the music, but music should not go too far ahead of the brain so that it gets lost.

There is one class of rhythmic difficulties that can be solved using a simple trick. This is the class of complex rhythms with **missing notes**. A good example of this is in the 2nd movement of Beethoven's Pathetique. The 2/4 time signature is easy to play in bars 17 to 21 because of the repeated chords of the LH that maintain the rhythm. However, in bar 22, the most important beat notes of the LH are missing, making it difficult to pick up the complex play in the RH. The solution to this problem is to temporarily restore the missing notes of the LH! In this way, you can easily practice the correct rhythm in the RH.

Dynamics, Formal Accents: Each time signature has its formal accent (louder notes). We use the notation: 1 is the loudest, 2 is softer, etc.; then the (Viennese) waltz has the formal accent 133 (the famous oom-pha-pha); the first beat gets the accent; the Mazurka can be 313 or 331. Common time has the formal accent 1323 or 1324, and cut time and 2/4 have the accent 1212. A **syncopation** is a rhythm in which the accent is placed at a location different from the formal accent; for example a syncopated 4/4 might be 2313 or 2331.

Musical phrases generally start and end softly, but the first beat of most rhythms carry the accent. This is why so many compositions start with a partial bar — to avoid that accent on the first beat. Therefore, in the "Happy Birthday" song, the first accent is on "Birth", not "Happy".

Logical Timing and Accents: This is where the composer injects additional music. It is a change in timing and loudness from the formal rhythm. Although rhythmic logic is not necessary, it is almost always there. Common examples of timing rhythmic logic are accel. (to make things more exciting), decel. (perhaps to indicate an ending) or rubato. Examples of dynamic rhythmic logic are increasing or decreasing loudness, forte, PP, sf, etc.

Beethoven's Tempest Sonata (Op. 31, #2), contains beautiful examples formal and logical rhythms (as practically any composition by Beethoven). In the 3rd movement, the first 3 bars are 3 repetitions of the same structure, and they simply follow the formal rhythm. However, in bars 43-46, there are 6 repetitions of the same structure in the RH, but they must be squeezed into 4 formal rhythmic bars! Playing 6 identical repetitions in the RH is wrong because the formal accents must be followed. Hint: the LH is "standard" and easy to figure out, so copy that rhythm to the RH. On the other hand, in bars 47 and 55, there is an unexpected "sf" that has nothing to do with the formal rhythm, but is an absolutely essential logical rhythm. Although the arrangements of notes is relatively simple, playing the dynamics correctly in this movement is complex, and practically no one would guess them correctly without Beethoven's markings. It is amazing how Beethoven cleverly used the formal accents to tell us exactly how to play it, for most of the music. The unexpected logical accents are a hallmark of Beethoven's genius and showed us that dynamics, by itself, is a powerful language, and that breaking the rules of the formal accents can produce a higher level of musical logic.

(27) Fast Play Degradation, Eliminating Bad Habits

Play any composition at full speed (or faster), and you may suffer **"Fast Play Degradation" (FPD)**. The following day, you can't play it as well. This happens mostly with HT play. HS play is more immune to FPD and can in fact be used to correct it. FPD occurs probably because the human playing mechanism (hands, brain, etc) gets confused at such speeds, and therefore occurs only for complex material such as HT play of conceptually or technically difficult material. Easy pieces tend not to suffer FPD.

Students who try to speed up HT can run into FPD problems and the standard solution had been to only practice slowly for long periods of time which wastes too much time.

HS practice is the better solution. This simplifies the music, reduces confusion and erases any bad habits that formed during fast HT play. One effective way to avoid FPD is to always play slowly at least once before quitting.

The most important thing about FPD is the knowledge that it exists, so that you don't get caught off guard, and know what to do to cure it. If you don't know anything about FPD and experience its symptoms, you can suffer psychological problems because nothing works for no known reason.

Bad Habits: Beginners start out with numerous bad habits that are readily identified by teachers. It is the teacher's job to prioritize them and correct them one by one. Common bad habits are poor touch, over-use of the damper pedal, weak (timid) fingers, stuttering, wrong speed, lack of rhythm and musicality, uncontrolled motions, etc. Bad habits are the worst time-wasters in piano practice because, once formed, they take such a long time to correct, whereas preventing them is much, much easier, if preventive measures are taken in time.

Some beginners bang away at the piano without regard to musicality. The student equates loudness to excitement. This happens because the students are so engrossed with the practice that they forget to listen to the sounds coming out of the piano. It is important to cultivate the habit of listening to yourself, and **it is the teacher's main job to show what "musical" sounds like. The ability to distinguish between musical and non-musical is the most important skill that students must cultivate.** Listening to yourself is harder than many people realize because many students expend all their effort playing, with nothing left for listening. The best way to get around this problem is to videotape the playing and listen/watch it to find ways to improve. There is no need to videotape all your life because that will waste too much time. Do it enough times until you learn how to listen to yourself and you will be able to listen while practicing.

Then there are those with weak fingers. This is caused by not relaxing, and not letting gravity take over. The student lacks confidence and subconsciously lifts the arms, which creates stress so that speed and musicality become impossible. These students must be taught the full dynamic range of the piano, how to make use of this range and, above all, to relax. Students practicing on old pianos with compacted hammers that are not voiced can develop "weak fingers" because such pianos produce too much sound when played normally. The best solution is to hire a piano tuner who knows how to voice the hammers.

Still another bad habit is playing at the wrong speed, either too fast or too slow, especially during a performance when students get excited and lose the sense of tempo. The right speed is determined by many factors, including the difficulty of the piece with respect to the technical ability, what the audience might be expecting, the condition of the piano, what piece preceded or will follow this piece, etc. Some students might tend to

perform pieces too fast for their skill level and end up making mistakes, while others are timid and play too slowly, thus not taking full advantage of the music. Playing slowly can be more difficult than playing at the correct speed, which compounds a timid player's problems. Those who perform too fast can become psychologically discouraged because they make too many mistakes and become convinced that they are poor pianists. These problems apply not only to performances but also to practicing; those who practice too fast can end up thinking that they are poor pianists because they make errors and progress is slow. Slowing down just a little may enable them to play accurately and beautifully and, in the long run, acquire technique faster. To combat this problem, some schools of piano do not allow fast play at all. That's not optimal, because the students will learn at a slower pace.

Beginners often play mechanically like a metronome, in an effort to "play accurately", and because they have not been taught the meaning of musicality. They need to be taught that rhythm is a language, and that the small deviations from strict timing are used to communicate musical concepts, etc..

Poor tone quality is another common problem. No one is listening during practice, so tone doesn't seem to matter; the student may not even be familiar with the concept of tone. Students must always strive for tone, because it is the most important part of the music. Good tone cannot be produced on a lousy or unregulated piano; this is the main reason why students need a decent piano and why tuning, regulation, and hammer voicing are more important than most students and their parents realize. Listening to good recordings is the best way to wake up the student to the existence of good tone. If they only listen to their play, they may have no idea what good tone means. On the other hand, once they pay attention to tone and start getting results, it will feed on itself and they can learn to produce sounds that attract an audience.

Stuttering is caused by stop-and-go practice in which a student has a habit of stopping to replay a section every time there is a mistake. At a mistake, *always play through it*; don't stop to correct it. Make a mental note of where the mistake was and practice that section later. Fish out a small segment containing that mistake (typically a few bars) and work on it. Once the habit of playing through mistakes is established, students can graduate to the next level of anticipating mistakes and taking evasive action, such as simplifying the section, maintaining the rhythm or melody through the flub, or even speeding up just a little and using hand memory to carry you through. These skills must be practiced every time you hit a mistake. Most audiences don't mind, and often don't even hear or remember the mistakes unless the rhythm or melodic line is broken.

Slowing down at anticipated flubs can be a dangerous thing. No matter how well it is memorized, playing anything is still dependent on hand memory. Slowing down can change the stimuli for hand memory and increase the chances of flubs. Often, you can prevent a flub by speeding up so that you depend more on hand memory. Therefore experiment with both approaches during practice. Without prior practice, speeding up is

a scary thing to do during a performance.

The worst thing about bad habits is that they take so long to eliminate, especially if they are HT habits. Therefore nothing accelerates the learning rate like knowing all the bad habits and preventing them before they become ingrained. For example, the time to prevent stuttering is when a student first begins piano lessons, when a few stops here and there seem harmless. In the beginning, most students don't stutter; however, they must be immediately taught to play through mistakes — it is a skill they must learn. At this stage, it is easy to learn; to teach a stutterer to play through mistakes, on the other hand, is a very frustrating task.

(28) Jumps, PP, FF, Feeling the Keys

Accomplished pianists jump effortlessly, playing rapidly and accurately no matter where the notes are. Students with no jump training can't figure out how anyone can do that. They have trouble because they tend to move the hand along an inverted V motion that makes it difficult to hit a note accurately because the hand is coming down at some arbitrary angle that changes with every jump. These changes increase the possibility of missing the notes, and the keys are played by a sideways motion instead of straight down. Another difficulty is that fast jumps are impossible because they can never get there in time.

Jumps (leaps) consist of four motions: (1) the takeoff, (2) a horizontal translation of the hand to the correct position, (3) feeling the keys at the destination, and (4) the actual downward motion to play. The combined motion should look more like an inverted "U" than an inverted "V". This inverted U has short legs and a flat top; that is, do not raise the hand far above the keys, at least in the beginning; the one exception is when you need to go over the other hand.

Get into the habit of making quick takeoffs regardless of the speed of the jump. There is nothing wrong with getting there way ahead of time. Even when practicing slowly, you should practice quick takeoffs so that the skill will be there when you need it. Start the take-off with a small downward and sideways kick of the wrist, launching the hand towards the destination. Unlike the downward motion at the end, the take-off does not have to be straight up, and you immediately start towards the destination.

The most important skill to practice is to make the horizontal motion as fast as possible so as to reserve enough time to locate the keys after the hand reaches its destination. You may be amazed at how much faster you can move horizontally with only a few days of practice -- something some students never achieve in a lifetime because they were never taught this motion.

To practice fast horizontal motions, sit anywhere with the elbow straight down, forearm pointing forward, fingers spread out in piano playing position. Quickly move the hand sideways, parallel to the floor, as in a jump motion. Move the hand rapidly away from you and stop, then immediately relax; the shoulder does not move. Then move

rapidly back to its original position. Practice these out and in motions, as fast as you can, but completely relaxing after each motion. Most of this motion is a swinging rotation of the forearm around the upper arm, with a small motion of the elbow. From day one, you should see immediate improvements in your jumps if you had never practiced this before; but in time, this horizontal speed will increase so much that jumps will quickly become easy.

Feeling the keys can be executed surprisingly quickly. There is usually plenty of time to do this. Therefore, it is a good policy to always feel the keys because it guarantees 100% accuracy. There are a few instances in which there is no time to feel the keys, and those few can be played accurately if you had located most of the other jumps accurately by feeling them. The habit of feeling keys improves your general accuracy for locating the keys even when not feeling them because you develop a more precise map of the key locations in the mind.

Now that you know the components of a jump, look for them when watching concert pianists performing. You should now be able to identify each component, and you may be amazed at how often they feel the keys before striking them and how they can execute these components in the blink of an eye. These skills will enable you to make long jumps, even without looking at the hands.

In order to reduce stress, relax all muscles as soon as the horizontal motion is over, and as soon as the notes are played. Frequently encountered pieces to practice easy jumps are: (1) for the LH, the 4th variation in Mozart's Sonata in A, #11 (K331); this variation has large jumps in which the LH crosses over the RH and (2) RH, 1st movement of Beethoven's Pathetique Sonata (Opus 13), right after the LH octave tremolos (after bar 50), where the RH makes jumps crossing over the LH. A more challenging passage is Chopin's Ballade Op. 23, at the end, the LH jumps in the first half of the "Presto con fuoco".

Use the easy jumps to practice accelerating the horizontal motion, stopping over the correct position, and feeling the keys before playing. The idea here is to establish a habit of always getting to the destination ahead of time. Once the quick horizontal motion is satisfactory, speed up the tempo and combine all four jump components into one smooth motion. Now your jump looks just like those of the concert pianists you envied. Better yet, jumps are now easy and fun!

PP, FF: Practicing loud or practicing on a piano with heavy action is bad for technique. Some pianists ask their tuners to add extra weight to the action, in the mistaken belief that this will strengthen their fingers; it certainly will, but it will also limit technical development. It is impossible to practice PP on such pianos, and FF will not be as loud because so much energy is wasted in pressing the keys instead of moving the hammers faster.

It is difficult to play softly (P), and PP is impossible, on a piano that is out of regulation or not voiced. Most uprights fail on both PP and FF tests, and this is one of the

major differences between uprights and quality grands. The fact that it looks like a grand does not automatically qualify it as a true grand. Practically all baby grands are not true grands. **If the instrument can't produce PP or FF, you can't practice them!** This is the main reason why so many students cannot play PP or FF; it is not the students' fault.

Except for high quality grands that are properly regulated, most acoustic piano actions are too heavy because of the difficulty of producing responsive mechanical actions that are lighter. Chopin and Horowitz's pianos are famous for their light actions.

Digital pianos do not have this limitation and therefore have lighter actions. They must have a certain minimum weight so that the pianist practicing on a digital can also play on acoustic pianos with their heavier actions. Today, they may still be too heavy for optimum weight, but this point is controversial because action that is too light is less forgiving in some respects: depending on the action and the pianist, a heavier action can give better results for difficult material because of the possibility of accidentally hitting wrong notes when the fingers are flying all over. This is one reason why quiet fingers [(24) Quiet Hands & Fingers] is so important. Therefore, the question of what key weight is best has not been settled, and probably depends on the individual; however, today's digitals, with their lighter actions, may be closer to the optimum than acoustic pianos.

Unfortunately, the lighter action of digitals does not mean that they are better in terms of response, PP, and FF. The more expensive digitals have better responses. To really test them out, they should be hooked to quality audio systems, especially the speakers. This is why many digitals are sold today, bundled with sub-woofers. PP is best practiced using staccato practice [(25) Staccato Practice, Soft Practice].

FF is a new skill; learning FF and technique at the same time is difficult — learn technique first, practicing at P, then add FF. FF is produced by the force from the shoulders more than the hands. It is a forceful acceleration during the keydrop. It is not necessary to lift the hand high above the keys; the acceleration *during* keydrop is the key. Relaxation is especially important for FF because any tension will siphon away the energy that you need.

(29) Scales: Nomenclature and Fingerings

Scales and arpeggios must be practiced, to acquire basic techniques and standard fingerings for routine playing and sight reading, so that they can be played without thinking about where each note and finger goes. Practice them in all the major and minor keys. Once you become familiar with the fingerings, there is no need to practice them every day although they make excellent warm up exercises.

The origins and properties of the chromatic and other scales are discussed in (76) Chromatic Scale. Here we discuss the nomenclature and fingerings. For theory discussions, the CDEFGAB notation is generally used and for singing melodies, such as in solfege classes, the doremifasolasi system is used (use si, not ti which was introduced later for no good reason).

The historical convention to fit the C major scale on all white keys was a mistake. The "uniform" key arrangement, consisting of alternate black and white keys throughout the keyboard, would have been better. This makes the octave one key narrower so that it is easier to reach wider chords, you need to learn only four scale fingerings for all keys, transposition is trivial especially for a full step, arpeggios are easier, the chromatic scale is easier to play, all distances between black keys are identical thus reducing errors, and students will learn piano faster. The only disadvantage is that the spaces between black keys will be narrower, making it more difficult for those with wide fingers.

In the nomenclature convention, it is unfortunate that C major was not named A major. Thus the octave numbers change at C, not A; therefore, at C4, the notes are numbered A3,B3,C4,D4, . . . These notes were named for the violin tuned at A and this convention was not coordinated with the keyboard. There was no reason why the violin couldn't have been tuned to F440, so that A major on the piano would be all white keys. For any scale, the first note is called the tonic, so C is the tonic of the C major scale. The lowest note of a 88 key keyboard is A(0) and the highest note is C8.

Table 1.1 Ascending Major Scales

RH Scale	**LH Scale**	**Sharps/Flats**
12312341, CGDAE	54321321	0,1,2,3,4 sharps
12312341, B	43214321321	5 sharps
12341231, F	54321321	1 flat
41231234, Bb	32143213	2 flats
31234123, Eb	32143213	3 flats
34123123, Ab	32143213	4 flats
23123412, Db	32143213	5 flats
23412312, Gb	43213214	6 flats

The standard **major scale** ascending fingerings (Table 1.1) are 12312345 (RH, one octave), 54321321(LH) for C,G,D,A,E major scales (with 0,1,2,3,4 sharps, respectively). The sharps increase in the order F,C,G,D,A, (G-major has F# , D-major has F# and C#, A-major has F#, C#, and G#, etc.) and for the F,Bb,Eb,Ab,Db,Gb, major scales, the flats increase in the order B,E,A,D,G,C; every interval between adjacent letters is a fifth. The violin's open strings are G,D,A,E. The letters always appear in the sequence GDAEBFC which represents the circle of fifths, and is worth memorizing. Because it is a circle, G comes after C. Look at B or Gb major scales in a music book and you will see how the 5 sharps or 6 flats line up in the same sequence on the staff. Thus 2 sharps will have sharps at F, C, three sharps will be F, C, G, etc. The flats increase in reverse order compared to the sharps. Each scale is identified by its key signature; thus the key signature of the G

major scale has one sharp (F#). Learn to recognize the interval of a fifth on the keyboard; then you can generate all the scales in order of increasing sharps (by going up in fifths from C) or in order of increasing flats (by going down in fifths); this is useful for practicing all the scales in sequence without having to refer to the printed scales.

Table 1.2 Ascending Harmonic Minor Scales

RH Scale	**LH Scale**	**Sharps/Flats**
12312341	54321321, A	0 sharp, G#
12312341	54321321, E	1 sharp, D#
12312341	43214321, B	2 sharps, A#
34123123	43213214, F#	3 sharps, E#
34123123	32143213, C#	4 sharps, B#
34123123	32143213, G#	5 sharps, F#
12312341	54321321, D	1 flat, C#
12312341	54321321, G	2 flats, F#
12312341	54321321, C	3 flats, B natural
12341231	54321321, F	4 flats, E natural
21231234	21321432, Bb	5 flats, A natural
31234123	21432132, Eb	6 flats, D natural

The **minor scales** are complex because there are three families of them, and can be confusing because they are often just called "minor" without specifying which of the three, or worse, each has been given several different names. They were created because they produce moods different from the others. The simplest minor scale is the **relative minor** (also called natural minor); it is simple because it shares the same key signature as its major relative, but its tonic moves up to the sixth note of its major relative, according to music textbooks. I find it easier to remember this as a minor 3rd down instead of a 6th up. Thus the relative minor of G major has its tonic at E and the key signature is F#, and is called E (relative) minor. Another minor is the **melodic minor**; it is created by raising the 6th and 7th notes of the relative minor by a semitone only when ascending; the descending part is unchanged. The third, and the most frequently used minor, is the **harmonic minor** which is created from the relative minor by raising the 7th note a semitone. Fingerings for the harmonic minor scales are shown in Table 1.2. The last column lists the raised note for the minor scale: thus A (harmonic) minor is ABCDEFG#A, and its relative major is C major.

(30) Thumb Under, Thumb Over, Glissando Motion, Pivoting

Scales and arpeggios are the most basic piano passages; yet the most important method for playing them is often not taught! There are two ways to play them. The first is

the well-known **"Thumb Under" (TU)** method and the second is what I have named the **"Thumb Over" (TO)** method.

In the TU method, the thumb is brought under the hand in order to pass the 3rd or 4th finger for playing the scale. This TU operation is facilitated by two unique structures of the thumb; it is shorter than the other fingers and can be moved under the palm.

In the TO method, the thumb is treated like any other finger and is not moved under the palm, thus simplifying the motion, as discussed below. Both methods are required to play the scale but each is needed under different circumstances; TO is needed for fast, difficult passages and TU is useful for slow, legato passages, or when notes need to be held while playing other notes.

For lack of a better terminology, I have named the TO method "Thumb Over" which is an obvious misnomer and might make it harder for a beginner to understand how to play it. I have tried other names, but none are any better; one advantage is that this outrageous nomenclature is can call attention to the existence of TO.

Before about 2010, many piano teachers were unaware of the TO method, even at conservatories. This presented few difficulties as long as the students did not progress to advanced levels. In fact, with sufficient effort and work, it is possible to play fairly difficult passages using the TU method and there have been accomplished pianists who think that TU is the only method they need, because that's all they were taught. In reality, for sufficiently fast passages, especially for the chromatic scale, they have learned to modify the TU method in such a way that it approaches the TO method. This modification is necessary because for such rapid scales, it is impossible to play them using TU.

Many students practice slowly initially and then ramp up the speed. They do fine using TU at slow speeds and consequently acquire the TU habit and find out, when they get up to speed, that they need to change to TO. This change can be a frustrating and time consuming task, not only for scales, but also for any fast run or arpeggio -- another reason why the ramping up method for increasing speed is not recommended; speed is increased by finding new motions.

The main piano playing muscles for the thumb are in the forearm. However, the thumb has other muscles that move it in the TU method. These extra muscles make TU a more complex motion that slows play, creates speed walls, and causes mistakes. Teachers who teach TO claim that, for those who use TU exclusively, 90% of their flubs originate with the TU motion (Whiteside, Abby,).

The disadvantages of the TU method can be demonstrated by observing the loss of thumb mobility in its tucked-in position. First, stretch all fingers out so that they are in the same plane. All the fingers, including the thumb, have mobility up and down. Now, wiggle the thumb up and down rapidly without forearm rotation -- it can move 3 or 4 cm vertically with ease (rapidly). Then, while still wiggling at the same rapid rate, gradually pull the thumb under the hand -- as it goes under, it loses vertical mobility until it

becomes immobile, almost paralyzed, when it is under the middle finger. Now stop the wiggling and thrust the thumb down (without moving the wrist) -- it moves down! This is because there is another set of muscles for pushing the thumb down. Then, using these new muscles, try to move the thumb up and down rapidly -- you should find that these new muscles are much clumsier and the up and down motion is slower than the wiggle rate of the thumb when it was stretched out.

TO is easier to learn than TU because it does not require the sideways contortions of the thumb, hand, arm, and elbow needed for TU. Beginners should be taught TU first because it is needed for slow passages and takes longer to learn. The TO method should be taught as soon as faster scales are needed, within the first two years of lessons. For fast learners, TO must be taught within months of their first lessons, as soon as they master TU.

Because there are two ways to play the scale, there are two schools of teaching on how to play it. The TU school (Czerny, Leschetizky) claims that TU is the only way that legato scales can be played and that, with sufficient practice, TU can play scales at any speed. The TO school (Whiteside, Abby,, Sándor) has gradually taken over and the more strict adherents forbid the use of TU, under any circumstance. Both extremes are wrong because both skills are necessary.

The TO teachers are understandably frustrated by the fact that advanced students passed to them by private teachers often do not know TO and it takes months or years to correct hours of repertoire that they had learned the wrong way. **Students should standardize to TO and use TU as an exception to the rule. Chopin taught both methods** (Eigeldinger, P. 37).

Although the TO method was rediscovered by Whitesides, etc., the earliest account of its use dates back to at least Franz Liszt (Fay). Liszt is known to have stopped performing and returned to improving his technique for over a year when he was about 20 years old. He was dissatisfied with his technique (especially for playing scales) when compared to the magical performances of Paganini on the violin, and experimented with technique. At the end of this period, he emerged satisfied with his new skills but could not teach others exactly what he had done to improve -- he could only demonstrate on the piano (this was true of most of Liszt's "teachings"). However, Amy Fay noticed that he now played the scale differently; instead of TU, Liszt was "rolling the hand over the passed finger" so that the thumb fell on the next key. It took Fay many months to imitate this method but, according to her, it "completely changed my way of playing" and resulted in a marked improvement in her technique generally, not only for playing scales.

How to play TO: consider the RH, C major ascending scale, played 1231234. The thumb is played like the other fingers; it is raised and lowered without the sideways TU motion under the palm. Since the thumb is shorter than the other fingers, it can be brought down almost parallel to the passed finger without colliding with it. Move the *hand* so that the thumb moves towards its new position. The forearm should be almost 45 degrees to

the keyboard (pointing left); this also moves the thumb in the right direction. For scales such as the C major, both the thumb and passed finger are on white keys and will necessarily crowd each other, so that you need to curl the fingers. The hand is rolled over the passed finger by using the passed finger as a pivot. The passed finger must then be quickly moved away as the thumb comes down. It is not possible to hold the passed finger down until the thumb plays, unlike the TU method. When you first try the TO method, the scale will be uneven and there may be a "gap" when playing the thumb. Therefore, the transition from passed finger to thumb must be quick even in a scale played slowly.

Glissando motion: When playing fast scales, the hand/arm orientations should be similar to those of a glissando, with a small forearm rotation (RH ascending, supinated [(36) Hand Motions]) so that all fingers point slightly backwards. This motion positions the thumb closer to the passed fingers, making the pass smoother, and the fingertips move backwards with each keydrop. This backwards motion helps to keep the fingers on the keys as the hand moves forwards. This was one of the most important motions taught by Chopin (Fraser). In TO, the hand is always moving smoothly forward, yet the vector force on the key is straight down, because of the glissando motion.

Pivoting can be used to play legato TO, without having to use TU, a method taught by Combe. In this action, the fingers and hand are pivoted around the tip of the passed finger so that the passed finger stays on the key as long as possible. The pivoting motion requires a clockwise forearm rotation (supination, RH ascending). Practice passing and pivoting of finger 3 using 123123123123. . . . fingering on just the white keys (C major). Similarly, practice pivoting on the 4th finger using 1234123412341234 . . . . fingering. Because a skilled pivoting motion can produce excellent legato, especially for slow passages, some teachers claim that TU is unnecessary.

Beginners find TO to be easier than TU, but those who learned TU for many years may initially find TO clumsy, uneven, and difficult to understand because changing the TU habits is so difficult.

For the RH descending scale, you pivot and roll over the thumb, which is easier than pivoting and rolling over the passed finger for the RH ascending scale. The glissando motion is now reversed, so that the fingers are pointing to the right (hand pronated). The 45 degree forearm position does not change.

For TO, the movement of the thumb is controlled mostly by the hand whereas for TU, the combined motion of the thumb and hand determines the thumb location. Because the hand motion is smooth, the thumb is positioned more accurately for TO than for TU, thus reducing mistakes. The ascending scale becomes similar to the descending scale, because you always roll over the passed fingers. Playing hands together becomes easier since all fingers of both hands are always rolling over. Another bonus is that the thumb can now play a black key. For students who know only TU, the thumb is not "free". We shall see that a free thumb is the most versatile finger [(31) Thumb, Most Versatile

Finger, Power Thumb].

The LH is the reverse of the RH.

Because some students have difficulty visualizing TO, I have posted a video of "TU-TOscale" on Youtube :

https://www.youtube.com/watch?v=ZLTbURVEEO4

The video shows the RH playing two octaves TO, ascending and descending, played twice. This is then repeated using TU. To non-pianists, these may appear to be essentially the same, although the TU motion was slightly exaggerated. This illustrates why videos of piano motions are not as helpful as one might think. The TO motions ascending are basically correct. The TO motions descending has one error -- a slight bending of the nail phalange of the thumb. At these moderate speeds, this slight bending does not affect the play, but in strict TO, the thumb should remain straight for both ascending and descending play. This example illustrates the importance of learning TO as soon as possible. My tendency to bend the nail phalange is the result of using only TU for many decades, before I learned TO. Watch the lessons on scale playing on Youtube by others and you will see that most of them teach only TU. However, when they play scales fast, they use motions close to TO. To see those videos in slow motion, go to YoutubeSlow. Motions not demonstrated in my videos are glissando motion and the pivoting action on the passed finger for TO legato.

How to practice fast TO scales: The RH C major ascending scale consists of the parallel sets (PSs) 123 and 1234. First, practice a fast 123, with 1 on C4. Then practice 1231 with the TO motion. The last 1 in the 1231 is the conjunction (continuity rule). Repeat with 1234, with 1 on F4, and then 12341, with the last 1 rolling over the 4, and landing on C5. Play fingers 234 close to the black keys in order to give the thumb more area to land on. Turn the forearm and wrist so that the fingertips of 2345 make a straight line parallel to the keyboard. The forearm should make an angle of almost 45 degrees to the keyboard. Then connect the two PSs to complete the octave. After you can do one octave, do two, etc.. Always play with the tip of the thumb, towards the front of the thumb nail.

One fast octave (about 1 octave/sec.) should be achievable after a few minutes of practice for anyone who has been practicing piano for over a year (let's not worry about evenness yet!). Practice relaxing to the point where you can feel the weight of the arm. When you become proficient with TO, long scales should be as easy as short ones and HT will be easier than with TU. There is never any need to practice fast scales HT and, until you become quite proficient, fast HT scale practice will do more harm than good because it wastes too much time for little gain, and causes stress. Most advanced teachers (Gieseking) consider practicing fast HT scales to be a waste of time.

To speed up the PSs, RH 123 and 1234, play them with one down motion of the hand, including the conjunctions. To connect the two PSs, you can either rotate the forearm or lift the hand at the end of the first PS. The up and down wrist motion is

preferred over the forearm rotation because it is simpler, and the rotation can be reserved for other uses (Sandor). If you now try to play several octaves, it may initially come out like a washboard.

The fastest way to speed up scale playing is to cycle only one octave, up and down, continuously. Once you are up to the faster speeds, cycle 2 octaves up and down. At high speeds, these shorter octaves are more useful because you need to practice how to reverse direction at the top and bottom. The way to play fast reverses at the top and bottom is to play them with a single downward pressure of the hand and reverse the glissando direction *before* you reach each end. For example, to reverse at the top, play the last ascending PS, the conjunction, and the first PS coming down, all in one downward motion. In this scheme, the conjunction is effectively eliminated by incorporating it into one of the PSs. This is one of the most effective ways of playing a fast conjunction -- by making it disappear! At the same time, reverse the glissando orientation before you reach the top.

Thus the glissando motion allows the hand to glide smoothly. Practice this motion when cycling one octave up and down; the glissando motion should resemble the sideways body motion of a skater, with alternate feet kicking sideways and the body tilting left and right. The hand should pronate or supinate with each change of direction of the octave. As in skating, where you must lean in the opposite direction before changing the direction of motion, the reversal of glissando hand orientation must precede the change in direction of the scale at fast speeds.

For the RH descending TO scale, practice the PS 54321, and the other relevant PSs, with and without their conjunctions. Make a small modification to avoid letting the thumb fold completely under the hand while the next PS is rolling over the thumb. Lift the thumb as early as possible while keeping the scale smooth, by raising and/or rotating the wrist to pull the thumb up -- almost the reverse of what was done for the ascending scale. If the thumb folds completely under the palm, it will become paralyzed and difficult to move to the next position. For TU play, the thumb can be allowed to fold completely under the palm. Because this motion is somewhat similar in TO and TU, and differ only in degree, it can easily be played incorrectly. Although the differences in motion are small visually, the difference in feel to the pianist should be like night and day for fast passages.

It is instructive to practice the B major scale for practicing TO. See Table 1.1 [(29) Scales: Nomenclature and Fingerings] for scale fingerings. In this scale, only the thumb and pinky play the white keys, except for the bottom starting finger (4) of the LH. All other fingers play the black keys. This scale has the following advantages:

(1) It is easier to play, especially for those with large hands or long fingers. Each key falls naturally under each finger and there is plenty of room for every finger. For this reason, Chopin taught this scale to beginners before teaching the C major scale.

(2) It is used to practice playing the black keys using flatter finger positions. The black keys are more difficult to play (easier to miss) using curled positions because they

are narrower, and require greater accuracy. Beginners often dislike the black keys for this reason. The flat finger positions completely solve this problem.

(3) The flat finger positions are better for practicing legato and tonal control. This builds confidence in playing black keys.

(4) TO play is easier with this scale. This is why C major was used to illustrate the TO method: with B major, it is more difficult to see the difference between TU and TO because TU is not needed. However, once you understand the difference, B major is better for practicing TO because it is easier.

(5) The LH, RH thumbs are synchronized in the B major scale, making it possible to practice HT, PS by PS. Thus HT play is easier than for the C major scale. Once you become proficient with B major HT, learning C major HT becomes easier, saving you time. If you want to show off how well you can play scales, use B major!! Thanks, Freddie!

Those who learned only TU must now learn TO. At first, it might feel as if the fingers get all tangled up and understanding TO is difficult. Good news: you already know how to play TO! Play a very fast chromatic scale, starting with C, (RH): 13131231313 . . . . . If you can play a fast chromatic scale, the thumb motion is the same as for TO because it is impossible to play a fast chromatic scale TU. Now slow down this fast chromatic thumb motion and transfer it to the B major scale. Once the B major TO is mastered, apply this motion to C major. The only difference between playing a TO scale and a fast chromatic scale is that you can play the chromatic scale with the hand almost perpendicular to the keyboard, instead of almost 45 degrees for the scale. You will find the glissando motion useful for the chromatic scale also, but the hand rotation is much smaller.

Those who are new to TO, and have learned many pieces using TU, must convert everything to TO. One way to accomplish the switch is to practice scales and arpeggios first so that you become comfortable with TO. Then learn a few *new* compositions using TO. After about 6 months or so, when TO has become comfortable, start converting all old pieces to TO.

TO and TU are the extremes of two ways to use the thumb: there is a continuum of intermediate motions between them. Learning TO will improve how you play TU because the thumb becomes more capable: it becomes free. This freedom transforms the thumb into a most versatile finger (next section).

We can never play scales well enough. When practicing scales, always try to accomplish something -- smoother, softer, clearer, more authoritative. Be sure to practice staccato after practicing with the PSs. Make the hands glide, the scale sing; add color, excitement. There is no such thing as a maximum speed in parallel playing. Speed and accuracy can be increased all your life -- which is a lot of fun and is certainly addicting. To demonstrate speed or to impress an audience, you can use scales and arpeggios at least as well as any piece of music, provided you had practiced musically all the time.

(31) Thumb, Most Versatile Finger, Power Thumb

The **thumb** is the most versatile finger; it lets us play scales, arpeggios, and wide chords. It has four major ways to move down (play a note):

(1) finger motion: with the hand motionless, play the thumb with only finger motion, by pivoting each finger at the knuckle (the "thumb knuckle" is at the wrist),

(2) wrist motion: with the forearm motionless and rigid fingers, play the thumb with wrist motion only,

(3) arm motion: with the fingers and wrist rigid, play the thumb by swinging the entire forearm down. This motion originates at the shoulder, and by

(4) Forearm rotation ((21) Forearm Rotation).

Practice each of these motions separately, eliminating all stress. First, practice each slowly, with large, exaggerated motion. Then increase speed by decreasing the motion. This exercise will reveal which is your fastest motion. Speed can be further increased by combining the motions because, when combined, smaller individual motions will be needed to accomplish the same key drop. Separating each motion is difficult at first, because we usually combine most of them for any thumb motion, which is why it is important to practice each motion separately.

Play with the tip of the thumb, not the joint (of the nail phalange); this will enable the thumb to slide and the wrist to be raised, thus reducing the chances of the other fingers accidentally hitting unintended notes. Playing with the tip makes the thumb as long as possible, which is needed because it is the shortest finger. This also increases the range and speed of the thumb movement; that is, for the same thumb movement, the tip moves farther and faster than the joint.

There are two thumb positions: weak and power. Place both hands on the keys, straight in front, the thumb nails facing each other; this is the weak position. The thumbnails are almost vertical to the keyboard, and the tips of the thumbs are bent slightly towards the fingers so that they are almost parallel to the fingers. This position is useful for slow or easy passages.

For technically difficult material, especially when power is needed, use the power thumb position: with both hands on the keyboard, extend the thumbs straight out, so that the thumbnails now face upwards towards your face (LH thumb on G3, RH thumb on G4). This position enables rapid play, makes optimum use of forearm rotation, allows complete relaxation, and utilizes the strongest muscles in the thumb: those powerful muscles that are used to push thumb tacks into a wall. Applying force in the weak position can cause pain and injury, not only to thumb muscles, but also elsewhere.

The power thumb position is attained by raising the wrist so that you play closer to the palm-side tip of the thumb. This automatically causes the thumb to point down and engages the strong muscles of the thumb. The weak thumb position is attained by lowering the wrist so that the hand is level with the forearm: you are now playing more

with the side of the thumb. In general, try the weak thumb position first, and if this is inadequate, gradually add the strong position. Thus the use of weak/strong thumb is analogous to TU/TO; they are not generally used in their extreme positions, but somewhere in between. Most of us think of the thumb as the strongest finger; however, even the pinky can overpower the thumb in its weak position, especially at high speeds. The strengths of the thumb and pinky can be balanced by a proper choice of the weak/power thumb positions, in applications such as the octave tremolo.

(32) Arpeggio, Cartwheel Motion, Finger Splits

Playing **arpeggios (arps)** is technically complex. Arps are "broken chords"; notes of "chords" played in succession. Arps are complex because many (36) Hand Motions, such as flat finger positions, thrust, pull, cartwheel motion (below), glissando, finger splits (below), TU or TO, must be combined. Those trained to use only curled finger positions will find arps to be scary difficult. Because of the large distances between notes, it is difficult to hit every note accurately.

Arps are played TO just like scales. TO arps is an extreme example of TO and serves as a clearer example of TO than for scales. TO is more necessary for arps than for scales because the thumb cannot be tucked under the hand to reach the next position — the distance is too far. New motions are needed to cover these longer distances accurately.

The standard arp fingering for the CEGCEG . . . .C arp is 123123. . . .5, RH, and 5421421. . . .1, LH ascending, and the reverse for descending. See Michael Aaron, Adult Piano Course, Book Two for fingerings of all arps and scales. Because arps jump over several notes, most people spread the fingers to reach those notes. For fast arps, this is a mistake because spreading the fingers slows down their motions and builds stress and fatigue. A better method is to move the hand instead of spreading the fingers, using the cartwheel motion and finger splits.

The **cartwheel motion** is especially useful for small hands. Place the left palm flat on the piano keys, with the fingers spread out like the spokes of a wheel. The fingertips from pinky to thumb fall on an approximate semi-circle. Now place the pinky above C3 and parallel to it; the hand must be rotated so that the thumb is closer to you. Then move the hand towards the fallboard so that the pinky touches the fallboard; the hand must be spread out at all times. If the 4th finger is too long and touches the fallboard first, rotate the hand sufficiently so that the pinky touches the fallboard, but keep the pinky as parallel to C3 as possible. Now rotate the hand like a wheel counter clockwise (viewed from above) so that each successive finger touches the fallboard (without slipping) until you reach the thumb. This is the cartwheeling motion in the horizontal plane. A supple wrist is needed for this motion.

If your reach is one octave, the cartwheeling motion should cover almost two octaves! Extra reach is gained because the center three fingers are longer than the pinky or thumb, and the circumference of a semi-circle is larger than its diameter.

Now repeat with the hand vertical, so the fingers point down. Start with the pinky vertical and lower the hand to play C3. Then roll the hand up towards C4; each finger will "play" the note that it touches. When you reach the thumb, this motion should cover almost twice the normal reach. We just learned three things: (1) how to "cartwheel" the hand, (2) this motion expands the reach without making any jumps, and (3) the motion can be used to "play" the keys without moving the fingers.

Cartwheeling is used with the hand somewhere between vertical and horizontal, and the fingers will be in the pyramid position [(4) Curled and Flat Finger Positions, Curl Paralysis] or slightly curled. Although cartwheeling will add keydrop motion, the fingers should also be moved to play the notes. Cartwheeling in the horizontal plane uses only the slow sideways motion of the wrist. Cartwheeling in the vertical plane uses the much faster motions of forearm rotation.

Your reach can be stretched even more by using **"finger splits"** (Fraser). Make a "V" with fingers 2 & 3 of the RH and place the "V" on a flat surface, at the edge, so that only the two fingers are on the surface and the rest of the hand is off the edge. Spread the "V" as far as you can, comfortably. Then rotate the arm and hand 90 degrees clockwise (supinate) so the fingers are now touching the surface with their sides. Now it is possible to spread the fingers even more; this is called finger splits. This works with any pair of fingers. Cartwheeling expands the reach to almost twice normal; adding finger splits expands it to over twice normal. Demonstrate this by repeating the above cartwheel motion, but with added finger splits.

The flat finger positions [(4) Curled and Flat Finger Positions, Curl Paralysis] are the best for playing arps because they allow play with the large front pads of the fingers. This greatly reduces the chances of missing those narrow black keys. Those who use curled fingers on black keys find arps scary and frustratingly difficult.

Therefore, by using a combination of TO, flat finger positions, cartwheel motion and finger splits, you can easily reach and play fast arps with little stress on the stretching muscles. This complex combination of motions is facilitated by a supple wrist and forearm rotation. As with every complex technical motion, practice each of the above individual motions separately before combining them.

(33) Fast Chromatic Scales

The **chromatic scale** consists of semitone steps. The most important consideration for chromatic scales is the fingering, because there are so many ways to finger it. The standard fingering, starting from C, is 1313123131345 for ascending RH, and 1313132131321 for ascending LH for one octave (the top is fingered for a return but is not necessary) and the reverse for descending. This fingering is difficult to play fast because it is composed of the shortest possible parallel sets and therefore contains the maximum number of conjunctions which limit the speed. Its main advantage is simplicity which makes it applicable to practically any chromatic segment, starting from any note,

and is the easiest to remember. One variation of this is 1212123121234, which enables a little more speed and legato, and is more comfortable for those with large hands.

The reason why those who never learned TO [thumb over, (30) Thumb Under, Thumb Over, Glissando Motion, Pivoting] can play chromatic scales fast is that they are the easiest to play TO and even those who think that they are using TU are actually using TO for fast play.

Several fingerings using longer parallel sets have been devised in attempts to enable faster play; all of the "accepted" sequences avoid the use of the thumb on a black key. The most commonly used is, starting from E, 123123412312 (Hauer, Czerny, Hanon). One complication with this fingering is that the starting sequence must be changed depending on the starting key in order to maximize velocity. Also, the RH and LH are different; this sequence uses 4 parallel sets. It can be simplified to 3 parallel sets for starting at C, 123412312345. With good TO technique, this scale might be playable, but even with TO, 41 and 14 fingerings are awkward. The restriction to avoid the thumb on a black key limits the choice of fingering and complicates matters because the fingering will depend on the starting note. If we allow thumb on a black key, a good scale is the **"4-finger chromatic scale"**, starting from C:

1234,1234,1234; 1234,1234,12345, 2 octaves RH ascending,

5432,1432,1432; 1432,1432,14321, 2 octaves LH ascending, with the thumb on G# for both hands and three *identical* parallel sets per octave - the simplest and fastest possible fingering. Reverse to descend. As far as I know, this fingering has not been discussed in the literature because of the thumb on a black key followed by passing over the 4th finger. In addition to speed, the biggest advantage is simplicity; the same fingering is used regardless of starting note (for example, use finger 3 for starting on D) ascending or descending. The fingering is the same for both hands (in reverse) and fingers 1 and 3 are always synchronized except at the ends. A good TO technique and flat finger position will facilitate the difficult 14 or 41 where the thumb is on G#. Try this on the last chromatic run in the Grave of Beethoven's Pathetique and you should notice a marked decline in the number of flubs and a significant increase in speed. Once you learn it for this run, it will work for any other chromatic run because the fingering never changes. In order to develop a smooth run, practice with the beat on every note, every other note, every third note, etc. Staccato practice also helps.

In summary, although most exercises are not helpful, practicing scales, arpeggios and the (4-finger) chromatic scale have a special place in piano technique acquisition. They can be a part of a pianist's daily practice program because they can be used to learn so many fundamental skills.

(34) Fast Octaves, Small/Big Hands

PS #1 [parallel set #1, (10) Parallel Sets Catalogue] should be used for practicing **fast repeat chords and octaves** (such as those in Liszt's Hungarian Rhapsody #6). Start

with quick double octaves, HS, as fast as possible without stress, CC,CC, where CC is the C octave; do not move around, like CC,DD until the single octave is satisfactory. Practice one octave for the LH and one for the RH so you can switch hands and use the better hand to teach the other. After a hard workout, always play slowly several times, completely relaxed, before switching hands or quitting.

There are two ways to increase speed. One is to reduce the vertical hand motion. For grands, this can be reduced to less than the maximum keydrop because of their special repetition mechanism. Uprights will require a larger amplitude. This principle of increasing speed with decreasing amplitude can be demonstrated with a basketball or tennis ball. First, bounce (dribble) it up and down 2-3 feet; then gradually reduce this height. As you push the basketball lower, its bounce frequency will increase. This happens because the basketball bounces back when it hits the floor. In piano, **your hand has to supply the bounce** when it hits the bottom of the keydrop. A second trick for increasing speed is to play the double octaves in one down motion. The basketball analogy works for this concept also because the fastest dribble occurs when you simply press down on the basketball: the same physical principles apply to the piano and the ball.

Then advance to 3 repeats, then to quads, then a series of quads, playing each quad with one down motion of the hand. Apply all the methods discussed above for acquiring technique. Where power is required, use the power thumb position [(31) Thumb, Most Versatile Finger, Power Thumb].

In order to play many octaves in succession, push down on the piano continuously as you play and let the bounce of the hand bring it back, as in the basketball example. Once you learn to provide the bounce, you can push down on the piano but the hand will not go down. The down pressure is needed because so many keys need to be depressed, and the faster the play, the greater the down force that is required.

At first, speed is acquired using the smallest keydrop possible, but once the skill is acquired, the amplitude of the hand motion can be increased. One way to increase the amplitude is to increase the bounce back from the keydrop.

After the repeated octaves is satisfactory, advance to moving octaves. Again, start first with only 2 octaves: CC,DD. Only when this is satisfactory, move on to three, CC,DD,EE, etc. Then CC,EE, and CC,FF, etc., gradually increasing the distance of the jumps [Jumps, PP, FF].

The key to the success of this method lies in finding ways to accelerate the double octaves such as CC,CC; black keys may be easier – the easier, the better. Once these fast doubles are attained, the brain "gets the idea" of what "fast" means, and how to do it. Then the rest of the work becomes easier. Most people will not be able to achieve all this in one or a few sittings, but will need to make use of post practice improvement [(23) Post Practice Improvement, Sleep, Fast/Slow Muscles]. Too many repetitions in one sitting can become counter-productive, resulting in loss of musicality and bad habits.

After about 10 minutes, the conditioning for post practice improvements becomes less effective, so that hours of repetitions will mostly be wasted or worse. Remember to practice slow, fully relaxed, a few times after every fast workout. Practice at P; resist the temptation to play louder, as that will only slow down the movements. This point is certainly counter-intuitive.

Small hands: For most pianists, the black keys may be easier because they stick out of the keyboard so that the chances of inadvertently hitting neighboring keys are lower. Unfortunately, those with small hands may not see much difference between black and white keys because the shortest distance between black octave keys is larger than the shortest distance between white octave keys by 1.3 cm, although the octave distance between the centers of all keys is the same. Therefore, try both black and white keys to see which is easier for you. For those with larger hands, the black octaves are significantly easier, and should be used.

There are two sets of muscles for spreading the fingers: one set to spread the palm only, and another to spread the fingers. Everybody naturally uses both sets, but those who are not aware that there are two sets of muscles tend to use mostly the finger spreading muscles, which is the wrong thing to do. This locks the fingers into position, making it difficult to move them and produces stress. Use mostly the palm spreading muscles in order to free the fingers to move. Most people with small hands keep the hands stretched all the time during the octaves. Pianists with small hands must do two things: (1) palm stretching exercises and (2) learn "rapid relaxation" [(8) Relaxation]. Palm stretching may not seem to accomplish much short term, but over a lifetime, it can make all the difference, especially as the ability to stretch decreases with age. Stretching [(54) Stretching and Other Exercises] must be done regularly all your life, and is most effective when started at a young age, when everything is still flexible. Rapid relaxation is an important skill to develop whether the hands are small or big, because rapid relaxation is not a natural body process and must be cultivated. Always practice octaves by quickly relaxing after each octave is played. Do not contract the hands, just release the spreading tension. These extra steps may seem to slow down the repetitions but, once they become a habit, the extra relaxation will allow faster play and will free enough energy to keep playing fast octaves indefinitely.

Those with **big hands**, especially fat fingers, have trouble playing between the black keys. They may need extra curl in order to avoid hitting the fallboard. One solution is to play the white keys in front of the black keys by using extra curl. Another is to twist the hand by pronating or supinating so that the fingers are inserted between black keys sideways because fingers are thinner than they are wide.

(35) Trills and Tremolos

For a 2323.... RH **trill**, start by practicing the 23 parallel set (PS), **following the procedures described in** (9) Parallel Sets (PSs), Conjunctions, Cycling, practicing in

quads, etc.. To speed up this PS quickly, use the 2.3 PS #1 [(10) Parallel Sets Catalogue], the notation 2.3 means 2 and 3 played as an interval. Alternate between 23 PS and 2.3 repetition as speed is increased, and practice relaxation. When the 23 PS is sufficiently fast, practice the 32, then 232, then 2323, etc. Starting the first two notes fast is the trick to playing fast trills, and a 23 PS is the best way, even after you have become expert at trills. Other fingers are treated similarly.

Fast trills are fundamentally different from slow trills because momentum becomes important in fast trills. Therefore, expect a change in the feel of the trill as it is sped up. One consequence of momentum is that fast trills work best at resonance frequencies. Don't be surprised if some frequencies (speeds) work better than others — this is normal. At first, practice only at frequencies that work well; once you improve beyond a certain level, you will be able to change speeds more easily.

Relaxation is more critical for the trill than almost any other technique because of the need for rapid momentum balance; there are too many conjunctions to rely solely on parallelism to attain speed. The momentum of the finger motion must be counteracted by arm rotation. Stress will lock the fingers to the larger members such as the hands and arms thus increasing the effective mass of the fingers. Larger mass means slower motion: the hummingbird can flap its wings faster than the condor and small insects even faster than the hummingbird (the low hum of the hummingbird vs the high pitched whine of the mosquito). It is therefore important to incorporate complete relaxation into the trill from the very beginning, thus freeing the fingers from the hand.

Trilling requires constant maintenance. To be a good triller, it is necessary to practice trills every day. Learn a piece with lots of trills and play it frequently; for the RH, a good piece is the end of Beethoven's Waldstein Sonata, Op. 53, third movement, starting at bar 176. Bach's inventions (#4, 7, 9, 10, 12) are good for practicing slow trills. Older methods of teaching advised matching the trill notes to notes in the other hand (by slowing down for practice) as indicated by Palmer (J. S. Bach, Willard A. Palmer Edition). The best method is to learn fast trills as discussed above and learn to trill *independently* of the other hand, at any trill speed.

The trill is not a series of staccatos. The finger tips must stay at the bottom of the keydrop between notes; i.e., the backchecks must be engaged after every note in order to hold the hammer still; if not, it will flop around and control over it will be lost, resulting in uneven or missed notes. But do not press down hard because that will slow down the trill; just the weight of the arm is sufficient.

Take note of the minimum lift necessary for the repetition to work. This lift distance can be almost twice as high for an upright as for a grand. Faster trills require smaller lifts; therefore, on an upright, you may have to slow down. Fast trills on less expensive electronic pianos can be difficult because their actions are inferior; this is one reason for purchasing the more expensive models. Thus, to test a digital, use a trill. As with every technical drill discussed in this book (especially those using PSs) always apply staccato

practice for the final technique acquisition step, even for trills.

Tremolos are practiced in exactly the same way as trills; just substitute a 15 PS for the 23 PS. Tremolos are treated in detail in (50) Beethoven's Pathetique, Op. 13, First Movement.

(36) Hand Motions

Hand motions are the secrets to technique acquisition and experimentation. When watching a concert pianist, most technical hand motions are not discernible. They are too small and fast so that most of the visible motions are exaggerations or irrelevant to technique unless you know what to look for. The hand motions: parallel finger [(9) Parallel Sets (PSs), Conjunctions, Cycling], (21) Forearm Rotation, [(30) Thumb Under, Thumb Over, Glissando Motion, Pivoting], and [(32) Arpeggio, Cartwheel Motion, Finger Splits], have already been discussed.

All finger motions must be supported by the major muscles of the arms; there is no such thing as moving one finger -- any finger motion involves the entire body. Hand motions are discussed only briefly here; for more details, consult the references: Fink or Sándor, and Mark for anatomy.

Pronation and Supination: There are two bones in the forearm, the larger radius, connecting to the thumb, and the smaller ulna, connecting to the pinky Mark, Thomas,. The ulna is held in position by the upper arm. The hand is rotated by rotation of the radius against the ulna; this causes the thumb to move more than the pinky, and is the main motion for playing the thumb. The downward rotation of the thumb is called pronation and the upward rotation is called supination.

Wrist Motion: The general wrist rule is to raise the wrist for the pinky and lower it to play the thumb. This is not a hard rule; there are plenty of exceptions, because practically every motion is a combination of motions. By combining wrist motion with pronation- supination, you can create rotary motions for playing repetitive passages such as LH accompaniments, or the first movement of Beethoven's Moonlight Sonata (RH). The wrist can be moved up or down, and side-to-side. Every effort should be made such that the playing finger is parallel to the forearm; this is accomplished with the side-to-side wrist motion. This configuration puts the least amount of lateral stress on the tendons moving the fingers and reduces the chances of injuries such as Carpal Tunnel Syndrome [(60) Injury, Health]. Habitual playing (or typing) with the wrist cocked at a sideways angle can cause injury. A loose wrist is also a prerequisite for total relaxation. Most students think of a supple wrist as one that moves up and down freely, but the sideways motion is the more important, and difficult one to cultivate. When sitting low, the wrist can also be turned sideways rapidly using forearm rotation; this could be one reason why some famous pianists sit so low.

Knowing how to **slide the fingers** will let you play with confidence even when the keys are slippery or if they get wet from perspiration. **Never depend on the friction of**

the key surface to play the notes because it will not always be there for you and it can lead to stress and injure the finger tip. Depending on friction is one of those bad habits that can cause numerous problems. Raising the wrist will cause the fingers to slide towards you during the key drop. Lowering the wrist will cause the fingers to slide away. Practice each of these sliding motions with all five fingers. With a stationary wrist, the fingers will not slide, even if the keys are slippery! Better still, sliding fingers will never be problematic; in fact, sliding the fingers is another technical skill that should be practiced (see claw below).

For controlling the friction between fingers and keys, most moisturizers (Lubriderm, Eucerin) can work wonders, but it will take some experimentation before you can learn to use them properly. Firstly, you need to apply a sufficient amount for it to work. But you need to wait for at least several minutes for all that moisturizer to be completely absorbed into the skin; otherwise it will wipe off on the keys and make them slippery. Even after complete absorption, any moisture on the skin, such as perspiration, will make the fingers very slippery.

Thrust and Pull: Thrust is a pushing motion, towards the fallboard, usually accompanied by a slightly rising wrist. With curved fingers, the thrust motion causes the vector force of the hand moving forward to be directed along the bones of the fingers. This adds control and power. It is therefore useful for playing chords, but it can cause injury. The pull is a similar motion away from the fallboard, and does not cause injury. In these motions, the total motion can be larger than the vector component downward (the key drop), allowing for greater control. Thrust is one of the main reasons why the standard finger position is curved. Try playing any large chord with many notes, first lowering the hand straight down and then using the thrust motion. You may get superior results with the thrust compared to straight down. Pull is useful for some legato and soft passages. Thus, when practicing chords, always experiment with adding some thrust or pull. Thrust and pull use different sets of muscles; thus fatigue can be reduced by switching between them.

Claw and Throw: Claw is moving the fingertips into the palm (increasing curl) and throw is the opposite: opening the fingers to their straighter positions. In addition to moving the fingertips up and down, they can also be moved in and out to play. These motions add greater control, especially for legato and soft passages, as well as for playing staccato. Like the thrust and pull, these motions allow a larger motion with a smaller keydrop. Thus, instead of always trying to lower the fingers straight down for the key drop, try experimenting with some claw or throw action to see if it will help. Note that the claw movement is much more natural and easier to conduct than a straight down. The straight down motion of the fingertip is a complex combination of a claw and a throw. The flat finger playing can be considered as one form of claw.

Flick: The flick is a quick rotation followed by counter- rotation of the hand; a fast pronation-supination combination, or its reverse. We saw that parallel sets can be played

at any speed. When playing fast, connecting parallel sets becomes a problem. One solution is the flick, especially when the thumb is involved, as in scales and arpeggios. Single flicks can be conducted extremely quickly with zero stress. However, quick flicks need to be "re-loaded"; i.e., continuous fast flicks is difficult. For connecting parallel sets, the flick can be used to play the conjunction and then be re-loaded during the parallel set.

(37) Hands Together

How do you know that you are ready to start HT? A good criterion is HS speed. Typically, the maximum HT speed is 50% to 90% of the slower of the RH or LH speed. As a general rule, get the HS speed well above final speed, typically 110% to 150% of final speed, relaxed, and in control.

There is a world of difference in how the brain handles tasks in one hand and tasks that require two-hand coordination, which is why you learn faster by practicing the hands one at a time. HT skills require the coordination of the two halves of the brain, and there are comparatively few nerve connections between them. This is why HT motions take longer to learn. Bad HT habits are the worst because, once formed, they take forever to unlearn because they took so long to learn.

Most HT practice methods are the same as for HS, such as segmental practice, most difficult sections first, continuity rule, etc., including practicing **without the pedal**, softly, and staccato practice, see (58) Summary of Method (One Page), item 15. This is why the instructions for HT practice appear to be so short: they have already been covered.

One method of HT practice is "adding notes": take a short segment and play the more difficult hand HS, repeating the section continuously (cycling); now start adding the easier hand, note by note. Make sure that, as you add notes, you keep the same fingering as during HS practice.

Another method is outlining [(38) Outlining, Beethoven's Sonata #1, Op. 2-1]. It is often difficult to play HT when the rhythms of the two hands are different, such as polyrhythms [(48) Chopin's Fantaisie Impromptu, Op. 66, Polyrhythms], or if important rhythmic notes are **missing** [(26) Speed, Rhythm, Dynamics]; detailed instructions are given in the links.

Learning to coordinate the two hands will require a lot of practice. The preceding HS work makes this coordination easier to learn because we only have to concentrate on coordinating, and not coordinating *and* developing technique at the same time.

Students who start HT without practicing HS first can end up with undetected mistakes in counting, etc.. Interestingly, these mistakes usually make it impossible to bring the music up to speed. There is something about wrong timing that creates its own speed wall. It certainly messes up the rhythm and the music. Therefore, if you run into problems with bringing up the speed HT, check the counting, using a metronome.

The biggest disadvantage of learning HS first is that, initially, the HT coordination

tends to be weak. Therefore, practice accurate timing between the hands, using staccato practice. The ability to play HT at speed is insufficient; the two hands must be accurately coordinated. Therefore, once you complete a piece HT, play it as often as you can and make music, because playing finished pieces is the most important part of learning piano *and developing technique*. Having a repertoire that can be played at a moment's notice is the difference between a musician and an amateur because you can truly develop technique to the level of a musician only by playing finished pieces. And that provides the necessary opportunities to practice HT.

(38) Outlining, Beethoven's Sonata #1, Op. 2-1

Outlining is a method for accelerating the learning process by simplifying the music; it works for HS, but is used mainly for HT practice. It allows the pianist to maintain the musical flow or rhythm, and to do this at the final speed almost immediately. This enables musical practice long before that segment can be played satisfactorily at speed and facilitates the acquisition of difficult technique by teaching the larger playing members (arms, shoulders) how to move. The simplifications are accomplished by using devices such as deleting "less important notes" or combining a series of notes into a chord. The original music is recovered by progressively restoring the simplified notes. Whiteside describes outlining on P. 141 of the first book, and P. 54-61, 105-107, and 191-196 of the second book, where several examples are analyzed.

For a given passage, there are many ways to simplify the score, and students using outlining for the first time will need some practice before they can take full advantage of the method. Advanced outlining can get far more complex than what students can manage and will need a teacher's help. However, everybody must eventually develop the ability to outline without help.

One idea behind outlining is that, by getting to the music first, the technique will follow more quickly because music and technique are inseparable. Outlining can also be used to increase the precision and improve the memorizing.

Easy methods of outlining are (1) deleting notes, (2) converting arps into chords, and (3) converting complex passages into simpler ones; this is where music theory comes in and can get complicated. An important rule is: although the music is simplified, retain the same fingering that was required before the simplification.

For HT outlining, simplify one or both hands so that you can play them HT easily, then gradually add the deleted material. Note that outlining is an extremely useful skill for sight reading.

Let's apply outlining to Beethoven's Sonata #1 (Op. 2, No. 1). I noted in the book review that Gieseking was remiss in dismissing the 4th movement as "presenting no new problems" in spite of the difficult and fast LH arpeggio (Prestissimo!). He probably didn't know how to solve problems using parallel sets and so could not give instructions. Let's complete the wonderful job Gieseking did in getting us started on this Sonata by making

sure that we can play this exciting final movement.

The first four triplets of the LH can be practiced by using parallel sets applied to each triplet and then cycling. Parallel set #1 is useful here; it is one type of outlining (simplifying the triplets into chords). The first triplet in the second bar can be cycled using the PS 524. The continuous 524 cycling strengthens the weak 4th finger. When the 4th finger becomes strong and under control, add the next note, 5241, then practice the PS 1235. TO is required everywhere. Then practice the ascending arpeggio of bar three, 5421 PS, then 542131. Practice the ensuing descending arpeggio using the same methods.

The RH is simple, you can use the rules for practicing chords and jumps [(34) Fast Octaves, Small/Big Hands]. So far, everything is HS work.

Use outlining to practice HT. Simplify the LH and play only the beat notes (first three bars): F3F3F3F3|F3F3F2E2|F2F3F3F3, with fingering 5555|5155|5155. These are the first notes of each triplet. When this outline is mastered HS, start HT practice. Once this HT becomes comfortable, adding the triplets will be easier, with much less chance of incorporating mistakes. Since these arpeggios are the most challenging parts of this movement, by outlining them, the entire movement can be practiced at any speed even if you cannot manage these fast triplets.

In the RH, the first three chords are soft, and the second three are forte. In the beginning, practice mainly accuracy and speed, so practice all 6 chords softly until this section is mastered. Then add the forte. As in all Beethoven compositions, following the dynamic (volume) markings is absolutely essential. To avoid hitting wrong notes, get into the habit of feeling the notes of the chords before playing them. For the RH octave melody of bars 34-36, be sure not to play with any crescendo, especially the last G. The entire Sonata is played without pedal. In order to eliminate any chance of a disastrous ending, play the last 4 notes of this movement with the LH, bringing the hand into position well before it is needed.

There are many ways to outline; the LH triplets can be played as chords, or as PSs. This can allow you to practice HT at the stage when you are still practicing the PSs. Use outlining as a method of last resort because it can consume a lot of time; it is often not necessary if you know all the other methods of this book.

(39) Damper (Sustain) Pedal, Physics of the piano sound

Practice any new piece without the (damper) pedal, HS and HT, until it can be played comfortably HT at final speed. All good teachers use this method. It might feel difficult, at first, to practice musically without the pedal where it is indicated; however, this is the best way to learn precise control. The "difficult" feeling arises because, without the pedal, you need to play every detail correctly. Students who practice with the pedal from the beginning will become sloppy players, develop numerous bad habits, and will not learn the concept of precise control.

Rank amateurs often over-use the damper pedal. The obvious rule is, if the music

doesn't indicate a pedal, don't use it. The action feels lighter with the damper pedal down, because the foot is holding the dampers off the strings instead of the fingers. Some pieces might seem easier to play with the pedal when playing very slowly but this is one of the worst traps a beginner can fall into. Most beginners do not realize that where pedals are not indicated, it is usually impossible to play the music at speed with the pedal because all the notes will run into each other, and you lose control over the individual notes. The pedal is a crutch because you never have to lift the fingers accurately. Such crutches ruin the technique because they allow you to "play" (slowly) without adequate technique.

One major objective of practicing without the pedal is to practice keeping the fingers down to hold the hammer still using the backcheck, see [(11) Basic Key Stroke; Legato, Staccato], after every note. When not in use, the hammer must be held still so that it is under control at all times; otherwise you lose control and can miss notes or play them too loud even when you play them correctly, because the hammer was flopping around. Do not push down hard, the "force of gravity" (arm weight) is adequate.

The pedal did not exist before Mozart's time; for example, no pedal is used in any of J. S. Bach's music. Mozart did not indicate any pedaling although, today, some pedaling is considered optional in some of his compositions and many editors have added pedal markings in his music. The pedal was fully developed by Beethoven's time, although it was not yet totally accepted as a serious musical tool. Beethoven used it with great success as a special effect; therefore, he tended to use it a lot (first movement of his Moonlight Sonata, third movement of Waldstein Sonata) or non at all (Sonata #1 and Pathetique Sonata, first and second movements of the Waldstein). Chopin used the pedal extensively to inject an additional level of harmonic logic into his music and fully exploited all the different ways of pedaling. Therefore, Chopin (and many later composers) cannot be played correctly without adequate training in pedaling.

See the references for all the different ways to pedal, when to use them, and how to practice those methods (Gieseking and Leimer, Fink, Sándor, Rubinstein, and "The Pianist's Guide to Pedaling" by Banowetz). These references provide helpful exercises for practicing proper pedaling. Try to master all these methods before using the pedal with an actual piece of music. Example: depress the pedal before playing the note for exciting as many strings to vibrate as possible. For sustaining only one clear note, depress the pedal after playing the note (but before you lift the finger); the longer you delay the pedal, the fewer sympathetic vibrations you will get. In general, develop the habit of depressing the pedal a split second after playing the note to produce a more harmonious tone. For producing a legato effect without too much blurring, rapidly lift and depress the pedal at every chord change. It is just as important to know when to lift the pedal as when to depress it. Clearly, the pedal must be "played" as carefully as you play the keys similarly to the basic keystroke.

Physics of the piano sound. Unlike the simple picture of fundamental and harmonic frequencies that are used when tuning a piano, the actual string vibrations

consist of a complex time dependent series of events. Therefore, I summarize here some general knowledge based on the physics of the piano sound. The piano produces an initial **prompt-sound** and a sustaining **after-sound** (Weinreich, Askenfelt). The string vibrations can be polarized, either parallel to the soundboard, or perpendicular to it. When the strings are struck, **vertically polarized** traveling waves are generated that move away from the hammer in opposite directions, towards the agraffes (capo bar) and towards the bridge. See Grand Piano Diagrams or Reblitz for names of piano parts. These waves travel so rapidly that they reflect back from both ends of the strings and pass the hammer several hundred times before the hammer bounces off the strings; in fact it is these waves that eventually throw the hammer back. **Horizontally polarized** waves are generated from the vertical waves because the piano is asymmetric. These traveling waves decay into standing waves consisting of harmonics (including the fundamental) because the standing waves are "normal vibration modes" (see a mechanics text book) that transfer energy slowly to the soundboards and are therefore long-lived. However, from the very beginning, the concept of fundamentals and harmonics remains valid because the Fourier coefficients (see a math or physics textbook) of the fundamental and harmonic frequencies are always large, even for the traveling waves, because the ends of the strings are rigidly fixed. The rigidity is supplied by the mass of the piano, which explains why good pianos are so heavy. The initial vertically polarized waves transfer energy more efficiently to the soundboard than the horizontally polarized waves and therefore produce a louder sound and decay faster; they create the prompt sound. The horizontally polarized standing waves produce the after-sound which gives the piano its long sustain. Energy is transferred back and forth from the vertical to horizontal polarizations, which produces the singing property of piano sounds.

If the damper pedal is depressed before a note is played, the initial time dependent traveling waves will excite all strings, creating a soft, but slightly dissonant, background roar. That is, in the prompt sound, the non-harmonic Fourier coefficients are significant; i. e., there is some white noise. If you place a finger on any string, you can feel it vibrate. However, octave and harmonic strings will vibrate with higher amplitudes than the dissonant strings, which is a consequence of the larger Fourier coefficients for the harmonics because the ends of the strings are fixed. If the pedal is depressed after the note is struck, there will be sympathetic vibration in octave and harmonic strings, but all the other strings will be quiet because the traveling waves have dissipated and the remaining standing waves contain only harmonics. This produces a clearer sustained note. The lesson here is that, in general, the pedal should be depressed immediately after striking the note, in order to produce a more harmonious sustain.

For **Für Elise**, use the pedal only for the large LH broken chord accompaniments (bar 3 & similar), bars 83-96 and the RH arpeggio passage (bars 100-104). Practically all of the first difficult interruption should be played without the pedal. Of course, everything should initially be practiced without the pedal until you have basically finished the piece.

By not using the pedal, technique improves fastest because you can hear exactly what you play, especially the hold and lift components of the basic keystroke.

(40) Soft Pedal: Hammer Voicing

Grand pianos: The soft pedal (the left pedal) is used to change the mood (timbre, tone) of the sound from percussive to more gentle. It is not designed to produce softer sounds, a fact many pianists do not know. Thus "soft pedal" is a misnomer for grands — in order to play pianissimo, you must simply learn how to play softly. You can produce almost as loud sounds with the soft pedal depressed as without. One difficulty with the soft pedal is that it (una corda, or more correctly due corde for the modern grand) is often not indicated, so the decision to use it is left to the pianist. Another problem is that too many teachers do not teach how to use it correctly.

In grands, the soft pedal causes the entire action (including the hammers) to shift to the right so that the hammers miss one string in the three-string section when it is fully depressed. The amount of shift should be the distance between adjacent strings in the three string section so that the two struck strings will hit the grooves of adjacent strings; otherwise, the sounds will not be even. The main requirement is that the unstruck string should completely miss the hammer.

The unstruck string acts as a reservoir into which the other two strings can dump their energy; the struck strings will drive the unstruck string into vibration. Since the vibration of the unstruck string is in anti-phase with the struck strings (a driven string is always in anti-phase with the driver), it takes the edge off the initial prompt sound and at the same time, excites more horizontal vibrational modes than when all three are struck in unison. The horizontal vibrations transfer energy less efficiently to the sound board and produces a softer sound with longer sustain.

When the soft pedal is depressed, only two strings can produce the prompt sound but eventually, all three strings contribute to the after-sound because the three strings are coupled. This reduces the prompt-sound so that the sound is less percussive.

In the double and single string sections, the strings have much larger diameters, so when the action moves sideways, the strings hit the side walls of the grooves, thus giving them a horizontal kick and increasing the after-sound by increasing the horizontal string vibrations. Thus the change in timbre is similar to that in the three string section. This mechanism is fiendishly ingenious!

Pianists not educated in the use of the grand's soft pedal will often use partial soft pedals and claim that it softens the sound. That is certainly true, but the effect is unpredictable from piano to piano and from note to note on the same piano. It is impossible for the piano technician to align all hammers and strings so accurately that the unstruck string will miss the hammer at the same pedal travel for every three string note. Thus the partial soft pedal effect will be uneven and non-reproducible from note to note. This is why a partial soft pedal is not a correct pedal usage; it is not a design feature of

grands.

With experimentation, it is possible to use a half soft pedal in which the strings are shifted half way so that they hit the soft "hills" between grooves, producing *very* soft sounds. **This might be one way to play PPP.** It might be a way to play softly on a piano that needs voicing badly. **Thus, with increasing pedal travel, the sound changes from normal to very soft to slightly soft and change in timber. Every student must be taught the correct use of the soft pedal on a grand**, which is to either depress it all the way, or release it completely. What kind of sound does it produce? When do you need it? The only way to correctly play softly on a grand is to make sure that the hammer is properly voiced.

The mistaken use of partial soft pedals with grands is so common because it works for **uprights and digitals**, and most students begin their lessons on them. In most uprights, the soft pedal causes all the hammers to move closer to the strings, thus restricting hammer motion and decreasing the volume; it is a true soft pedal, and a partial soft pedal works. Unlike the grands, loud sounds cannot be produced on an upright when the soft pedal is depressed. It has only a minor effect on timbre. There are a few upscale uprights in which the soft pedal works similarly to that of the grands.

Hammer voicing: If it is necessary to close the grand lid in order to play pianissimo, the hammer almost certainly needs voicing [re-shaping, needling, etc., (78) Polishing Capstans, Hammer Voicing]. Grands are designed to be played with their lids open. Students should practice with the lid open because they will perform with the lid open, and it is the only way in which you can hear the true sound of a grand, including PP and FF. With properly voiced hammers, you should be able to control soft playing to any desired degree with a open grand. **With worn, compacted, hammers, playing PP is impossible.** Too many students had never practiced PP because it was impossible on their pianos.

A compacted hammer transfers its energy to the strings during an extremely short time interval at impact and the hammer immediately bounces off the strings. This high efficiency of energy transfer gives the feeling of a very light action. That is why there are old grands that feel feather light. Softer hammers will make the action feel heavier. This is because, with the softer impact point of the hammer, it stays on the string longer, so that the string is pushed out of its original position before all the hammer energy is transferred to the string. The energy transfer becomes less efficient and the pianist must use more force to produce the same volume of sound. **Thus voicing can change the apparent key weight more than lead weights.** The piano technician must strike a compromise between voicing the hammers sufficiently soft so as to produce a pleasant tone and enable pianissimo, but sufficiently hard so as to produce adequate sound. For all except the highest quality pianos, the hammer needs to be on the hard side in order to produce enough sound and to make the action feel nimble, which makes such pianos difficult to play PP. This in turn can "justify" use of the soft pedal when it should not be

used. The majority of practice pianos are not voiced often enough especially because uprights don't produce enough sound to begin with, and they are effectively closed pianos, unlike grands. Voicing the hammers would further reduce the sound output.

The action should also be regulated in order to enable PP (the let-off properly minimized, etc., Reblitz, Arthur,). Piano owners who know nothing about voicing can make the piano tuner's job difficult because, after the hammers are properly voiced, the owner will complain that the action is too heavy to play. In reality, the owner had become accustomed to playing a feather light action and never learned how to play with real power to generate that gorgeous piano sound. Compacted hammers, when played FF, will produce a harsh, unpleasant sound that can damage the ears [(61) Hearing Loss]. Piano owners should make sure that their tuners can voice hammers because many tuners do not routinely voice hammers.

The fact that a partial soft pedal should not be used on a grand should not be controversial but often is, because even some advanced pianists mistakenly think that (1) the soft pedal is for producing softer sounds and (2) if a full soft pedal gives a certain effect, a partial soft pedal should give a partial effect on a grand. Anecdotal accounts indicate that use of partial soft pedal on a grand is widespread. One might think that we should be able to use a partial soft pedal with reproducible results by a very slight soft pedal, in which case all the strings in the 3-string section will hit the sides of the grooves in the hammer. When the strings just miss their grooves, the sound will be softer because this area of the hammer had not been compacted by previous playing. Even this scheme will not work, because it will affect only the 3-string section, resulting in a jarring transition from three string to the two string section. Also, nobody has enough foot accuracy to control such a small pedal action.

In summary, "soft pedal" is a misnomer for the grand. Its main effect is to change the timbre of the sound. A loud sound played with the soft pedal depressed will be almost as loud as without the soft pedal, because roughly the same amount of energy was transferred to the strings. Of course, the sound will change, because its timbre has changed. Provided that the piano is regulated and the hammers are voiced, PP will be possible without the soft pedal. A partial soft pedal will produce unpredictable, uneven effects. A partial soft pedal works on most uprights and digitals, but a partial soft pedal habit cultivated while practicing on uprights and digitals can produce unexpected results when performing on a grand.

(41) Playing Cold, Warming Up, Conditioning

Playing cold means sitting down and playing without any warm-ups. It is a necessary preparation for performing because it is the fastest way to strengthen your performance ability. In the majority of informal situations in which you might play, you will not have 20 minutes to warm up. Practice playing cold every time you start practice in order to be able to play almost anything at any time, as all concert pianists can.

Playing cold can save a lot of time by using it to warm up and to maintain a repertoire. Use cold practice to find out what can be played cold and what can not, and how long it takes to warm up so that you can play more difficult material. There are numerous instances when slow practice is needed, and that can be done cold. Memorize everything you learn, and you will be able to play cold anywhere there is a piano.

For those who had never practiced playing cold, it might seem impossible at first but, with just a little practice, you will be surprised at how quickly your abilities will strengthen. The ultimate objective is to establish a permanently warmed up state in which you can play without warmups. Thus, like parallel sets and staccato practice, playing cold is both a diagnostic device for finding weaknesses and a tool for correcting them.

Warming up, Conditioning: If you hadn't played the piano for days and sit down to play, the hands are "cold" and need to **"warm up"**. "Cold" hands are incapable of executing technically difficult material but, once warmed up, they can perform miracles. Why is there such a large difference? What changes are occurring in the hands? The physiology of warming up is not adequately understood. Once it is understood, we may be able to find ways to accelerate this process, or even maintain it permanently, so that concert pianists do not need to warm up prior to performances, and students can save a lot of time.

Pianists often warm their hands to accelerate this "warming up" process. That doesn't work well because the muscles that need warming are in the arms. In cold weather, warming the hands (e.g., wearing mittens) can be counter-productive because the reaction to cold is initiated by the feeling of cold at the hands. Keeping the hands warm only makes them more sensitive to cold, eliciting a stronger "cold!" reaction when exposed to cold. **It is better to dip the hands in ice water several times a day to acclimate them to cold so that the body will** *naturally* **keep the hands warmer.** Do not leave the hands in ice water too long; just cool the skin where the cold sensors are. Eskimo hands in the arctic function as well as those of people living near the equator because their hands have been conditioned to function at low temperatures. **The most effective solution in cold weather is to warm the body so that it can send warmer blood to the hands.**

The importance of staying limber is illustrated by the enormous efforts many pianists expend to keep the fingers warmed up. Gould wore gloves most of the time (probably the wrong thing to do), and Liszt carried a dummy piano around to practice on, when no pianos were available (good idea).

Conditioning refers to the readiness to play resulting from daily practice; it is like a permanent "warmed up" state. Playing easy pieces for a long time is not as effective for conditioning as practicing difficult material for shorter times. With enough hard work, you can skip one day of practice without significant detriment, whereas if you practice only easy material, skipping one day will decrease conditioning noticeably. Thus at every practice session, end the session with a good workout using difficult material. Make sure

that you avoid fast play degradation by playing slowly, everything that was played fast, before quitting. The physiology of conditioning is not understood and research is needed in order to find simple ways to achieve it. Well conditioned, warmed hands can perform miracles compared to cold hands; too many pianists believe that exercises achieve these conditions, but music is better, and nourishes the brain. Playing cold is a necessary component of piano practice.

(42) Musicality, Touch, Tone, Color

Musicality has never been defined in so many words. Music is an combined inborn and acquired language we use to communicate with one another and even with ourselves. Bach and the great composers embedded the definition of music in their compositions because the human language and scientific knowledge were, and still are, inadequate. In addition, their own understanding of music was incomplete, and we can not even decipher every lesson that they embedded in their music. We can only reverse-engineer existing music to see what it is made of. The result of this reverse-engineering is the subject of today's music theory (Scoggin, Nancy,).

Teachers play a critical role in showing students how to play *and practice* musically. After many years of lessons, students are expected to learn technique and to **develop a sensitivity to musicality**. For example, most pieces of music begin and end with the same chord, a somewhat mysterious rule which is a result of basic chord progression rules. Combe taught that musical phrases generally start and end with softer notes, with the louder ones in between; when in doubt, this is a good default principle. This is one reason why so many compositions start with a partial bar – the first note of a bar usually carries the beat and is too loud. There are many books that discuss musical interpretation (Gieseking, Sándor), and we will encounter numerous pointers throughout this book.

Although musical talent is necessary to compose music, the ability to play musically is not that dependent on the brain. In fact, a majority of us is more musical than we give ourselves credit for and it is the lack of technique that limits our musical expression at the piano. We have all listened to famous pianists and noticed that one is better than the other -- that is more musical sensitivity than we will ever need to make music.

Music is a **partly inborn language** consisting of **rhythm, melody, and logic**. During one's life (including the time in the womb), a person can learn additional elements of musical language, so that music appreciation is partly acquired. Rhythm incorporates timing and dynamics (loud, soft). Melody operates in pitch space and is based on harmony; i.e., the most important pitch space for music is a subset of pitch space called the (76) Chromatic Scale. Logic contains everything we know and don't know about what makes music, music; it is defined by how the brain reacts to music. Logic makes music limitless, free from our limited knowledge of math, science, cosmology, etc. Thus Beethoven used "group theory" concepts [(67) Mozart's Formula, Beethoven and Group Theory] before mathematicians and physicists recognized their importance to

semiconductor technology that led to computers — **Beethoven is the grandfather of the internet!** Statements such as "music is not math" makes no sense because music includes math — there is no reason why anything should be excluded from music. Knowledge can only help the musician. Musicality is learned by playing music from many composers, and knowing the details of how and why each one was composed.

Carefully connect each bar to the next bar (or measure, or phrase). These bars/measures do not stand alone; one logically flows into the other and they all support each other. They are connected rhythmically as well as conceptually. This point may appear to be trivially obvious; however, if performed consciously, you might be surprised by the improvement in the music.

There must always be a conversation between the RH and LH. They don't talk to each other automatically even if they were timed perfectly. You must consciously create a conversation between the two hands, or voices.

"Cresc." means that most of the passage should be played softly; only the last few notes are loud, which means that it is important to start softly. Similarly, for other indications (rit., accel., dim., etc); make sure that you have reserved space for the action to take place mostly near the end. These "expression tools" create mental illusions; for example, if you ramp up a cresc. gradually, it is like walking up a slope, whereas if you wait till the last moment and increase it exponentially, it is like being thrown up in the air, which is more effective.

Strive more for accuracy than expressive rubato; rubato is often too easy, incorrect, and not in tune with the audience. Expressions are usually the tiniest deviations from strict accuracy; they are seldom big.

Many students feel uncomfortable practicing when others are around to listen; some even think that intense piano practice is necessarily unpleasant and punishing to the ear. These are symptoms of common misconceptions resulting from inefficient practice methods. With correct practice methods and musical play, there should be nothing unpleasant about piano practice sessions. It makes no sense to practice non-musicality! The best criterion that you are practicing correctly is the reaction of others -- if your practice sounds good to others, then you are doing it right. Musical practice builds mental stamina because it requires so much concentration. Laziness of the brain is in fact the major cause of the desire to separate technique from music, and practice non-musically; this is not the brain's fault — evolution has conditioned it to conserve energy. Unfortunately, it doesn't work for pianists because it only cultivates non-musical playing, and reduces brain stamina [(20) Endurance, Brain Stamina]. The need for musicality is a major reason why exercises don't work.

Touch is a basic aspect of musicality and must be developed from day one of piano lessons. Beginners always start with inappropriate touch that teachers can immediately spot and correct by demonstrating what musical touch sounds like. As students develop, it becomes a personal thing; if poor touch becomes ingrained, it becomes difficult to change

because the brain has become de-sensitized to it. Students should listen to others playing (especially teachers and other students, not only concert pianists); they will hear a surprising range of touch and can compare them to their own. It is important to hear the bad and the good. The idea is not to imitate someone else's "beautiful" touch, but to eliminate undesirable aspects of their own. Imitation is impossible because touch is influenced by everything from how the music is visualized in the brain to every aspect of a person's technique and musical history. Touch should be practiced at all speeds all the time, unlike color which is easiest to bring out near the final speeds.

Tone is like touch, but is partly dependent on the piano, such as the distribution of harmonics and other sounds produced by the piano. Typical descriptions of tone are light, smooth, clear, heavy, deep. Light and clear can be practiced using staccato practice. Smooth, heavy, and deep might be achieved with heavier use of the damper pedal and practicing legato play. **Playing deep* can be achieved by acceleration** through the keydrop, making use of the hammer shank flex (Askenfelt, Anders, Ed.,). This is particularly easy for the grand because the acceleration is needed only until the jack releases the hammer, not all the way to the bottom of the keydrop. This property of grands is one reason why students need to practice on grands when they advance beyond intermediate level, because it requires a different technique.

Pianos make a lot of extraneous sounds. To hear them, play fast, FF music on a digital with the sound turned off. Most acoustic pianos create even more extraneous sounds than digitals, but they are not audible because you are accustomed to them, and the string sound can not be turned off. To hear some of the extraneous sounds of acoustics, play fast, FF music for 20 minutes using ear plugs or head phones so that most of the high frequency noises are filtered out and you become accustomed to this new sound. Now, remove the ear plugs and play the same music — you will be surprised by the amount of non-music noise you will hear! These noises are an integral part of the piano sound and can add to its richness for quality pianos.

The condition of the hammers and the elasticity of the strings affect the tone. Compacted hammers and old strings that have lost their elasticity produce more higher harmonics and the "honky-tonk" type of sound.

Color is a unique musical quality of a particular piece of music, a composer, a scale, etc., created by the sum total effect of all the elements in the music. It becomes increasingly important as the pianist advances to higher levels. It is frequently discussed, but specific colors have seldom been described in words (except for simple descriptions such as happy, sad, energetic, etc.) because the human languages are inadequate. A few aspects of color have been identified, such as key color (Bach), Chopin's special staccato and legato, or elements of Debussy associated with nature and water. Mozart has his own unique color like no other; it is conceptually deep, yet is based on the simplest constructs. Thus, although it may be exciting to play Mozart like a Beethoven, it is not true Mozart that reflects the instruments of his time and the simpler musical expectations before

Beethoven exploded on the scene. Color depends mostly on the composer, so try to recognize color in performances by concert pianists and to bring them out in your playing. Practicing too loud produces a harsh touch and erases most color; of course, color does not automatically disappear in passages played FF. Thus it is important for students to develop the ability to recognize color.

***An accelerating keydrop** creates maximum hammer shank flex, which maximizes the effective mass of the hammer. The effectively heavier hammer creates more low fundamental frequencies, a characteristic of deep tones.

(43) Problems with Hanon Exercises

Since about 1900, Charles Louis Hanon's (1820-1900) exercises have been taught by a majority piano teachers. The popularity of exercises grew rapidly in the vacuum created by a lack of documented efficient practice methods until it culminated in the exercise craze of the 1930s with the publication of Cortot's "Rational Principles of Pianoforte Technique" that contained no principles but was just a compilation of exercises. The title illustrates the lack of understanding of how technique is acquired. Few teachers understood this until recently when knowledge about efficient practice methods became more available because of improving communications. Even today, there are pianists who claim that Hanon is helpful, from force of habit because they grew up with it.

I used Hanon exercises extensively in my youth which is why I know about their shortcomings. Czerny, Cramer-Bulow, etc., type lesson pieces, that I also used, share many of these disadvantages. Hanon is a prime example of how Cortot's "rational principles" [intuitive methods! (1) Practice Routines, the Intuitive Method] can mislead *generations* of pianists into using methods that are inferior to known efficient practice methods. Here are some reasons why the days of repeating Hanon for a lifetime are over:

(1) Hanon makes a surprising claim in his introduction with no rationale, explanation, or experimental evidence: "The Virtuoso Pianist, in 60 Exercises". Advanced teachers today know that such a claim is amateurish; yet Hanon has survived through generations of pianists because better alternatives were seldom taught from a lack of communication among piano teachers. Hanon implies that the ability to play these exercises will enable anyone to play anything -- which shows a lack of understanding of how technique is acquired. All advanced pianists today agree that Hanon is not for acquiring technique, but might be useful for "warming up". There are many better pieces for warming up than Hanon, such as etudes, numerous Bach compositions, scales, and arpeggios and, most importantly, your own repertoire. The skills needed to play any significant piece of music are incredibly diverse - almost infinite in number; certainly not 60 exercises.

(2) All 60 are mainly exercises in two hands playing the same notes an octave apart, plus a few in opposite directions. This HT motion is a major limitation for acquiring technique because the better hand cannot practice skills more advanced than the weaker hand. At slow speed, neither hand gets much workout. At maximum speed, the slow hand is stressed while the better hand is playing relaxed. Because technique is acquired mostly when playing relaxed, the weaker hand develops bad habits and the stronger hand gets stronger. The best way to strengthen the weaker hand is to practice that hand only. In fact, the best way to learn Hanon is to separate the hands as recommended in this book, but he is unaware of HS practice. Locking the two hands only teaches how to coordinate the hands, but does nothing to teach independent control of each hand. In practically all music, the two hands play different parts.

(3) There is no provision for resting a fatigued hand. This leads to stress and injury. A diligent student who fights the pain and fatigue in an effort to carry out Hanon's instructions will build up stress, acquire bad habits, and risk injury. The concept of relaxation is never even mentioned. Piano is an art for producing beauty; it is not a macho demonstration of how much punishment your hands, ears, and brain can take. Dedicated students often use Hanon as intense exercises in the belief that piano is like weight lifting and that "no pain, no gain" applies to piano. Such exercises might be performed up to the limit of human endurance, even until some pain is felt. "Strengthening the fingers for technique" is a terrible misconception; technique is a set of skills, not "finger strength" which will actually slow the fingers [(23) Post Practice Improvement, Sleep, Fast/Slow Muscles].

(4) The Hanon exercises can destroy the student's musicality. It does not require a musical genius to compile a Hanon type of exercises. The joy of piano comes from the one-on-one conversations with the greatest geniuses that ever lived. For too many years, Hanon has taught the wrong message that technique and music can be learned separately. Bach's music benefits both the hands and the mind. Hanon excerpted most his material from Bach's Toccata and Fugue and other compositions — if it is from Bach, how can you go wrong? Hanon showed us how, by deleting the music! He also deleted almost all of Bach's technical lessons, because Hanon was not aware of them.

(5) Many pianists use Hanon as warm-up exercises. This conditions the hands so that it becomes impossible to play "cold", something any accomplished pianist should be able to do, within reasonable limits. Since the hands are cold for at most 10 to 20 minutes, "warming up" robs the student of this precious, tiny, window of opportunity for practicing cold [(41) Playing Cold, Warming Up, Conditioning]. Those who use Hanon for warm-ups can be misled into thinking that it is Hanon that is making their fingers fly, while in reality, any good practice session will do that. The Hanon teachings have led to the belief that only Mozart can just sit down and play, and that the rest of us can't perform such "magical feats". In order to be able to "play on demand", quit Hanon and practice playing cold - what Mozart did was common sense, not magic.

(6) If students used their "Hanon time" to practice real music, they would acquire a lot more technique. Who wouldn't rather play Mozart, Bach, Chopin, etc., than Hanon, acquire technique, and build a repertoire they can perform?

(7) Hanon gives no instructions on how to acquire technique. He cannot help if you get stuck at a difficult passage; he does not provide any diagnostics for why you can't play a given passage. The PSs provide both diagnostics and solutions for many situations. What little advice he does dispense, have all been shown to be wrong! So let's look into them:

(i) He recommends "lifting the fingers high", which will create stress and slow down the fingers. I have never seen a famous pianist lift the fingers high. Hanon's advice has misled students into thinking that piano should be played by lifting the finger and plonking it down. Ouch!

(ii) He recommends continuous practicing of both hands, as if piano technique is some kind of calisthenics. He is totally unaware of the benefits of HS practice.

(iii) He recommends playing his exercises every day, but once any skill is acquired, it doesn't need to be reacquired over and over. Once all 60 pieces are learned and up to speed, every hour that Hanon is repeated is a wasted hour -- what will we gain?

(iv) He is apparently aware of only the thumb under method, whereas the thumb over method is more important.

(v) In most exercises, he recommends fixed wrists which is only partially correct. His didn't understand what "quiet hands" means.

(vi) He does not teach a majority of the important hand motions, although there are a few wrist exercises for repetitions. His format of locked 2-hand practice limits the options for practicing different hand motions; it is impossible to experiment using Hanon.

(8) The Hanon exercises do not allow for practicing at the kinds of speeds possible with the PS exercises. Without the use of such speeds, certain fast speeds cannot be practiced and there is no possibility of practicing "over-technique", more technique than necessary to play that passage - a safety margin for performances.

(9) Hanon wastes time. The student ends up with insufficient time to develop a repertoire. A person who has 2 hrs to practice every day, playing Hanon for 1 hr as recommended, would waste half of his piano lifetime! Teachers, who don't know how to teach, assign Hanon in the hopes that the student will accidentally discover technique by repeating Hanon exercises. That technique could have been taught in a few days while it may take years to be discovered accidentally using Hanon, if ever. It took Liszt two years to discover TO; today, we can teach it in a week or less. The Hanon student becomes the next generation of teachers who assign Hanon exercises, etc., which explains why Hanon has persisted for this long, and why the acquisition of technique was such a mystery.

Thanks to improved documentation and communications, the Age of Exercises is finally over and piano pedagogy can advance freely, instead of getting stuck with

incorrect beliefs that slowed progress for over 100 years.

EXAMPLES OF APPLICATIONS

Listed in order of difficulty; the three Beethovens are about equally difficult.

(44) Für Elise

Learning Für Elise is treated in:
(3) Starting a Piece;
(5) Reading, Fingering;
(7) Difficult Sections First, Segmental Practice, Continuity Rule;
(9) Parallel Sets (PSs), Conjunctions, Cycling;
(14) Memorizing, Close Your Eyes and Play;
(39) Damper (Sustain) Pedal, Physics of the piano sound.

(45) Practice Routines: Bach Inventions, Sinfonia

Piano practice routines should be either memorizing or technical sessions, don't mix them because playing other things during memory sessions will confuse the material being memorized. The first process when starting a new piece is to memorize; so let's learn three of Bach's 2-part Inventions: #1, #8, and #13. I will go through #8 in detail. After learning #8, try #1 by yourself and then start on #13. We learn all three simultaneously here, but if that proves too taxing, try two (#8 and #1), or even just #8. It is important to try only what you can handle easily, because the objective here is to demonstrate how easy it is. As Combe said, how young or old you are, or how many years you have taken piano lessons, is not that important. You can start learning these Inventions practically anytime you want, and use them to practice the methods of this book, as with the Für Elise. Nothing terrible will happen to students with lower skill levels; they will progress more slowly, but will learn a lot in the process. **Below is a step by step example of how to start learning a piece**; however, true technique is developed after the learning is over, when you can play it to your heart's desire, and can concentrate on the music.

Invention #8, day one, **memorizing.** The time signature is 3/4 so there is one beat per quarter note and each bar (measure) has 3 beats. The key signature shows one flat, which places the key one step counter-clockwise from C major on the circle of fifths -- or F major (not D minor because the music does not use C# and starts and ends with notes of the F major chord). In bar one, the first beat note of the RH is missing ("start with softer note" rule). Play with a slight accent on notes 2 and 4 (beat notes), and the heaviest accent on the first note of bar two — these are clever uses by Bach of basic rhythm rules dictated by the time signature. The pedal is not used in any of the Bach Inventions.

Start by memorizing in **small segments**, bars 2 to 4 of the LH, including the first four notes of bar 5 (**continuity rule**). It should take about a minute to memorize; then try

playing it at speed. Then close your eyes, and play this LH section in your head (**Mental Play**, MP, don't play on the piano), mentally visualizing every key or note (keyboard or photographic memory), and fingering. Then do the same for the RH, bars 1 to 4, including the first 4 notes of bar 5. Now return to the LH and see if you can play it without the score, and similarly with the RH. You should never have to refer to this part of the score again, unless you have a blackout, which will happen once in a while. Go back and forth between the LH and RH until you are comfortable, with and without the piano (MP). This will take a few more minutes. The whole procedure takes about 5 minutes; less for a fast learner. You will find fingering suggestions on most sheet music; for example, W. A. Palmer's "J. S. Bach, Inventions and Sinfonias" by Alfred.

Now memorize bars 5 to 7, including the first beat of bar 8. This should take another 5 minutes. These are HS practices but you are free to try HT at any time; however, do not waste time practicing HT if you do not make easy progress because we have a schedule to follow! When starting bars 5 to 7, don't worry about forgetting the previously memorized bars -- put them out of your mind. This will reduce mental tension and confusion (by not mixing different memorized sections), and make you partially forget the previously memorized section, forcing you to re-memorize later for better retention. Memorizing is partly the job of the subconscious brain, so let it do its job while the conscious brain moves on to the next. Once you are comfortable with bars 5-7, connect bars 1-7, including the first beat of bar 8. It may take 3 minutes to do both hands, separately, including MP practice.

Next memorize bars 8-11, and add them to the previous sections. Let's assign 7 minutes to this part, for a total of 20 minutes to memorize bars 1-11 and to bring them up to speed, HS, both hands. If you have technical difficulties with some parts, don't worry, we will work on that later; just memorize it.

Next, abandon bars 1-11, don't even try to remember them -- it is important to remove all sense of anxiety from the conscious brain and let it concentrate on the immediate task, and work on bars 12-23. Use the following segments (the conjunctions should be obvious): 12-15, 16-19, and 19-23. Bar 19 is practiced twice in order to give extra work for the difficult 4th finger in the LH. Work only on bars 12- 23 until you can play them in succession, HS, both hands, which should take 20 minutes.

Then finish off bars 24 to end (34). Use the following segments: 24-25, 26-29, and 30-34. This may require 20 minutes, for a total of 1hr to memorize the whole Invention HS. You can now either quit and continue tomorrow, or review the three sections. Don't worry about whether you will remember everything tomorrow (you probably won't), but have fun, maybe even try to connect the three sections or to play the beginning parts HT to see how far you can go. Work on parts that give you problems when you try to speed them up, breaking them into as small segments as possible. You can also start on the second piece, Invention #1. Between days 1 and 2, practice MP away from the piano whenever you have time (but not when driving a car).

Day two: review each of the three sections, Invention #8, then connect them. The only requirement on the 2nd day is to play the whole piece HS from beginning to end, both on the piano and in MP, completely memorized. Work on bringing up the speed, using **parallel sets**, and go as fast as you can without making mistakes. Practice **relaxation**. If you start to make mistakes, slow down and cycle the speed up and down in short segments. It may be easier to memorize playing fast, and you might get memory lapses playing slowly, so practice at different speeds. Beginners have most difficulties at chord changes, which often take place at the beginning of a bar. Chord changes create difficulties because the change requires a new set of fingerings and notes.

Start **staccato practice** so that you convert parallel playing to playing with finger independence. This should also help with increasing speed and relaxation. Staccato practice does not mean non-musical play, so pay attention to musicality. **Practice softly**, even where "f" is indicated.

At about this time, you should feel **quiet hands**. If you cannot get close to the final speeds, you will need to be satisfied without quiet hands. Return to HS work for increasing speed later. Otherwise, make sure that you have quiet hands and can play faster than final speed HS, before starting HT. Watch your fingers and suppress any involuntary, unnecessary finger movements so that you have both quiet hands and **quiet fingers**. Quiet hands is one of the most important lessons embedded in the Inventions because you will need it when playing HT.

If completely comfortable HS on the 2nd day, you might start HT, using the same small segments used to learn HS. The first note of bar 3 is a collision of the two hands, so use only the LH for this note, and similarly in bar 18. Accentuate the beat notes to synchronize the two hands.

Pay attention to the rhythm and dynamics from the very beginning, checking with the sheet music. Then slow down and work on accuracy. To prevent the slow play from speeding up, concentrate on each individual note. Repeat this fast-slow speed cycle and you should improve noticeably with each cycle. Wherever you have technical difficulties, use the parallel set exercises to increase speed quickly, followed by staccato practice. Practice time: less than an hour.

Day three, technique session: learn HT in the three major sections as you did with HS. As soon as you notice confusion with HT, go back to HS to clear things up. Increase the speed HS. Those with insufficient technical skill will have to play slower, because relaxation is more important than speed.

From here on, you will have to depend on post practice improvement to experience any major improvement. However, in 3 hours over 3 days, you have memorized the piece, can play HT, and can MP the entire piece HS.

Start memorizing **Invention #1**, while you polish up #8. Memorize #1 completely, then practice the two pieces alternately without the sheet music. Work on #1 until you start to forget #8, then go back and refresh #8 and work on it until you start to forget #1,

working in segments. Remember that you *want* to forget a little so that you can relearn, which is what is needed to establish long term memory. This also removes the anxiety over whether you will successfully memorize or not because the brain functions best when it is relaxed and worry-free. There are psychological advantages to using these "win-win" methods: if you forget, that is exactly what you were looking for; if you can't forget, that's even better! You might find that forgetting is harder than you thought. The amount you can memorize at one time increases as you gain experience and add more memorizing tricks. Because memory is associative, the more you memorize, the more you can memorize because the number of associations increase. Memorizing is also a positive feedback process in which the faster you memorize, the faster you can play, and the faster you play, the easier it is to memorize because at faster speeds you memorize at higher levels of abstraction.

Day four: There is not much you can do to rush the first piece technically after two or three days. For several days, practice #8 by playing HS, then HT, at different speeds according to your whim of the moment. All technical work is done HS; HT is only for coordinating the two hands and making music. As soon as you feel ready, practice HT, but return to HS if you start making mistakes, have memory lapses HT, or have problems getting up to speed. **Practice HT in segments, jumping from segment to segment at random.** Start with the last small segment and work backwards to the beginning.

Isolate the trouble spots and practice them separately. Most people have a weaker LH, so bringing the LH up to faster than final speed may present problems. For example, the last four notes of the LH in bar 3 (Inv. #8), 4234(5), where (5) is the conjunction, may be difficult to play fast. In that case, break it up into three parallel sets (PSs): 42, 23, and 345. Then connect them: 423 and 2345. 423 is not a PS (4 and 3 play the same note), so you cannot play this as fast as PSs. First practice the PSs as chords and then practice relaxation, playing in rapid quads. Then convert the chords to PSs, then join them and practice them staccato to develop finger independence. You should feel a distinct improvement the next day, and a lot of improvement after a week.

When you can play it HT, start playing HT in your mind (MP). This should take a day or two. Those who have difficulty with HT MP should use only HS at first, and make HT MP a long term objective. MP HT only what you can do comfortably; your MP ability will slowly grow with time; it may take months or even years for older pianists.

By **day 5 or 6**, you should be able to start piece #13 and begin practicing all three pieces every day. An alternate approach is to learn only piece #8 well first, then after you have gone through the entire procedure and have become familiar with it, start #1 and #13. The main reason for learning several pieces at once is that these pieces are short and you will be playing too many repetitions in one day if you only practiced one. Over-practicing will not gain you much technique and can lead to bad habits and loss of musicality. Remember, from day one, you will be playing at speed (HS, in segments), and from day two, you should be playing at least some sections faster than final speed — this

leads to a lot of repetitions in a short period of time.

Beyond day two or three, how fast you progress will depend more on skill level than memory ability. Bach designed these Inventions for learning to coordinate the two hands as well as hand independence. In #8, one hand plays staccato while the other plays legato which requires independence of the two hands. Be sure to practice **forearm rotation** with bars 15, 21-3 in RH and 19-20, 24-5 in LH; all other bars should be played quiet hands. All three pieces discussed here should be completely memorized in one to two weeks and should begin to feel comfortable, at least with the first piece.

Let's say that for over a week, all you did was to memorize new pieces. Now if you go back to old pieces that were memorized previously, you should find that you don't remember them as well any more. This is normal and is a good time to re-polish those old pieces. You are done; congratulations!

Most people have a **weaker LH**; bring the LH technique up as close to the RH level as possible. Bach is particularly useful for balancing the hands because both hands play similar passages. You know immediately that the LH is weaker if it cannot keep up with the RH. For other composers, such as Chopin, the LH is usually easier and does not provide a good LH test.

Bach's music has a notorious reputation of being difficult to memorize and play fast, and is highly susceptible to fast play degradation. If this is the first time you used the methods of this book, you will be memorizing and playing at speeds you never dreamed possible; however, be mindful of fast play degradation and always **play slowly before quitting**.

The Bach Inventions provide more challenges for the LH because the bass hammers and strings are heavier. The amount of technical material he crammed into these compositions is incredible: finger independence (quiet hands, control, speed), RH-LH coordination as well as independence of the two hands (multiple voices, staccato vs. legato, colliding hands, ornaments), harmony, making music, strengthening the LH as well as the weaker fingers (finger 4), all major parallel sets, uses of the thumb, standard fingerings, etc. The ornaments are parallel set exercises; they are not only musical ornaments but are also an integral part of technical development. Using the ornaments, Bach asks you to practice parallel sets with one hand while simultaneously playing another part with the other hand, and creating music with this combination!

Be careful not to play Bach too loud, even where F is indicated. Instruments of his time produced much less sound than modern pianos so that Bach had to write music that is filled with sound, with few breaks. One of the purposes of the numerous ornaments and trills in Bach's time was to fill in the sound. Thus his music tends to have too much sound if played loudly on modern pianos. Especially with Inventions and Sinfonias, in which the student is trying to bring out all the competing voices, there is a tendency to play each succeeding voice louder, ending up in loud music. The different voices must compete on the basis of musical content, not loudness. Playing more softly will also help to achieve

total relaxation and true finger independence and control. One way to avoid playing too loud is to subordinate one hand (play it softer), and alternate this between the two hands in different sections. Generally, the lagging hand should be subordinated; #8 starts with the LH as subordinate because it lags the RH. Pay attention to the conversations between the two hands, and the harmonies they produce.

To learn a **Sinfonia** (3-part Inventions), try #15 which is easier than most of the others, if slowed down. It is very interesting, and has a section in the middle where the two hands collide and play many of the same notes. As with all Bach compositions, this Sinfonia contains a lot more than first meets the eye, so it can be a lot of fun to play. However, it is allegro vivace! Quite difficult to play at speed, requiring high level technique. The time signature is a strange 9/16, which means that the groups of six 1/32 notes in bar 3 must be played as three beats, not two (three pairs of notes instead of two triplets). This time signature results in the three repeat notes (there are two in bar 3) that have thematic value and they march across the keyboard in characteristic Bach fashion. When the two hands collide in bar 28, raise the RH and slide the LH under it, both hands playing all the notes. If the thumb collision is problematic, eliminate the RH thumb (upper hand) and play only the LH thumb. In bar 36, be sure to use the correct RH fingering: (5),(2.3),(1.4),(3.5),(1.4),(2.3).

Finally, let's discuss the last necessary step in memorizing -- analyzing the structure, or the "story", behind the music. The memorizing process will be incomplete until you understand this story. For Invention #8, the first 11 bars comprise the "exposition". Here, the RH and LH play basically the same thing, with the LH delayed by one bar, and the main theme is introduced. The RH is dominant, teaching the LH what to do. The "body" consists of bars 12 to 28, where the roles of the two hands are initially reversed, with the LH leading the RH, followed by some intriguing developments in which the two hands compete for supremacy. The ending starts at bar 29 and brings the piece to an orderly finish. The ending is the same as the end of the exposition -- the piece effectively ends twice, which makes the ending more convincing. Beethoven developed this device of ending a piece twice and raised it to incredible heights.

(46) Bach Used Parallel Sets to Compose His Inventions

There is an essay on Bach's Inventions and their history, etc., by Dr. Yo Tomita. Each Invention uses a different key that was important in the Well Temperaments favored during Bach's time and therefore exhibits key color; unfortunately, key color disappears when the piano is tuned to today's Equal Temperament. The Inventions were initially written for his oldest son Wilhelm Friedemann Bach when he was nine years old, around 1720. They were subsequently updated and taught to other students. Today, students should be able to start learning the Inventions before age seven because we have figured out how to practice them.

Here, we analyze Bach's 2-part Inventions from structural points of view in order to

explore how and why he composed them. Bach used advanced musical concepts in harmony, counterpoint, etc., that music theoreticians are still debating to this day, while Hanon, Czerny, etc., wrote "lesson music" just for their finger training value. Below, we examine the Inventions at the simplest structural level, which leads to an astounding

Discovery: each Invention is based on a small number of parallel sets (PSs)! Now, you might say, "Any composition can be decomposed into PSs, so what's new?" The new element is that each Invention is based only on one or two chosen PSs, starting with the simplest and introduced in order of increasing complexity with increasing Invention number. *Before* I made this discovery, I had catalogued the PSs according to complexity [(10) Parallel Sets Catalogue], and Bach basically used the same sequence of complexity! To demonstrate this, we list these PSs below for each Invention. In order to concentrate on simple PSs, Bach avoids the use of thirds and more complex intervals (in one hand); thus he wanted his students to master simple PSs before the more complex ones.

I use the term "linear" to denote PSs in which the fingers play sequentially (e.g., 12345), and "alternating" when alternate fingers play (132435). PSs are joined to form "motifs" in these Inventions. Because the motifs were created using specific PSs they were not chosen because of their musical content, but were chosen for their pedagogical value and the music was then added by the genius of Bach. Thus only Bach could have achieved such a feat; which explains why Hanon failed. Another reason why Hanon failed was that he did not know efficient practice methods while Bach did.

Only one representative member of each PS is listed below for each Invention; Bach used them in many variations, such as reversed, inverted, etc., a composition tool called symmetry operations [(67) Mozart's Formula, Beethoven and Group Theory].

List of the PSs in each Invention (listed for the RH; LH is similar):

#1: 1234 and 4231 (linear followed by alternating); this was a mistake because the first Invention should deal only with the simplest (linear) sets. Accordingly, in a later modification of this Invention, Bach replaced the 4231 with two linear sets, 432,321. This modification provides the strongest evidence for my thesis that Bach used PSs as the structural units in the Inventions. This modification teaches how to cope with different rhythms without introducing new PSs. We now have an explanation of why there are two Invention #1s!

#2: Linear sets as in #1, but with a wider variety of conjunctions. An added complexity is that the same motif, appearing at different times, requires different fingerings.

#3: 324 and 321 (alternating followed by linear). A short alternating set is introduced.

#4: 12345 and 54321 with an unusual conjunction. These longer linear sets and the unusual conjunctions increase the difficulty.

#5: 4534231; full blown alternating sets.

#6: 545, 434, 323, etc., the simplest example of the most basic 2-note PSs joined by one conjunction; these are difficult when the weak fingers are involved. Although they are simple, they are an extremely important basic technical element, and alternating them between the two hands is a great way to learn how to control them (using one hand to teach the other). Arpegic PSs (531) are introduced.

#7: 543231; this is a combination of #3 and #4 and is therefore more complex than either one.

#8: 14321 and the first introduction of "Alberti" type combination 2434. Here, the progression in difficulty is created by the fact that the initial 14 is only one or two semitones which makes it difficult for combinations involving the weaker fingers. It is amazing how Bach not only knew all the weak finger combinations, but was able to weave them into real music. Moreover, he created situations in which we had to use the difficult fingerings he wanted us to practice.

#9: The lessons here are similar to those in #2 (linear sets), but are more difficult. The PSs are strung together into longer motifs and played with more difficult ornaments.

#10: This piece consists almost entirely of arpegic sets. Because arpegic sets involve larger distances between notes, they represent another progression in difficulty, especially for youngsters. Bach was obviously aware that arps are harder than scales.

#11: Similar to #2 and #9; difficulty is increased by making the motifs longer than for the preceding pieces. In all the preceding pieces, there is only a short motif followed by a counterpoint section which makes it easier to concentrate on the PSs.

#12: This one combines linear and arpegic sets, and is played faster than previous pieces.

#13: Arpegic sets, played faster than #10.

#14: 12321, 43234; a more difficult version of #3 (5 notes instead of 3, and faster).

#15: 3431, 4541, difficult combinations involving finger 4. These finger combinations become especially difficult to play when many of them are strung together.

The above list shows that:

(i) There is a systematic introduction of increasingly complex PSs.

(ii) There is a progressive increase in difficulty, with emphasis on developing the weaker fingers.

(iii) The "motifs" are carefully chosen PSs and conjunctions, selected for their technical value.

The fact that motifs, chosen for their technical usefulness, can be used to create some of the greatest music ever composed is intriguing. This is nothing new to composers: that famous melody in Beethoven's 9^{th} symphony is just a play on the simplest structure, the major scale. To the average music aficionado who has fallen in love with Bach's music, these motifs take on special significance with seemingly deep

musical value because of the familiarity created by repeated listening. It is not the motifs themselves, but how they are used in the composition that produces the magic. If you look only at the motifs, there is hardly any difference between Hanon and Bach, yet no one would consider the Hanon exercises as music. The music consists of the motifs and the counterpoint section, so named because it acts as the counterpoint to what is being played by the other hand. The counterpoint serves many purposes, such as creating music and teaching a myriad of technical lessons.

Thus music is created by some "logical" sequence of notes that is recognized by the brain; we shall explore this idea more fully in the [(68) Theory, Solfege] section.

Bach's lessons: Bach was not a trained analyst, teacher, or writer, in the sense that he left no instruction manuals on how to teach. His most proficient language was music. Therefore the best he could do was to embed his lessons into his compositions: the human language was woefully inadequate (how would one describe key color??). The structures of his Inventions suggest that he was aware of most of the major principles of this book (PSs, segmental and HS practice, quiet hands, HS memorizing, etc.) because, without them, the Inventions can be devilishly difficult to memorize and to play. Of course, you can say that about practically any piece of music, but in Bach's case, it is *extreme*. Thus it is important to "read" those embedded lessons: they indicate that he may have been the greatest piano teacher that ever lived. He also tried to exhaustively cover all scales, key colors, etc., and may even have left us instructions on how to tune the chromatic scale (Larips.com, , Bach's temperament).

(47) Mozart's Rondo, in Sonata No. 11 in A major, K331 (300i)

The term **sonata** has been applied to many types of music and does not have a unique definition because its definition evolved with time. In the earliest times, it meant music or song. Until Mozart's time, "sonata" meant instrumental music with one to four parts: Sonata, Minuet, Trio, and Rondo. A sonatina is a small sonata. There is also a sonata allegro, initially developed as the first part of a sonata, symphony, concerto, etc.; it generally contained an exposition, a development, and a recapitulation. The sonata allegro is important historically because this basic structure was gradually incorporated into most compositions. Curiously, no part of this sonata (K331) is in sonata allegro format (Hinson, P. 552); instead, the Sonata part is replaced by a theme and 6 variations. Variation V is Adagio and should not be rushed. Then comes a break in the form of a minuet-trio, a form of dance. The minuet originated as a French court dance with 3 beats and was the predecessor of the waltz. The waltz format also includes mazurkas that originated as Polish dances, which is why Chopin composed so many mazurkas. The (Viennese) waltzes have the accent on the first beat; the Mazurkas have the accent on the second or third beat. Waltzes started independently in Germany as a slower dance with three strong beats; it then evolved into the popular dances that we now refer to as "Viennese". "Trio" refers to music played with three instruments; therefore, you will hear

three voices in this trio, a violin, viola, and cello. Trios gradually went extinct as quartets gained popularity. Both the minuet and trio in this sonata have the time signature 3/4. Thus every first beat carries the accent; knowing that it is in a dance (waltz) format makes it easier to play the minuet-trio correctly. The trio should have a totally different air from the minuet (a convention in Mozart's time); this change in air gives the transition a refreshing feel. Don't forget the "Menuetto D. C." (Da Capo, which means return to the beginning) at the end of the Trio; thus you play minuet-trio-minuet. The final section is the Rondo, which has the general structure ABACADA. . . , that makes good use of a catchy melody, A. This entire sonata is sometimes referred to as a variation on a single theme, which is probably wrong, although the Rondo resembles Variation III, and the Trio resembles Variation IV.

We now discuss how to practice the **Rondo**. It has the structure (BB')A(CC')A(BB')A'-Coda. The time signature is a lively cut time; can you figure out the key of BB'? The rest of this Rondo is in A, as is the formal key of this sonata. This Rondo starts with the "B" structure, constructed from a short motif of only 5 notes, repeated twice with a rest between them in bars 1-3; it is repeated without the rest in bar 4. He uses the same motif as a conjunction between these repetitions at the end of bar 3. It is then repeated at half speed in bars 7 and 8 and the last 2 bars provide the ending. Bar 9 is the same as bar 8 except that the last note is lowered instead of raised; this abrupt change in the repeating pattern is one way to signal an ending. The half speed units are disguised by adding two grace notes in the beginning, so that, when the entire B is played at speed, we only hear the melody without realizing that the whole section is created using only one 5-note motif! He repeated the same motif 8 times in 8 bars to compose one of his famous melodies. He multiplied a one second motif by 16 times, and because the BB' uses B twice, the total multiplication factor is 32 times! The entire sonata consists of these repeated sections that are 8 to 10 bars long. There are several sections that are 16 or 32 bars long, but these are multiples of the basic 8 bar sections. This explains how he composed such a long sonata using a minimum of basic materials — he took advantage of the most basic property of music - repetitions. More details are presented in the section on structural micro-analysis of repetitions in (67) Mozart's Formula, Beethoven and Group Theory. This type of analysis is helpful for memorization and mental play – after all, mental play is how he composed them!

The technically challenging parts are (1) the fast RH trill of bar 25, (2) the fast RH runs of bar 36-60, (3) the fast broken RH octaves of bars 97-104, and (4) the fast LH Alberti bass of bars 119-125. Examine them and start practicing the most difficult one first. The broken chords in the LH (bar 28, etc., and in the Coda) should be played very fast, like grace notes. Match the first note of the LH broken chords with the RH octaves.

(1) For fast trills, go to (35) Trills and Tremolos. Don't try to learn bar 25, HT by slowing it down. Make sure that the HS work is completely done using bars 25 and 26 as a practice segment, then combine the 2 hands at speed. Always learn to combine things

HT at speed (or close to it) first, and use slower speeds only as a last resort because if you succeed, you will save *lots and lots* of time and avoid forming bad habits. Advanced pianists never have to combine hands by slowing down. In fact, slowing down HT accurately is more difficult than combining the hands at final speed; it makes no sense for beginners to use the more difficult method.

(2) Use PSs to get up to speed quickly for bars 36-60, being extra careful to get the fingering right. To prevent missing notes, use staccato practice.

(3) The broken octave sequence of bars 97-104 is not just a series of broken octaves, but two melodies, an octave and a half-step apart, chasing each other.

(4) Use PSs for the fast Alberti [(9) Parallel Sets (PSs), Conjunctions, Cycling] of bars 119-125.

How do you make music that sounds like Mozart? Simply follow the expression markings on the music. For Mozart, each marking has a precise meaning, and if you follow every one of them, including the time signature, etc., the music becomes an intimate, intricate conversation.

Let's examine the first 8 bars in detail.

RH: The first four notes (bar 1) are played legato followed by an eighth note played light staccato. The staccato creates an anticipation that something is coming and the rest heightens the anticipation. This construct is repeated; then the 4-note motif is repeated at double speed (2 motifs per bar) in bar 4, and climaxes at the C6, bar 5, played legato *firmly*. The two following staccato notes form the conjunction to the ending bars 5-8, played staccato, sustaining the level of excitement. The series of falling notes in bars 8-9 brings this section to a close, like a vehicle slowing down to a stop. It is Allegretto, and therefore should not be played too fast. Meanwhile:

LH: The LH accompaniment provides a rigid skeleton; without it, the whole 9 bars would flop around aimlessly. The clever placement of the ties (between the 1st and 2nd notes of bar 2, etc.) not only emphasizes the cut time nature of each bar, but brings out the rhythmic idea within this exposition; it is like a fox trot dance – slow, slow, quick-quick-slow in bars 2-5, repeated in bars 6-9. Because every note must be staccato in bars 6-8, the only way to bring out the rhythm is to accent the first note of each bar. After all the preceding staccatos, both notes of bar 9 (both hands) are legato and slightly softer in order to provide an ending, and both hands lift at the same instant.

The strategic placing of legato, staccato, ties, accents, etc., is the key to playing Mozart, while accurately maintaining the rhythm. A typical example is the last 3 chords at the end — it is an unbelievably simple device (a hallmark of Mozart): the first chord is a staccato and the remaining two are legato. Play it any other way, and the ending becomes a flop. Therefore, these last 3 chords should not be pedaled although some scores (Schirmer) have pedal markings on them — no wonder students have trouble bringing out the Mozart in the music. Better pianists tend to play this Rondo without pedal. Hopefully, you should now be able to continue the analysis for the rest of this Rondo and

produce music that is uniquely Mozart.

After you are comfortable HT without the pedal, add the pedal, which is optional. In the section starting at bar 27, the combination of broken LH chords, RH octaves, and pedal (as indicated in most editions) creates a sense of grandeur that is representative of how Mozart created grandeur from the simplest constructs. The pedal is in principle inappropriate here because most octaves must be played staccato with strategic legato octaves needed for the expression. Think of the oxymoron of a staccato octave that is pedaled! Mozart correctly indicated the staccato but wrote no pedal markings (pedals weren't invented yet). Less pedal is always looked upon by the pianist community as indicating superior technique; if you have the technique, the music can come out better without it because you have more control.

The rest of this sonata (preceding the Rondo) is beautiful Mozart and a lot of fun to play. Because it is so long, I did not memorize it, so that I could use it to practice (sight) reading, because it is relatively easy.

(48) Chopin's Fantaisie Impromptu, Op. 66, Polyrhythms

You should learn Chopin's Fantaisie Impromptu, Op. 66 because:

(1) everyone likes this composition and respects anyone who can play it,

(2) without the efficient learning methods it is very difficult to learn,

(3) the exhilaration of suddenly being able to play it, is unmatched,

(4) the challenges of the piece are ideal for experiencing the effectiveness of efficient practice methods; it can be very educational,

(5) this is the kind of piece that you will be working on all your life in order to do "incredible things", so you might as well start now! And,

(6) it teaches hand independence, a new skill for playing polyrhythms, and some magical things you can do with polyrhythms, such as playing three times faster than your maximum speed.

Many students have difficulty with this piece because they can't get started and this makes them doubt their ability to learn it. After about two years of piano lessons (or even sooner for some), you should be able to tackle this piece using the learning tricks of this book. Even if you can't quite get to the speeds you want, you will learn many valuable lessons about how to practice difficult material.

Figure out the key first. Hint: after the G# "announcement", it starts with C# in bar 3 and the composition ends with C#. The Largo starts with Db (same note as C#!). But is each in a major or minor key? The large number of sharps and flats worries beginners because they are more familiar with the white keys. However, the black keys are easier to play once you know the flat finger and Thumb Over methods, because they stick out, reducing the chances of hitting adjacent notes and making legato easier by using the front pads of the fingers. Chopin may have chosen these "far out" keys for this reason, because the scale does not matter in the Equal Temperament [(77) Circle of Fifths, Temperaments]

that his tuner probably used. We know who Chopin's tuner was, but don't know the temperament that he tuned; however, the best tuning for far out keys is Equal Temperament which makes it the most likely tuning. With the Well Temperaments used up to Beethoven's time, some Chopin pieces can produce annoying dissonances. Therefore, students should be informed that Chopin chose black keys because they are easier to play and taught B major scale (maximum number of black keys) to beginners instead of C major.

HS, LH: Although the last page is the most difficult, we shall break the rule about starting with the difficult parts and start with the simpler beginning because of the need to learn how to play polyrhythms. Speed should not be a limiting factor for the LH, because it is not very fast. The suggested LH fingering for bar 5 is 532124542123. Start by practicing bar 5 by cycling it continually. Practice without the pedal.

Practice in small segments and memorize them. Suggested segments are: bars 1-4, 5-6, 1st half of 7, 2nd half of 7, then 8, 10 (skip 9 which is the same as 5), 11, 12, 13-14, 15-16, 19-20, 21-22, 30-32, 33-34, then 2 chords in 35. If you cannot reach the 2nd chord, play it as a very fast ascending broken chord, with emphasis on the top note. For the wide LH stretch in the second half of bar 14 (starting with E2), the fingering is 532124 if you can reach it comfortably. If not, use 521214.

One difficulty in bar 7 is that the 4th finger must be lifted quickly so as to be able to play the ensuing 5 and 3 without the 4 inadvertently hitting a note. With finger 4, do not try to lift it because that is a slow motion that will cause stress; instead, flick it out straight into the flat finger position, a faster motion. If other fingers flick out with the 4, that is OK. Many pianists (including famous ones like Horowitz) developed a bad habit of completely curling fingers 4 and/or 5 to prevent them from hitting keys inadvertently. It is better to cultivate the habit of stretching them out into the flat finger position. Once you develop the curling habit, it will be impossible to get rid of it.

After each segment is memorized and satisfactory, connect them in pairs. Then play the whole LH from memory. Increase the speed by cycling and don't forget to practice mental play. **In Chopin's music, the pinky and thumb notes are most important, so practice playing these two fingers with authority, especially for the RH (below).**

Now add the cartwheel motion to the cycling. Cycle the first 6 (or 12) LH notes of bar 5 (where the RH first joins in). Cartwheeling is useful for small hands because it expands the reach and makes it easier to relax because there is less need to keep the fingers spread widely apart. Use flat finger position and add a small amount of glissando motion.

HS, RH: The RH is the bigger challenge, but all you have to do is apply the methods already discussed. Practice the fast runs using parallel sets. For the rising arpeggio in bar 7, use the thumb over method; it is too fast for thumb under. The fingering should be such that both hands tend to play the pinky or thumb at the same time; this makes it easier to play HT. This is why it is not a good idea to fool around with

the fingerings of the LH -- use the fingerings as marked on the score.

HT, Polyrhythm: To understand this piece, we must analyze the mathematical basis of the 3 versus 4 polyrhythm. The RH plays very fast, say 8 notes per second (actually, a little slower). At the same time, the LH is playing at a slower rate, 6 notes per second. If all the notes are played accurately, the audience hears a note frequency equivalent to 24 notes per second, because this frequency corresponds to the smallest time interval between notes. That is, if your RH is playing as fast as it can, then by adding a *slower* play with the LH, Chopin succeeded in accelerating this piece to 3 times your maximum speed!

But wait, not all of the 12 notes are present; there are only 7, so 5 notes are missing. These missing notes create an additional **"pattern"**. This pattern creates a wavelike effect within each measure and Chopin reinforced it by using a LH arpeggio that rises and falls like a wave in synchrony with this pattern. The acceleration of a factor of 3 and the extra pattern are mysterious effects that the audience can feel but they have no idea what created them, or that they even exist. Mechanisms that affect the audience without their knowledge (such as magic tricks) produce more dramatic effects than ones that are easily understood (such as loud, legato, or rubato). The great composers have invented an incredible number of these hidden mechanisms. Musicians are actually just magicians, but can claim to have special talents because of widespread historical beliefs.

Start practicing the polyrhythm with either the first or second half of bar 5 where the RH comes in for the first time. We use the second half because of the smaller stretch of the LH and there is no timing problem with the missing first note in the RH for the first half. The easiest way to learn the 3,4 timing is to do it at speed from the beginning. Don't try to slow down and figure out where each note should go, because that will introduce an unevenness that will become impossible to correct later on. First, cycle the six notes of the LH continually, then switch hands and do the same for the eight notes of the RH, at the same tempo as you did for the LH. A metronome may be useful for this step. Next cycle only the LH several times, and then let the RH join in. Initially, you only need to match the first notes of each cycle accurately; don't worry if the others aren't quite right. In a few tries, you should be able to play HT fairly well. If not, stop and start all over again, cycling LH, HS and then adding the RH. Since almost the whole composition is made up of things like the segment you just practiced, it pays to practice this well, until you are very comfortable and accurate. To accomplish this, change the speed. Go very fast, then very slowly. As you slow down, you will be able to take note of where all the notes fit with respect to each other. Fast is not necessarily difficult, and slower is not always easier. You will be practicing this composition HS for years after you initially complete the piece because it is so much fun to experiment with this fascinating composition, and HS is the only way to correct any unevenness in the LH that develops from playing HT too much.

Learning HT at speed, instead of slowing it down and figuring out where each note

fits, is a necessary skill that every pianist must learn. If you learn it by slowing it down, you will have to go through the same time-consuming procedure with every different polyrhythm and every change of fingering. Once you learn to do it at speed, every polyrhythm becomes simple — you will play any new polyrhythm almost instantly. This is a form of finger independence that has many other uses.

O**utlining** can be helpful; simplify the six notes of each LH arpeggio (e.g., C#3G#3C#4E4C#4G#3) to two notes (C#3E4, played with 51). There should be no need to simplify the RH. This ensures all notes, from the two hands that fall on the same beat, to be played accurately together. Also, for students having difficulty with the 3-4 timing, this simplification will allow play at any speed with the difficulty removed. By first increasing the speed in this way, it will be easier to pick up the polyrhythm. Then gradually add the missing notes.

If you are learning this piece for the first time, the 3X polyrhythm frequency may not be audible initially because of lack of accuracy. When you finally "get it", the music will all of a sudden sound "busy". Thus the piece can be made to sound faster by slowing down and increasing the accuracy. Although the RH carries the melody, the LH must be clearly heard; otherwise, both the 3X effect and the extra pattern will disappear.

This composition begins with the loud octave G# fanfare that introduces the rhythm, played by the LH. The missing note in bar 5 gives the impression that the rhythmic unit is one bar. The missing note is then restored in bar 11, thus doubling the "pattern" repeat rate, giving the impression of a sudden acceleration. In the second theme (bar 13), the flowing melody of the RH is replaced by a new melody consisting of four notes per bar, giving the impression of quadrupling the rhythm. This "rhythmic acceleration" culminates in the climactic forte of bars 19-20. This Allegro section is based on the illusion of hyper speed, without actually playing faster, using polyrhythm and rhythmic acceleration.

The audience is then treated to a breather by a "softening" of the rhythm created by the delayed RH melodic (pinky) note and the gradual fading, accomplished by the diminuendo and ritenuto down to PP. The whole cycle is then repeated, this time with added elements that heighten the climax until it ends in the crashing descending broken chords. For practicing this part, cycle each broken chord as parallel sets.

Most Chopin pieces can be played within a wide range of speeds. However, if you play faster than Allegro, the 3x4 multiplication effect disappears. This is because the 3X speed becomes too fast for the ear to follow. Above about 20 Hz, repetitions begin to take on the properties of sound to the human ear. Therefore above 20 Hz we hear a new "low frequency sound". Thus 20 Hz is a "sound threshold". This is why the lowest note of the piano is an A at about 27 Hz. Here is the big surprise: there is evidence that Chopin heard this sound threshold! Note that the first part is labeled Allegro agitato. On the metronome, Allegro corresponds to a 3X speed of 10 to 20 Hz, the right frequency to hear the multiplication, just below the "sound threshold". "Agitato" means enunciate each note

clearly so that the 3X frequency is audible. When this fast section returns after the Moderato section, it is labeled Presto, corresponding to 30 to 40 Hz -- he wanted us to play it below and above the sound threshold! Therefore, there is mathematical evidence suggesting that Chopin knew about this threshold. Was Chopin's accuracy so high that he could produce the "low frequency sound"?!! What is certain is that the multiplication effect disappears, and there is little doubt that Chopin heard that. Many pianists play the first section too fast, above the sound threshold, which we now know is a mistake because that is not what Chopin intended. It is doubtful if anyone has the accuracy to produce the "low frequency sound". It would be an interesting experiment to program a computer to play this piece with sufficient accuracy produce both the 3X and "low frequency sound" effects.

The Moderato section is the same thing repeated four times with increasing complexity. Therefore, learn the first repetition first because it is the easiest, which makes it easier to learn the other three. Then learn the 4th repetition because it is the most difficult and will require the most practice time. As with many Chopin pieces, memorizing the LH well is the quickest way to build a firm foundation for memorizing because the LH usually has a simpler structure that is easier to analyze, memorize and play. Moreover, Chopin often created different versions of the RH for each repetition while using essentially the same notes in the LH as he did in this case; therefore, if you learn the first repetition, you already know most of the LH parts for all the repetitions.

Notice that the 4,3 polyrhythm is now replaced by a 2,3 polyrhythm played much more slowly. It is used for a different effect, to soften the music and to enable a freer, tempo rubato. Now, you can play very slowly, yet the music is filled with sound! As with the 3,4 polyrhythm, practice HT at speed instead of working out where each finger goes at slow speed. The trill in the 1st bar of the 4th repetition, combined with the 2,3 timing, makes the 2nd half of this bar difficult. Since there are 4 repetitions, you might play it without the trill in the first repetition, then an inverted mordent the 2nd, a short trill the 3rd, and a longer trill the last time around.

The Presto part is similar to the first except that it is played faster, resulting in a totally different effect, and the ending (from bar 46) is different. This ending is difficult for small hands and may require extra RH cycling work. Here, the RH pinky carries the melody, but the answering melancholic, thumb octave note is what enriches the melodic line. Be sure to observe the P in order to make the FF more effective. The piece ends with a nostalgic restatement of the slow movement theme in the LH. Let's reiterate that, for Chopin, the thumb and pinky play the most important notes.

Distinguish the top note of the LH melody (G# - bar 7 from the end) clearly from the same note played by the RH by playing it louder, holding it longer, and then sustaining it with the pedal. **The G# is the most important note in this piece.** Thus the beginning sf G# octave is not only a fanfare introducing the piece, but a clever way for Chopin to implant the G# into the listeners' minds. Therefore, don't rush this fanfare; take

your time and let the G# sink in. If you look throughout this piece, you will see that the G# occupies all the important positions. In the slow section, the G# is an Ab, which is the same note. This G# is another one of those devices in which a great composer is repeatedly "hitting the audience on the head with a two-by-four (G#)", but the audience has no idea what hit them. For the pianist, knowledge about the G# helps interpret and memorize the piece. Thus the emotional climax of this piece comes at the end when both hands play the same G# (bars 8 and 7 from the end). Therefore, this LH-RH G# must be executed with the utmost care, and clearly heard (quite difficult), while maintaining the fading RH G# octave.

When you are satisfied with all technical aspects, insert the pedal; it should be cut with every chord change which occurs either once per bar or twice per bar. The pedal is a rapid up and down ("cutting the sound") motion at the first beat, but you can lift the pedal earlier for special effects. No pedal for bars 11, 9, 8, 6, 5 from the end.

One cautionary note: even after you can play the piece satisfactorily, it is important to practice HS so that you do not develop bad habits in the LH. Bad habits in the RH are audible and are therefore not problematic; you can easily detect and correct it. However, inaccuracies in the LH are not easily audible, and any error will cause the 3X multiplication to disappear.

(49) Beethoven's Moonlight: First, Third, Movements

Moonlight Sonata, Op. 27, No. 2, First Movement

Beethoven's compositions are probably the best music with which to study and illustrate musical principles because he used everything and almost never wasted anything; all the principles appear and apply everywhere, in their clearest *extremes*. Thus his music contains the densest examples of these principles/structures and has the lowest risk of giving us misleading clues because they are extreme. Thus when he applies a principle, you can't miss it if you know what to look for. For the casual listener who is not analyzing his music, these principles are invisible, which amplifies their effectiveness because they mysteriously control the audience without their knowledge. Part of deep music is the use of principles that control the audience without their knowledge, the magic in music.

Beethoven often "broke the rules" to produce glorious music. Why did "breaking the rules" produce better music? Simply because those rules were wrong! Without a proper understanding of music, it is too easy to deduce "musical laws" that are incorrect. Thus Beethoven teaches us not only what is right, but also what is wrong.

The most important controversy concerning this movement is the pedaling. The "conventional pedaling" frequently used ignores the instructions by Beethoven ("senza sordini" – don't lift the pedal for the entire piece!), and applies conventional pedaling rules, as amply described elsewhere (Wikipedia, Chapman, Brian, [click on "Moonlight print version"]). This produces music with clear harmony. But the pianist has two options

for playing this piece; either take Beethoven's indication literally, or use conventional pedaling as too many pianists have done historically – obviously, the two methods will result in totally different music.

Some evidence points to the conventional pedaling as the one Beethoven had in mind (Chapman). After all this piece is easy enough for anyone to play, and was widely played during Beethoven's time, probably using conventional pedaling, yet there is no record of Beethoven objecting to such pedaling. Thus, the conventional interpretation of "senza sordini" was that it was a short-hand way for Beethoven to say that the pedal should be used throughout, but can be lifted judiciously as needed. Use "conventional" pedaling when you want to play a clear, harmonious Moonlight that most audiences expect. Concentrate on bringing out the harmonies and de-emphasize the dissonances, such as the jarring ninths. This is the "safe" way to play it but . . . . . .

The increasingly accepted view is that "senza sordini" should be taken literally and points out its wonderful consequences (below). Beethoven always indicated his expression markings with the greatest care; everything he wrote down was there for a very good reason. Some pianists argue that the continuous pedal worked for Beethoven because the pianos of his time did not have the sustain of today's grands and that continuous pedal on today's grands would "muddy" the music (Wikipedia Beethoven, section on "Beethoven's Pedal Mark"). If this were true, we should be able to use continuous pedal on an upright or other inferior piano with less sustain – of course, it still muddies the music. Therefore, the correct interpretation is that this "muddiness" was intentional. It produces a constant, dissonant, background "roar", which not only creates an ominous, ever present, sadness, but also a stark contrast against the beautiful harmonies of the piece. The dissonances make the harmonies stand out! Two Beethoven extremes -- an extreme pedal and extreme dissonance vs harmony!

This particular use of the pedal is an invention by Beethoven, and represents an unique innovation in the universe of piano music, at a time when the pedal was not even considered a serious musical invention. It was enabled for the first time by the sonority of the new pianos of that time, and Beethoven took full advantage of it. Extreme contrasts are a hallmark of Beethoven; thus the first movement is played full pedal while the third hardly uses any. I have greatly enjoyed playing according to Beethoven's intention of a sad, even painful music with deeper emotions, achieved by contrasting the painful dissonances with the clearest harmonies. Only by playing Beethoven's way and exploring its marvelous consequences (using today's grands) can anyone understand why he marked it "senza Sordini" — he meant it!

The first bar presents clear harmony. Then Beethoven jars you with the first dissonance (full tone down from C#), a B octave in the LH in bar 2, producing the start of a dissonant "background roar". Thus in just 2 bars, he has introduced his concept of the contrast between harmony and dissonance. Bars 3 & 4 complete this introduction, with clear harmonies riding on a background of growing dissonance created by the pedal.

Bar 1 is not just a series of 4 triplets. They must be logically connected; therefore, pay attention to the connection between the top note of each triplet and the bottom note of the next triplet, but with the accent on the recurring bottom note. This connection is especially important when transitioning from one bar to the next, and the lowest note often has melodic value, as in bars 4-5, 9-10. The RH of bar 5 starts with the lowest note, E, and the music rises all the way to the G# of the 3-note theme. Therefore, this theme should not be played "alone" but is the culmination of the arpegic rise of the preceding triplets.

By bar 5, the dissonant background is complete, and he introduces his 3-note theme - the same note repeated three times - you can't have a clearer harmony than a note with itself (works even if the piano is out of tune!). Beethoven frequently inserted sarcasm into his music, and this device may have been his way of ridiculing the fact that too many pianos were out of tune. Note that there is a PP marking only on those three notes – the audience must search for those notes amongst the background dissonance. The speed of this piece will depend on the sonority (sustain) of the piano; it will be played faster on a typical upright, but slower on a quality grand. Thus the numerous arguments in the literature about how fast to play this piece miss the senza sordini factor. As with most Beethoven's compositions, if you want to play it correctly, you must play it exactly according to Beethoven's instructions.

Beethoven explores this harmony-dissonance contrast with some beautiful, but sad, melodies and harmonies, until, in bar 16, he introduces the concept of *pain* with the dissonant 9th in the RH. This is the only Beethoven composition that I know of, in which he used pain; therefore, this sonata is unique not only because of the use of a dissonant background, but also because it contains a musical description of pain. This is a sad piece, but true sadness is painful, and Beethoven inserts pain by punctuating this composition with dissonant 9ths at the deepest depths of despair. In "conventional" play, the lower note is played so softly that the dissonance becomes inaudible, which misses an important element of this movement. Note that, at the same time, there is the repeated "tolling of the bell" – the almost endless repetition of the B in the RH (over 5 bars), which builds up the tension that concludes by descending in the following bars, further increasing the desperate sadness. The 9th dissonance is created against this repeated B which should be emphasized because it is the beat note.

The **repeated beat notes** carry a melodic line that extends over many bars, creating tension, and eventually resolves to release that tension. The magic of Beethoven's repeated notes is that he uses chord progressions such that even through a chord progression, the same note can be repeated. Thus Beethoven invented **minimalist music** [(50) Beethoven's Pathetique, Op. 13, First Movement], now taken up by the likes of Phillip Glass, and used it extensively. We shall see more examples in the first movements of his Pathetique and Appassionata, discussed below. Minimalism was just one component of his complex, immortal music, and it always resolves into something

special. This device is used several times, so make sure that you don't miss any of them.

Immediately following the dissonant 9th in bar 16 is the cresc.-decresc. in the LH, which echoes the emphasis on the 9th and confirms its prominent role, a sigh of extreme sadness.

If you have difficulty reaching the RH ninth of bar 8, play the lower note with the LH; similarly, at bar 16. In these instances, you cannot completely hold the legato in the LH, but the legato in the RH is more important, and lifting the LH will be less audible because of the pedal. If you can reach it easily, play the ninth with the RH because that will allow you to hold more notes in the LH. Bars 32-35 is a series of rising triplets of increasing tension. Bars 36-37 should be connected, because is it one smooth release of that tension.

The beginning is PP to bar 25 where there is a crescendo, decreasing to P in bar 28, and returning to PP in bar 42. In most cresc. and decresc., most of the increase or decrease should come near the end, not near the beginning, especially in soft music. There is an unexpected crescendo in bar 48, and an abrupt jump to P at the first note of bar 49. This is the clearest indication that Beethoven wanted a clear harmony superposed on a dissonant din created by the pedal, in support of "senza sordini". If you don't lift the pedal in between, the inescapable effect is a harmonious P passage buried in the loud, dissonant background produced by the preceding bars. This produces a much more dramatic effect than if the pedal were cut to play the P. If there were any previous questions about the use of the "background roar" these two bars should put an end to those doubts. These two bars are Beethoven's way of saying, "If you still don't get it, I can't help you".

Bar 60 is a "false ending"; an ordinary composer would have ended the movement there by returning to the starting key, but Beethoven nostalgically picks up the 3-note theme again, and gradually ends the piece, softer and softer, to the final PP. Most of Beethoven's compositions have this "double ending" a very effective device for ending a composition with conviction. Most composers have difficulty finding one good ending; Beethoven usually gives us two, and the final one is a marvel of ingenuity, as if to ridicule the "standard endings". Thus it is a good idea to play the first ending as if it were the end, and then pick up the music into the true ending.

Having decided to fully engage the damper pedal throughout, the first rule in practicing this piece is not to use the pedal at all until you can play it comfortably HT. This will enable you to learn how to play legato, which can only be practiced without the pedal. Start by memorizing HS, say bars 1-5, and immediately commit it to mental play. Pay attention to all the expression markings. It is in cut time, but the first two bars are like an introduction and have only one LH octave note each; the rest are played more strictly cut time. Continue memorizing in segments until the end. I found the first half of this movement particularly easy to forget, and it was necessary to use mental play for secure memorization.

The LH octaves must be held. Beethoven considered octaves to be special (probably because they are the only intervals that are just [tuned perfectly]); therefore always pay special attention to octaves when playing his music. Play the LH C# octave of bar 1 using fingers 51, but immediately slip the 4, then 3 finger onto the lower C#, replacing the 5, holding this lower C# down. You will end up holding the octave 31 before you reach bar 2. Now hold the 3 as you play the B octave of bar 2 with 51. In this way, you maintain complete legato in the LH going down. You cannot maintain complete legato with the 1 finger, but hold that as long as possible. In the transition from bar 3 to 4, the LH octave must ascend. In that case, play the F# of bar 3 with 51, then hold the 5 and play the next G# octave with 41. Similarly, for bars 4 to 5, play the second G# octave of bar 4 with 51, then replace finger 1 with 2 while holding it down (you may have to lift the 5) so that you can play the following chord of bar 5, fingers 521, and maintain the legato. Hold as many notes as you can, especially the lower note for the LH and the upper note for the RH, throughout the whole movement. There are usually several ways to "hold", so experiment to see which works best. The choice of a specific hold depends on hand size. For example, the LH octave of bar 1 could have been played 41 or 31 so that you do not have to replace any fingers; this has the advantage of simplicity, but has the disadvantage that you need to remember that when you start the piece. Decide on a specific hold procedure when you first memorize the piece and always use that same one.

Why hold the note legato when you are eventually going to hold all the notes with the pedal anyway? If you lift the key but hold the note with the pedal, the backcheck releases the hammer, allowing it to flop around, and this "looseness" of the action is audible – the nature of the sound changes. Moreover, as commander of the piano, you always want the backcheck to hold the hammer so that you have complete control over the entire piano action. This control is important – you can't control the PP if the hammer is flopping around. Holding improves accuracy because the hand never leaves the keyboard and the held note acts as a reference for finding other notes.

The final two chords should be the softest notes of the entire movement, which is difficult because they contain so many notes. For HT play, this movement presents no problems. Once you have memorized the whole movement and can play it HT satisfactorily, add the pedal.

Third movement

This movement is difficult because of the speed. Many Beethoven compositions cannot be slowed down because of their rhythm. In addition, it requires a minimum reach of a 9th, comfortably. Those with smaller hands will have more difficulty learning this piece. It is a variation on the first movement played very fast and agitato – this is confirmed by the observation that the top double octave of bar 2 is an abbreviated form of the 3-note theme of the first movement.

For those who are learning this sonata for the first time, the most difficult section is the two-hand arpeggic ending (bars 196-198; this movement has 200 bars). We start with

this difficult section, RH first. Skip the first note of bar 196 and practice the following 4 ascending notes (E, G#, C#, E), as parallel sets, which we cycle. Make an elliptical, clockwise motion (as seen from above) of the hand. We divide this ellipse into two parts: the upper part is the half towards the piano and the lower part is the half towards your body. When playing the upper half, you are "thrusting" the hand towards the piano, and when playing the lower half, you are "pulling" the hand away from it. These ellipses can be extremely narrow; don't exaggerate them. First, play the 4 notes during the upper half and return the hand to its original position using the lower half. This is the thrust motion for playing these 4 notes. The fingers tend to slide towards the piano as you play each note. Now make a counter clockwise motion of the hand and play the same 4 ascending notes during the lower half of the ellipse. Each finger tends to slide away from the piano as it plays each note. Those who have not practiced both motions may find one better than the other. Advanced players should find both motions equally comfortable.

For the RH descending arp, use the first 4 notes of the next bar (same notes as in preceding paragraph, an octave higher, and in reverse order). Again, the pull motion is needed for the lower half of the clockwise motion, and the thrust is used for the upper half of the counter clockwise rotation. For both ascending and descending arps, practice both thrust and pull until you are comfortable with them. Now see if you can figure out the corresponding exercises for the LH. Notice that these cycles are all parallel sets and therefore can eventually be played extremely fast.

Having learned what the thrust and pull motions are, "why do we need them?" First, the thrust and pull motions use different sets of muscles. Therefore, given a specific application, one motion has to be better than the other. Students who are not familiar with these motions may randomly pick one or switch from one to the other without even knowing what they did. This can result in unexpected flubs.

A neutral position is the collapsed ellipse, a straight line; however, you use a different set of muscles whether you approach the neutral from the thrust or the pull. That is, under certain circumstances, a neutral position approached from either thrust or pull is better. The difference in feel is unmistakable when you play them. This is why you need to learn both. The pull motions use the fleshy parts of the fingers whereas the thrust motions tend to use the fingertips which tends to injure the fingertips and to strain the attachment of the fingernails. This is an example of experimentation that everyone must learn to conduct.

The other difficulties in this movement are concentrated in the arps and alberti accompaniments; once these are mastered, you have conquered 90% of this movement. For those without sufficient technical skill, be satisfied with getting up to about quarter-note = MM120 on the metronome. Once you can play the entire movement comfortably at that speed, you might try to mount an effort towards presto (above 160). It is probably not a coincidence that with the 4/4 signature, presto corresponds to the rapid heart beat of a excited person. Note how the LH accompaniment of bar 1 sounds like a beating heart.

Most students will have more difficulty with the LH than the RH; therefore, once the RH of bars 196-8 is fairly comfortable, start practicing the RH arps of bars 1 and 2, while still practicing the LH part of bars 196-8. One important rule for playing arps rapidly is to keep the fingers near the keys, almost touching them. Use flat finger positions for black keys and curled positions for white keys. In bars 1 to 2, only the D is played with curled fingers (RH). Learn to quickly flatten or curl any finger.

The pedal is used only in two situations: (1) at the end of bar 2, at the double staccato chord, and all similar situations, and (2) bars 165-166, where the pedal plays a critical role.

Next, practice is the tremolo type RH section starting at bar 9. Work out the fingering of the LH, bars 9-10, carefully -- those with smaller hands may not be able to hold the 5th finger down for the duration of the 2 bars. If you have difficulty interpreting the rhythm of this section, listen to several recordings to get some ideas. For the difficult RH bars 9 - 10, break it up into 2-note PSs; first practice them as intervals (PS #1), then as 2-note PSs, then work on finger independence using forearm rotation and staccato practice.

Then comes the LH Alberti bass starting at bar 21, and similar RH parts that appear later; see (9) Parallel Sets (PSs), Conjunctions, Cycling for how to practice them. The next difficult segment is the RH trill of bar 30. This first trill is best performed using 3,5 fingering and the second one requires 4,5, see (35) Trills and Tremolos. If you can't trill that fast, just play a turn. For those with small hands, these trills are as difficult as the arps at the end, so they should be practiced from the very beginning. These are the basic technical requirements of this piece. Bar 187 is an interesting combination of a "scale" and an arp; if you have difficulty figuring out its rhythm, listen to several recordings to get some ideas. Don't overlook the fact that bars 188 and 189 are adagio.

Start HT practice after all these technical problems are solved HS. There is no need to practice using the pedal until you start HT. Bars 163, 164, are played without pedal. Then application of the pedal to bars 165, 166, gives them a special meaning. Because of the fast pace, there is a tendency to play too loud. This is not only musically incorrect, but technically damaging; practicing too loud can lead to fatigue and speed walls; the key to speed is relaxation. It is the P sections that create most of the excitement. For example, the FF of bar 33 is only a preparation for the following P, and in fact, there are very few FF's in the entire movement. The section from bar 43 to 48 is played P, leading to just one bar, #50, played F. Polish up every section using staccato practice.

(50) Beethoven's Pathetique, Op. 13, First Movement

This movement is an excellent example of Beethoven's use of **extreme contrasts**. Knowing these extremes makes it easier to play it correctly and create the magic that is Beethoven.

Grave: this section is almost devoid of **rhythm**, whereas the following Allegro is

the height of rhythmic music. Another obvious contrast is **volume**. The first chord of bar 1 is F and all the remaining notes are P. Because even this most obvious concept is not always understood, there has been some controversy as to how to make the transition from F to P, especially as regards the use of the pedal. Beethoven did not indicate any pedal markings, so a purist should play the entire sonata without pedal; however, if you choose to use the pedal, it should be used in such a way that it cannot be noticed and does not interfere with Beethoven's contrasts. Some have advocated fluttering the pedal. But this is wrong because it does not produce maximum contrast. The solution is simplicity itself. If you use the pedal, simply cut the pedal and immediately play the P. Maximum volume contrast!

The second, equally important contrast, is **speed**. Grave is a slow tempo. Yet there are runs at 1/128 speed! Set to a metronome, these fastest runs are humanly impossible to execute. It is obvious what Beethoven is telling us: "this section is of slow tempo, but play the fast runs as fast as you can". Thus the concept of repetitive rhythm has clearly been thrown out the window.

The run in bar 4 is very fast; there are 9 notes in the last group of 1/128 notes; therefore, they must be played as triplets, at twice the speed of the preceding 10 notes. This requires 32 notes per beat, impossible for most pianists, so you may have to use some rubato; the correct speed may be half the indicated, according to the original manuscript. The 10th bar contains so many notes that it spans 2 lines in the Dover edition! Again, the last group of 16 notes at 1/128 speed is played at twice the speed of the preceding 13 notes, impossibly fast. The 4-finger chromatic fingering [(33) Fast Chromatic Scales] may be useful at such speeds. You can start these runs at a slightly slower speed and accelerate to your maximum at the end. Every student learning this Grave for the first time must carefully count the notes and beats so as to get a clear idea of the rhythm. These crazy speeds can be an editor's error, but is probably Beethoven's way of saying "as fast as you can".

The first and 3rd movements are variations on the theme in the Grave. The LH carries the emotional content, although the RH plays the catchier melody. (Aside: the popular song, "You Are My Sunshine" was taken almost verbatim from the 3rd movement.) Pay attention to the hard staccato and sf in bars 3 and 4. In bars 7 and 8, the last notes of the three rising chromatic octaves must be played as 1/16, 1/8, and 1/4 notes, which, combined with the rising pitch and the cresc., create the dramatic effect of increasing tension. This is vintage Beethoven, with maximum contrast: soft-loud, slow-fast, single note-complex chords.

In addition, this Grave contains many other musical elements, such as the use of **chromatics** (semitones). Although I have not found any explanations of why chromatics produce music, there are plenty of statements in the literature to the effect that music in the romantic age became increasingly chromatic. Here, it is easy to see that the most intensely musical notes are chromatic.

Allegro: by contrast, this section is dominated by a lively rhythm. He starts by using the simplest device, an octave tremolo. Beethoven loved the octave and used it extensively. The octave holds a special place within the chromatic scale because it is the only interval that is just (perfect harmony) everywhere on the piano, regardless of temperament (tuning) or key signature. Beethoven certainly knew this and took full advantage of it. Pianists familiar with temperaments know that octaves are "stretched" [See (xi) in (79) Tuning Tools and Skills], and this stretch adds a certain mystery and extra excitement to the octave; mystery because, in spite of the stretch, the harmony is perfect, and excitement because of the higher frequency caused by the stretch. He begins his Appassionata with a double octave, which results in the maximum audible stretch [(51) Beethoven's Appassionata, Op. 57, First Movement]. Piano tuners often test the tuning using double octaves.

Let's work on the LH **octave tremolos** starting at bar 11. For some, these tremolos seem impossible, and many students have injured their hands by over-practicing them. The last thing you want to do is to practice this tremolo for hours in the hopes of building endurance -- that is the surest way to acquire bad habits and suffer injury.

Since the octave tremolos are needed for both hands, we will practice both; if the RH catches on faster, you can use it to teach the LH. To speed up this tremolo (C2-C3), practice the 51 PSs. Start by practicing repeated 5.1 octaves [PS #1, (10) Parallel Sets Catalogue]. If the LH tires, practice the RH Ab4-Ab5 octave that you will need later. Once the repeated octaves becomes satisfactory (four quads at the desired speed or faster, relaxed, without fatigue), change over to PSs. A quick way to increase speed is to play a fast double octave, 5.1,5.1, then immediately follow with two 51,51 PSs; ie, replace the octaves with PSs. When these become satisfactory, increase to three, then four, etc. In the final motion, the tremolo is played mostly with forearm rotation. This agitated LH tremolo controls the emotions while the audience is trying to figure out the curious RH. Therefore, the "magic" is controlled by the dynamics and chromatics of the LH, in addition to the stretched octaves.

Practice everything softly and work on relaxation. When you find the right motions, hand positions, etc., you will actually feel the fatigue draining out of the hand as you play and you should be able to rest and even rejuvenate the hand while playing rapidly. You have learned to relax! At this point, some pianists can immediately play the tremolos at any speed they want. If, however, the tremolos are still just PSs, we need a more detailed procedure.

To convert the PSs to technique, practice finger tremolo using exaggerated finger motions, playing a very slow tremolo, lifting fingers high and lowering them to play the keys with finger motion only. Then speed up to the fastest comfortable speed by decreasing the amount of motion. Now repeat with forearm rotation only: fix the fingers to the hands and play the tremolo using only arm rotation, slowly, in exaggerated way. All up and down motions must be rapid; to play slowly, simply wait between motions, and

practice rapid and complete relaxation during this wait. Now gradually speed up by reducing the motions, to your fastest comfortable speed. After each is satisfactory, combine them; because both motions contribute to the tremolo, you need very little of each, which is why you will be able to play very fast.

At the fastest speeds, the pinky can dominate over the thumb; in this case, add as much power thumb position [(31) Thumb, Most Versatile Finger, Power Thumb] as you need to balance the two fingers. Then finish off with staccato practice. Practice this series from PS #1 to staccato practice just enough for maximum post practice improvement. Do not over practice. Then repeat the next day, etc., until you can play the tremolo as fast and as long as you want.

Note that the volume is P until bar 14, then increases until bar 18 (most of the increase should be within bar 18) and suddenly returns to P in bar 19. These volume changes must be controlled more by the LH than the RH. Beethoven was a master of these dynamics that seem to have no logical explanation, yet "work" musically. Many students make the mistake of starting the cresc. in bar 12, reaching a maximum at bar15.

Another rhythmic device is Beethoven's clever and careful use of the time signature to indicate where the volume accents should go. Pianists must be careful here because even respected editors such as Schirmer have made mistakes that ruin Beethoven's original intent. Use the Urtext edition (Dover), which is more accurate. For example, in the third bar of the Allegro, Schirmer indicates a syncopated sf on the second beat, which makes no sense. Schirmer may have inserted this sf in the belief that these mysterious RH intervals are modified forms of the theme in the Grave. This sf is not present in the Dover edition, which restores the correct cut-time rhythm; that is, *follow the time signature*! The incorrect rhythm would be impossible to play at the correct speed — no wonder students using the Schirmer edition can't get up to speed despite diligent practice!

An important volume accent occurs in the LH at bars 37 and 41 of the Allegro where the preceding cresc. indicates that the LH tremolo volume must increase rapidly in anticipation of the sf in bars 38 and 42. These are unique volume accents so prevalent in Beethoven's compositions. Thus to make the music "sound like Beethoven", these volume accents must be carefully observed.

Schirmer makes another mistake in bar 139, the third bar in the Allegro after the second Grave, where an accent is indicated on the E octave, another meaningless syncopation. Again, this accent is not indicated in the Dover edition and the music smoothly follows the time signature. It is extremely important to follow the time signature by giving extra weight to the first beat in the complex rhythmic section from bar 149 to 194, in such a way that the audience can follow the rhythm. These bars comprise one of the best examples of Beethoven's use of rhythm to dominate the music, so that the rhythm should be exaggerated while faithfully following the time signature. Thus Schirmer's volume accent indications in bars 149 - 155 are all wrong; instead, follow the time signature as indicated by Beethoven (Dover edition).

Every note, instrument, expression marking, etc., in Beethoven's music has a purpose and a reason, more so than any other composer. Thus inserting your own expressions into his music without fully understanding his intentions is a dangerous thing to do, as illustrated by the Schirmer editions. Students using the Schirmer edition will end up with music that is not only nonsensical, but also rhythmically impossible to play.

Repetition in rhythm is important because it enables us to control time, which we normally can not. Beethoven used repetition to great effect. Note the LH Bb tremolo starting at bar 43; it continues for six bars (48 Bb's!) and ends with a Bb octave for two bars, where the Bb is taken over by the RH for a total of 56 Bb's. Then he changes the tremolo to a "Bb hold" for the next 12 bars in the LH (bars 51 to 62), which then resolves into the next repetition of Ab's. Thus the 68 repeated Bb's are used to control the emotion for 20 bars using the LH, while the audience is distracted by the interesting activity in the RH. This use of the stealth control of the emotions with the LH while distracting the audience's attention with the interesting RH gives depth to Beethoven's music. Most pianists think that the LH is just a common type of accompaniment to the RH that carries the main melody — that's what Beethoven wants the audience to think; in the meantime, the real emotions are controlled by the repeated Bb; that is why it is *held*. Deeper music is easier to play correctly if you know its structure. These LH repetitions continue for a long time, until it finally resolves into the Eb of bar 89, so that the Eb must be clearly emphasized. Thus the repetitions, and the tensions they create, followed by the final resolution, are basic components of Beethoven's music. The interminable repeated notes represent **minimalist music** that Beethoven invented and used frequently. These are usually hidden by distracting the audience with a more catchy material playing at the same time.

Speed is obviously an important element of the Allegro. This speed contrasts with the slow movement of the Grave; thus the Grave is there so that you will appreciate the speed of the Allegro. Getting 10 fingers to move faster than the human brain is quite a challenge. By converting the LH octaves into a rapid tremolo at the start of this Allegro, he immediately doubled the speed, a simple device for any accomplished pianist. Later on, he uses the Alberti construct (bar 90) to quadruple the speed. These bars contain so many notes that they allow exquisite control of the emotions in a way that the audience is unable to figure out, which makes the music timeless. Therefore, in the alberti sections, every note of the alberti must be heard; it is a mistake to play so fast that only the melodic line of the RH pinky is heard. Because of these types of devices, it is not possible to arbitrarily slow down or accelerate a Beethoven composition without compromising the original intents of the composer.

Volume (FF) is used in this piece to indicate the ending: an unbelievably simple device. As usual, he gives us a false ending in bar 294, which then leads to the real ending in bars 308-9. This FF must be louder than anything else in this movement for the ending to be convincing and final. The final two chords are exact quarter notes, unlike the

gaudy full notes of the false ending (bars 293-4) – Beethoven is injecting humor by ridiculing such gaudy "standard endings" by making it obviously flowery.

Although speed is essential in this Allegro, it is often played too fast. Such speeds result in the almost total loss of the deeper concepts that saturate Beethoven's music and make them immortal. Certainly, it is possible to drive the audience to delirium by mere speed and that device is a legitimate pianistic license – after all, this is entertainment, but that is not the real Beethoven, in which every note, rest, etc., is important and must be heard.

(51) Beethoven's Appassionata, Op. 57, First Movement

Beethoven modified the **"fate motif"** of his 5th symphony, and used it to compose this movement. What appears to be the first 3 notes of an arpeggio that starts this movement is actually a modified form of the fate motif (three repeat notes and a surprise note, [(67) Mozart's Formula, Beethoven and Group Theory], ending with the accent on the third "surprise" note, F. In this construct, the second note of the 4-note fate motive is silent, resulting in a 3-note "arpeggio". He tells you that he is using the fate motif by displaying it in bar 10. For those not analyzing this movement in detail, it seems as if he just stuck the fate motif there because it "fit"; the reality is that the entire movement is based on it.

This sonata is the piano version of his 5th symphony! Both were written at about the same time. Thus in this "arpeggio", the accent is on the third note, not the first, as in a normal arpeggio. The Appassionata starts with the second movement of his 5th symphony, and the following movements basically follow the symphony.

The starting "arpeggio" is played in double octaves, quite possibly to take advantage of the stretch effect [section (xi) in (79) Tuning Tools and Skills]; stretch is smaller for a single octave. I don't know if he knew about stretch, but he must have heard it; otherwise, there would be no compelling reason to use a double octave. Piano tuners use double octaves to check unison tunings, etc., because of this special property. It is an incredible characteristic of Beethoven's music that every note, construct, etc., that he used, such as a double octave, was placed there for a specific reason.

He used the fate motif is as **conjunctions** to connect sections or musical phrases or even bars. One application is to connect the beginning of the introduction (bars 0-11), with its ending (bars 14-15): the conjunction is the repeated fate motifs in bars 12-13. Another use occurs at the end of bar 16, where it is used to launch bar 17.

The next use as conjunction is astounding, and it connects bar 34 to bar 35; the last triplet of bar 34 and the first note of bar 35 form the fate motif. The preceding long series of triplets creates a tension that is finally resolved by the motif. Simultaneously, it launches you into the **main theme** of this movement (starting at bar 35), one of the most beautiful musical passages ever composed, constructed entirely out of the modified fate motif. The repeated triplets leading to bar 35 is Beethoven's version of **minimalist music**

which he used to great effect to build up tension and provide a continuous series of notes with which to create expression — in this case an anticipation of something special to come.

Yet another use as conjunction appears between bars 78 and 79, where it is used to launch a new section; there are similar applications elsewhere. In bars 130-134, the fate motif is spelled out without modification. These bars again serve as a conjunction between major sections.

By far the most interesting conjunction application appears in bars 235-240, where he uses the **"group theory"** (symmetry transformation) method to create a long conjunction. He used the "pitch space" to compose the 5th symphony [(67) Mozart's Formula, Beethoven and Group Theory], but here, he adds the "time space" to gradually slow down the fate motif, and then suddenly accelerate it to launch the final section of this movement. Of course, he also uses the volume and pitch spaces to great effect. It is clear that Beethoven was aware of "group theory" type space concepts, long before mathematicians and physicists discovered their importance – a true genius.

For many years, I wondered about the mysterious trills that appear in this movement, such as at bars 3 and similar, and bars 44-46. They obviously carry some thematic value, but without understanding the role of the trills, it wasn't clear how to play them, and every pianist played them differently; obviously, they didn't know either. I finally realized that the trills, followed by its ending turn, was a modified form of the fate motif! This interpretation gave a clear indication of how to play them – the trill represents the repeat notes (trills contain repeat notes) and the turn at the end represents the surprise note and carries the accent, and that is why these trills have thematic value. Now I know exactly how to play them!

The similarity between the beginning arpeggio and the main theme starting at bar 35 is well recognized (Gutmann). The arpeggio is a schematized form of the main theme, to ensure that its rhythm is implanted in the audiences' mind. The schematic is inverted, to hide his diabolic scheme from the audience. Beethoven had psychologically prepared us for the main theme by giving us only its rhythm! This is why he repeats it, after raising it by a curious interval -- he wanted to make sure that we recognized this unusual rhythm. He used the same device at the beginning of the 5th symphony, where he repeated the fate motif. Thus, when the main theme appears, we feel familiar with it. Beethoven does not indicate a special accent on the third note of the arpeggio (the time signature takes care of that!), which is intentional because this accent must appear natural and should not be overdone because THAT is reserved for the final section near the end.

This final section starts with an accelerated version of the main theme. In bar 243, there is (at last!) the sf on that "surprise note". Beethoven is asking the pianist, "NOW do you see where the accent is?" Not only accented, but the interval jump to the accented note is expanded compared to the main theme, to produce an unmistakeable exaggeration with a jarring harmony. This outlandish sf note must be played as outlandishly as possible

because, by now, the audiences have heard the same construct hundreds of times (but don't even realize it, although they somehow feel it).

Speed is obviously important in this composition, and it is technically difficult. This means that most pianists will be playing it at their top speed. But at bar 81, Beethoven needed a slight acceleration (as recognized by Chapman – click on "Sonatas for the Piano"). How did Beethoven solve this problem, when, possibly, he himself couldn't play any faster? He deleted one note from the previous six-note groups of phrases, so that, playing at the same speed between notes, the tempo is accelerated by 20%, the exact acceleration he wanted! You can't be any more mathematically precise and concise! Some might argue that this acceleration "violates the time signature", and that the correct way to play is to keep the over-all tempo constant but to slow down the 5-note group. This is an example of how Beethoven "broke the rules" to compose great music, proving that many "established rules of music" are wrong. If "accel." is permissible, why not an increase in speed of 20%? Of course, the final decision is up to the pianist because whether you accelerate by 20% or slow down the 5 notes, you are breaking some kind of rule.

Not only the acceleration in bar 81, but there is also the deceleration in bar 82 under the two octave Gs, where the sixth note is restored in the left hand. This extra note tells you exactly how much to slow down, which then enables the re-acceleration in bar 83.

We can examine any bar as an example of how Beethoven composed deep, or immortal music. Of course, musicality, something that can't be quantified, is probably the largest part of immortality. But there is an amazing amount of complexity that can be quantified practically everywhere you look in Beethoven's works. This complexity certainly contributes to depth in music because no audience can figure out all the complexities at once and they change rapidly as the music progresses. Let's list some of the complexities built into one bar (81):

1. the 20% acceleration discussed above,

2. the 5-note grouping, which introduces an aura of uncertainty and mystery absent in the "standard" 6-note groupings of the preceding bars,

3. the change in key signature from F minor to C major at bar 67,

4. the clear RH melodic line of the familiar "arpeggio" heard at the very beginning (this is what the audience is supposed to be "following"), while

5. the actual emotions are controlled by the rapid LH notes,

6. nothing is unfamiliar here because the rapid LH grouping is derived from the "arpeggio" itself, played at break-neck speed,

etc., there are more!

Thus there are frequently 5 or more musical elements crammed into every bar. This must be one reason why, no matter how many times you listen to Beethoven, you can hear something new.

The use of group theoretical type concepts and complex structures might be extra

dimensions that Beethoven wove into his music, perhaps to show us how smart he was. It may or may not be the mechanism by which he generated the music. Whatever the reality, the above analysis gives us a glimpse into the mental processes that inspire music. Simply using these devices shouldn't result in music. Or, are we coming close to something that Beethoven knew but didn't tell us?

(52) Fake Books, Jazz, Improvisation

It is important to learn **contemporary music** because it is educational (music theory, improvisation, new music genres), transforms you into a better performer, greatly widens your audience, rapidly expands your repertoire, creates many performance and income opportunities, makes you a more complete musician, gives you a greater sense of empowerment, requires only a modest investment of time — classical students are more than half way there already and, compared to classical music, you get quicker rewards for a given investment of time.

What is the most important skill you need to learn? Chords! Basic chords (3-note), inversions, major/minor, dominant 7th, diminished, augmented, larger chords, and how to use them. You can learn just a few of them, and start performing immediately. You also need to learn all the scales, and to coordinate the RH melody with the LH accompaniment (things you already know if you learned classical), the circle of fifths and chord progressions. You can be playing the simplest things in a matter of weeks; but it will take a year for most students to feel comfortable with this genre. For example, there is no such thing as true improvisation for at least a few years because true improvisation is almost as difficult in this genre as composing is, in classical. Although contemporary music is often considered to be freer than classical, it is restricted to a narrower range of musical parameters, which makes improvisation easier. What is generally referred to as improvisation is "practiced improvisation" in which you choose from optional "improvisations" that were previously practiced. The greatest reward of all this effort is that you will develop the ability to play by ear [(18) Play by Ear (PBE), Composing], which is one of the genius skills [(65) Creating Geniuses].

Begin study with Neely's "How to Play from a Fake Book". Fake books are simplified sheet music in which only the RH melody and the associated (LH) chords are indicated. It is up to the pianist to decide how to play these chords – this is why you need to learn all about chords; not only are there many of them, but each can be played in many different ways. Fake books are easy to start with because you don't have to know chord progressions – they are given to you on the sheet music.

The next reviewed book to use is "How to play the piano despite years of lessons" by Cannel and Marx, which is not a book about technique; instead, it teaches how to play jazz, popular songs, or from fake books. Again, we learn all about chords but, in addition, we learn about the circle of fifths and chord progressions, so that you can "play by ear" – remembering a melody, you should be able to figure out the melody with your RH and

add your own LH without a fake book. Gets you started immediately by playing simple stuff – read the review for more details. This is the only book of the three discussed here that treats rhythm, which is especially important in jazz.

A third book you may want to read is Sabatella's "A Whole Approach to Jazz Improvisation" which provides definitions of all the chords and scales, as well as discussions of jazz history and what music you should listen to, as examples of how they are played. This book can be browsed free (see review), but there are no lessons, songs, or music to play – just theory and discussions for those interested in jazz concepts.

Perhaps the happiest finding in all this is how restrictive the chord progressions are, in terms of the circle of fifths (see Cannel & Marx, Sabatella). This makes it easy to get started, giving you the time to advance progressively into more complex music. From a general music education point of view, we must all learn the circle of fifths because it is needed for tuning the violin, understanding temperaments and learning how to tune the piano in the temperaments, figuring out all the scales, their chords, and the key signatures, as well as understanding music theory. The section on (17) Absolute Pitch, Relative Pitch will be useful for this genre also. For those who are just starting piano but want to learn both classic and contemporary, Humphries, Carl,, may be the best choice.

In summary, the process of learning this genre consists of practicing the chords and scales sufficiently so that, given a melody, you can figure out the right chords that go along with it. You will learn to recognize the chord progressions, and use music theory. Therefore, if you take a long term approach, and start with a few simple pieces, you can start performing almost immediately and be able to keep advancing on your own schedule. It is important that you perform these pieces as soon as possible, and to quickly learn your strong/weak points. Because this genre is still young, the instruction books are not all consistent; for example, the circle of fifths in Sabatella goes clockwise with respect to the sharps, but goes counter clockwise in Cannel and Marx, and exactly how you should use the 7th chords depends on which book you read. The most important skill you will develop is play by ear [(18) Play by Ear (PBE), Composing].

(53) Sight Reading, Sight Singing, Composing

Sight reading means playing unfamiliar music, by reading the sheet music at the correct speed, and is a skill that is distinct from mere reading at slower speeds to learn a new composition. Beginning students should be taught reading first, then memorizing, and then sight reading. At advanced levels, sight reading involves the application of basic music theory, such as chord progressions and harmonies. Here are the basic rules for sight reading (see Richman for more details):

(1) Keep the eyes on the music; do not look at the keyboard/fingers. Glance at the hands occasionally when necessary for large jumps. Develop a peripheral vision so that you have some idea of where the hands are while still looking at the score and can keep track of both hands simultaneously. Feel the keys before playing them; although this

applies whether you are sight reading or just reading, it is critical in sight reading. Try to "get there ahead of time" for jumps; therefore, practice the jump maneuvers [Jumps, PP, FF].

(2) Learn all the common musical constructs: Alberti bass, major and minor scales and their fingerings as well as the arpeggios, common chords and chord transitions, common trills, ornaments, etc. When sight reading, you should recognize the constructs or phrases and not read the individual notes. Memorize the locations of those very high and very low notes as they appear on the score so that you can find them instantly. For those notes high above (or below) the staves, start by memorizing all the octave C's, then fill in the others, beginning with notes closest to the C's.

(3) Look ahead of where you are playing, about one bar, or even more, as you develop the skill at reading the music structure. Get to the point where you can read one structure ahead so that you can anticipate fingering problems and can avoid getting yourself into impossible situations. Although fingering suggestions on the music are generally helpful, they are often useless for sight reading because, although they may be the best fingerings, you may not be able to use them without some practice, and may not have time to figure them out. Therefore, develop your own set of fingerings for sight reading.

(4) Play through mistakes and make them as inaudible as possible. The best way to do this is to make it sound as if you had modified the music -- then the audience does not know whether you made a mistake or changed it, especially because you will often have to simplify things that are too complex to sight read. This is why students with basic music theory training will have an advantage in sight reading. Three ways to make mistakes less audible are (i) keep the rhythm intact, (ii) maintain a continuous melody (if you can't read everything, carry the melody and omit the accompaniment), and (iii) practice simplifying those parts that are too complicated to sight read. For advanced sight readers, the most powerful tool is the ability to simplify the music: eliminate ornamentals, fish out the melody from fast runs, etc.

(5) "Practice, practice, practice". Although sight reading is relatively easy to learn, it must be practiced every day in order to improve. It will take most students from one to two years of diligent practice to become good. Because sight reading depends so heavily on recognition of structures, it is closely related to memory. You can lose the sight reading ability if you stop practicing; however, just as with memory, if you become a good sight reader when young, you will be good all your life.

Keep adding to the "tricks of the trade" as you improve. Practice the art of scanning through a composition before sight reading it, in order to get some feel for how difficult it is. Then you can figure out ahead of time how to get around the "impossible" sections. You can even practice it quickly, using a condensed version of the learning tricks (HS, shorten difficult segments, use parallel sets, etc.), just enough to make it sound passable. I have met sight readers who would talk to me about some sections of a new piece for a

while, then play through an entire piece with no trouble. I later realized that they were practicing those sections in the few seconds they had while they were distracting me with their "discussions".

Gather several books with easy pieces. Because it is initially easier to practice "sight reading" with familiar pieces, you can use the same compositions to practice sight reading several times, a week or more apart. This will familiarize you with common constructs and phrases. "Sonatina" books, Mozart's easier sonatas, and books of easy popular songs, are good books for practicing. For the easiest pieces, you might use the beginner books, or the easiest Bach pieces. Although you can develop a lot of sight reading skills with familiar pieces, you must eventually practice with pieces that you had never seen before in order to develop true sight reading skills. The most useful skill for help with true sight reading is sight singing, or solfege. Learning absolute pitch is one of the best ways to develop sight singing.

Sight singing and composing: To be able to write down a music or your composition, it is necessary to study dictation. Practice dictation by practicing sight singing. Take any music and read a few bars and sing it or play it using MP. Then check it out on the piano. If you do this with enough music that you had never heard before, you will learn sight singing and develop the dictation skills.

For practicing to play "by ear", practice sight reading. Once you become fairly good at sight reading (this may take over 6 months), start playing out your own melodies on the piano. The idea behind learning sight reading is to familiarize yourself with common runs, chords, accompaniments, etc., so that you can find them quickly on the piano. Another way is to start playing from fake books and practicing improvisation.

When **composing**, don't worry if at first you find it difficult to start a piece or end it – they have simple solutions you can learn quickly later. Start by building a collection of ideas that you can later assemble into a composition. Don't worry that you have never had any lessons in composition; it is best to develop your own style first, then study composition to help you to nurture that style and to solve problems such as making your music longer or finding an ending. Music never comes "on demand", which can be frustrating; therefore, when ideas come, you must work on them immediately.

Composing at a good concert grand can be inspirational. Although digital pianos are adequate for composing popular music and practicing jazz improvisations, a quality grand can be very helpful when composing high level classical music.

Once you have composed for several years, start taking composition lessons. Don't try to learn all the composition rules at once, but learn them as you need them. Mental play skills are necessary for composing. Not having absolute pitch will be a major handicap.

(54) Stretching and Other Exercises

The hand has two sets of muscles that spread the fingers/palm to reach wide chords.

One mainly **opens the palm** and the other mainly spreads the fingers apart. When stretching the hand to play wide chords, use mainly the muscles that open the palm. The feeling is that of spreading the palm but with free fingers; i.e., spread the knuckles apart instead of the fingertips. Spreading the fingers helps to widen the palm but it interferes with the finger movement because it tends to lock the fingers to the palm. Cultivate the habit of using the palm muscles separately from the finger muscles. This will reduce both stress and fatigue when playing chords, enable faster play and a more rapid relaxation, and improve control. In the end, you will use both sets of muscles, but it is useful to know how to spread the palm independently of the fingers.

Palm spreading: It is more important, but more difficult, to stretch the palm instead of the fingers. One way is to place the right palm over the left palm, right arm pointing left and left arm pointing right, with the hands in front of the chest. In this position, thumb meets pinky; interlock the thumbs and pinkies so that fingers 2,3,4 are on the palm side and 1,5 protrude on the back side of palm. Then push the hands towards each other so that thumbs and pinkies push each other back, thus spreading the palm. Also, exercise the palm and finger spreading muscles while simultaneously applying the pushing force. This spreading is not an isometric exercise, so the stretching motions should be quick and short. Regular (daily) stretching from youth can make a considerable difference in the reach when you get older, and periodic maintenance will prevent the reach from decreasing with age, as it normally would. The webbings between fingers can be stretched by jamming them against each other using the two hands. For example, to stretch the webbings between fingers 2 and 3, spread those 2 fingers on both hands to form Vs. Then jam the vertices of the 2 Vs (the webbings) against each other to stretch them. For maximum effectiveness, use the palm and finger spreading muscles to stretch the palm with every jamming motion. Again, don't perform these like isometric exercises but use quick spreading motions. Most people have a slightly larger left hand, and some can reach more by using fingers 1,4 than 1,5.

Finger spreading: In order to test whether the fingers/palm are fully stretched, open the palm and fingers for maximum reach; do this on a flat surface with the wrist touching the surface. If the pinky and thumb form a almost straight line, you can not increase the reach any more. If they form a "V", then the reach can be expanded by performing spreading exercises. Another way to test this alignment is to place the palm on a table top at the edge of the table with the thumb and pinky down the edge, so that only fingers 2, 3, and 4 are resting on the table top, and the finger tips of 1 and 5 are touching the table edge. If the thumb and pinky form a triangle with the edge of the table, the stretch can be expanded. Perform a spreading exercise by pushing the hand towards the table edge so as to spread the thumb and pinky apart; when fully opened, thumb and pinky should form a straight line.

When playing wide chords, the thumb should be curved slightly inwards, not fully stretched out. For those who have thumbs that can bend backwards, pay attention to this

thumb position for maximum stretch; if you form the habit of bending the thumb all the way backwards, this habit will be almost impossible to reverse and make TO difficult. It is counter-intuitive that, by bending the thumb in, you can reach further; this happens because of the particular curvature of the thumb's fingertip.

There are a few exercises that may be helpful for technique.

F**inger independence** and **lifting** exercises are performed by first pressing all five fingers down, e.g., from C to G using the RH. Then play each finger four times: CCCCDDDDEEEEFFFFGGGG; while one finger is playing, the others must be kept down, to the bottom of the keydrop. Do not press down firmly; that will create stress. The gravitational weight of the hand should be enough. Beginners may find this exercise difficult in the beginning because the non- playing fingers tend to collapse from their optimum positions or lift involuntarily, especially if they begin to tire. If they tend to collapse, try a few times and then switch hands or quit; do not keep practicing in the collapsed or uncontrolled condition. Then try again after some rest. One variation of this exercise is to spread out the notes over an octave. This type of exercise was already in use during F. Liszt's time (Moscheles). They should be done using the curled as well as the flat finger positions. Some piano teachers recommend doing this exercise once during every practice session.

For **finger lifting** exercises, repeat the above exercise, but lift each finger as high as you can, quickly and immediately relax. The motion should be as fast as you can, but with control. Again, keep all the other fingers down with minimal pressure. As usual, it is important to reduce stress in the fingers that are not being lifted. Practice rapid relaxation immediately after the fast lift.

Everyone has problems with lifting the **4th finger**. There is a mistaken belief by many that we must be able to lift the 4th finger as high as all the others and therefore they expend an inordinate amount of effort trying to achieve this. Such efforts have been proven to be futile and even harmful. This is because the anatomy of the 4th finger does not allow it to be lifted beyond a certain point. The only requirement on the 4th finger is not to depress a key inadvertently, which can be met with only a small amount of lift, especially for the flat finger positions. Therefore play at all times with the 4th finger barely off the keys or even touching them. Practicing difficult passages with inordinate effort at lifting this finger higher can cause stress in fingers 3, 4, and 5. It is more productive to learn to play with less stress as long as the 4th finger is not interfering in any way. The exercise for lifting the 4th finger independently is performed as follows. Press all fingers down, CDEFG, as before. Then play 1,4,1,4,1,4, . ., with the accent on 1 and lifting 4 as quickly and as high as you can. Then repeat with 2,4,2,4,2,4, . . . Then 3,4, then 5,4. You can also do this exercise with 4 on a black key. Both the finger independence and lifting exercises can be performed without a piano, on any flat surface.

Another way of lifting the 4th finger is to flick it out into the flat finger position instead of lifting it. This motion is preferable for most cases because it is faster than the

lift motion. Try the above exercises by using the flicking motion instead of the lift. You should notice that the flicking motion is faster and the finger tip lifts higher than the lifting motion, and creates less stress. In actual playing, you will use both.

Stretching the flexor muscles and tendons: We mainly utilize the flexors for playing the piano and the extensors are insufficiently exercised. This makes it difficult to lift the fingers, especially the 4th, against the over-developed flexors. One way to alleviate this problem is to perform stretching exercises for the flexor muscles and tendons. Form a flat LH and place all the LH fingers against the RH palm and use the RH to push the LH fingers backwards towards the forearm. A person with very flexible flexors will be able to push the fingers all the way back until they touch the forearm (not many). Most people should be able to push the fingers past the point at which the fingers are at 90 degrees to the forearm. Push as far as you can (without pain) for six seconds, then release for four seconds; repeat several times. Do same with the RH fingers. Perform this once daily and you will be amazed at how much more you can stretch in just a few months. This will make it easier to lift the fingers and prevent them from curling up completely when not in use.

Even "mindless exercises" might have some uses, such as just before a strenuous performance, when you need to conserve as much energy as possible.

Historically, exercises were invented for a good reason: to solve specific technical problems. Misuse of exercises started when they replaced knowledge based practice methods, enabling teachers with little knowledge to "teach" piano.

During the periods leading up to the "exercise craze" of the 1900s (Cortot, Alfred,,), and even today, there is belief that the best techniques require practicing extremely difficult exercises, many of which never occur in actual music. Thus the most difficult exercises were created with the belief that you aren't an advanced pianist if you can't play them. This belief also influenced the piano culture in which certain difficult pieces of music had to be mastered in order to be considered an advanced pianist, whether those pieces were to be performed or not. This culture was partly accepted by Chopin, Liszt, etc., who wrote Etudes for the purpose of developing technique. Such "technical pieces" are now a part of advanced piano culture and certainly contribute to better technique. Practice methods for such advanced technique, for which there is presently no documentation, should be researched and added to what is in this book.

Conclusion: using daily finger exercises to "strengthen the fingers" for technique acquisition is obsolete. We now understand the role of efficient practice methods and most of them have been documented. There are a few stretching exercises for increasing the reach and reducing the natural deterioration with age. There are etudes, technically difficult pieces, etc., that are needed for demonstrating advanced technique.

(55) Performance Preparation, Videotaping

(1) Videotaping: One of the best ways to improve musical playing and to practice

for performances is to videotape your playing. You will be surprised at how good and how bad the different parts of your performances are. They are often quite different from what you imagine yourself to be doing: good touch? rhythm? tempo accurate and constant? What motions are breaking up the rhythm? Do you clearly bring out the melodic lines? Is one hand too loud/soft? Are the arm/hands/fingers in their optimum positions? Are you using the whole body -- i.e., is the body in synch with the hands or are they fighting each other? All these and much more become immediately obvious. The same music sounds different when you are playing it compared to when you are watching it on video. You may be slowing down at difficult sections and playing too fast in easy ones. Are the pauses long enough? Are the endings convincing?

The recording session will reveal how you react in an actual performance. If you make a mistake or have a blackout, do you react negatively to mistakes and become discouraged, or can you recover and concentrate on the music? Some students will smile or make faces at a mistake, but that is not appropriate; the best policy is to ignore it because you want to attract the least attention to mistakes. During a performance, students tend to get blackouts, etc., at unexpected places where they had no trouble during practice. Recording sessions can flush out most of those problem spots. Pieces are not "finished" unless you can record them satisfactorily.

The main disadvantage of videotaping is that it takes a lot of time, because you must watch the recordings — precious time you could have spent practicing. Every time you correct a section, you must re-record and listen again. The videotaping *sessions* are not a waste of time because that is part of practice time. It is something that every piano student must do, yet is too often neglected. Today, you can videotape on a smart phone and immediately watch it on the computer.

(2) Performance Preparation Routines: Even if a student can play perfectly during practice, he can make mistakes and struggle with musicality during a recital without a proper performance preparation routine. Most students intuitively practice hard and at full speed during the week preceding the recital, and especially on the day of the recital. In order to simulate the recital, they imagine an audience listening nearby and play their hearts out, playing the entire piece from beginning to end, many times. This practice method is the single biggest cause of mistakes and poor performance. The most telling remark I heard most often is, "Strange, I played so well all morning but during the recital, I made mistakes that I don't normally make!" To an experienced teacher, this is a student practicing out of control without any guidance about right and wrong methods of performance preparation.

Teachers who hold recitals in which the students perform wonderfully and win all the piano competitions keep a tight leash on their students and control their practice routines closely. Why all this fuss? All mistakes originate in the brain. All the necessary information must be stored in an orderly manner in the brain, with no confusion. This is why improperly prepared students always play worse in a recital than during practice.

When you practice at full speed, a large amount of confusion is introduced [(27) Fast Play Degradation, Eliminating Bad Habits]. The environment of the recital is different from that of the practice piano, and can be distracting. Therefore, you must have a simple, mistake-free memory of the piece that can be retrieved in spite of all the added distractions.

Through trial and error, experienced teachers have found practice routines that work. The most important rule is to limit the amount of practice on recital day, so as to keep the mind fresh and uncluttered. Recall that any improvement in technique and memory occur during sleep [(23) Post Practice Improvement, Sleep, Fast/Slow Muscles], so that practicing on the day of the recital can only make things worse, something that is so counter intuitive. The brain is unreceptive on recital day. It can only become confused. Only experienced pianists have sufficiently "strong", trained brains and performance capabilities to assimilate something new on recital day. By the way, this also applies to tests and exams at school. Most of the time, you will score better in an exam by going to a movie the night before the exam than by cramming. A major reason why cramming doesn't work is that it deprives the student of a good night's sleep.

The practice routine for recital day is to play *nearly* full speed once, then medium speed once and finally once slowly. That's it! No more practice! Never play faster than recital speed. Don't play your heart out, play with minimal expression and reserve your "heart" for the performance; otherwise, you will lose the freshness and find that you have nothing left during the performance. Notice how counter intuitive this is. Since parents and friends will always act intuitively, it is important for the teacher to make sure that any person that comes in contact with the student also knows these rules, especially for the younger students. Otherwise, in spite of anything the teacher says, the students will come to the recital having practiced all day at full speed, because their parents made them do it.

This routine is for the typical student and is not for professional performers who will have much more detailed routines that depend on the type of music being played, the particular composer, and piece to be played. Clearly, for this routine to work, the piece will have had to be ready for performance way ahead of time, at least six months. Even if the piece has not been perfected and can be improved with more practice, the above paragraph is the best routine for the recital day.

If, during these allowed practices, you make a mistake that is "stubborn" (most students can recognize these), it will almost certainly recur during the recital. In that case, fish out the **few bars** containing the mistake and practice those at moderate speeds and HS (always ending with slow play), then test it at almost final speed, and end with several slow plays, just those few bars. If you are not sure that the piece is completely memorized, play the insecure section very slowly several times. At this time, MP is critical -- it is the ultimate test of memory and readiness to perform. Practice MP at any speed and as often as you want; it can also calm nervous jitters because it satisfies the urge to practice on performance day, and keeps you occupied instead of worrying and

getting more nervous.

Avoid extreme exertion, such as playing a football game or lifting or pushing something heavy (such as a concert grand!). This can suddenly change the hand memory and you can make unexpected mistakes. Of course, mild warm-up exercises, stretching, calisthenics, Tai Chi, Yoga, etc., are beneficial.

For the week preceding the recital, always play at medium speed, then slow speed, before quitting practice. You can skip the medium speed if you are short of time, or if the piece is particularly easy, or if you are a more experienced performer. Medium is about 3/4 speed, and slow is about half speed. More generally, medium speed is the speed at which you can play comfortably, relaxed, and with plenty of time to spare between notes. At slow speed, you need to pay attention to each note; the more difficult, the slower, but preserving the same hand motions required at speed.

Up to the day before the recital, you can work on improving the piece, especially musically and HS. But within the last week, adding new material or making changes in the piece (such as fingering) is not recommended, although you might try it as a training experiment to see how far you can push yourself. The ability to add something new during the last week is a sign that you are a strong performer; in fact, purposely changing something at the last minute is a good performance training method that some teachers use, if you are a sufficiently strong performer.

For working on long pieces such as Beethoven Sonatas, avoid playing the entire composition many times. It is best to practice short segments of a few pages, or one movement at most, always including a few bars of the next section or movement. Practicing HS is also an excellent idea. Although playing too fast is not recommended in the last week, you can practice at higher speeds HS.

Avoid learning new pieces during this last week. That does not mean that you are limited to the recital pieces; you can still practice any piece that was previously learned. New pieces will often cause you to acquire new motions that affect or alter how you play the recital piece. usually, you will not be aware that this happened until you perform and wonder how those strange mistakes crept in.

Make a habit of playing your performance pieces "cold" when you start any practice session. Of course, "playing cold" has to be done within reason. If the fingers are totally sluggish from inaction, you cannot, and should not, play difficult material at full speed; it will lead to stress and bad habits. Simply slow down to playable speed. Some pieces can only be played after the hands are completely limbered up, especially if you want to play it musically, such as bringing out the color.

Practice just the starting few bars, from several days prior to the recital. Pretend that it is recital time and play those few starting bars anytime you walk by the piano. Choose the first line and practice a different number of bars each time. Don't stop at the end of a bar, always include the first beat of the next bar. You might photographically memorize the first few bars. When you start a piece easily and beautifully during a recital, you will

be surprised at how well the rest comes out; on the other hand, even a small problem at the beginning can ruin the whole performance.

Blackouts are some of the most disastrous events but they can be eliminated by using several procedures. The first is mental play (MP). When practicing MP, learn to picture the entire structure of the composition in your mind and develop the ability to know where in that structure you are playing. Then practice starting from anywhere in that structure, so that you can restart after a blackout.

One cause of blackouts is dependence on hand memory which is dangerous because hand memory is notoriously unreliable. This is because it is a reflex memory that depends on stimuli from previously played notes and largely bypasses the brain. Thus if any circumstance changes, such as a different piano, or a concert hall, nervousness, or the presence of an audience, the stimuli will change, resulting in a blackout. Once a blackout happens, all the usual stimuli disappear and the pianist is unable to re-start. For a student who has only hand memory, the only alternative is to re-start at the beginning.

Slow play is the best way to reduce the dependance on hand memory because reflexes are speed dependent; this forces the brain to intervene and take over the playing. **Therefore, playing slowly before quitting is absolutely essential for the week before a performance.**

Practice recovering from mistakes. Attend student recitals and watch how students react to their mistakes; you will easily spot the good reactions and the inappropriate ones. A student showing frustration or shaking the head after a mistake is creating three mistakes out of one: the original mistake, an inappropriate reaction, and broadcasting to the audience that a mistake was made. Every practice session must be a practice session for avoiding mistakes, making them unnoticeable. Pretend that you are accompanying a choir or playing a concerto and must pick up the music at the correct spot.

(3) Casual Performances are probably the most effective and easy ways to practice performing. Common types of casual performances are playing pieces for testing pianos in stores or playing for friends at parties, etc. These are different from formal recitals because of their greater freedom and reduced pressure. Nervousness should not be an issue, and is in fact one of the best ways to practice methods for controlling or avoiding nervousness.

For an easy start, play snippets (short segments from a composition). Start with simple ones; pick out the best sounding sections. If it doesn't work out too well, start on another one. Same, if you get stuck; time to move on to a new piece. This is a great way to experiment and find out how you perform and which snippets work. Do you tend to play too fast? It is better to start too slow and speed up than the other way round. Can you adjust to a different piano -- especially one that is out of tune or difficult to play? Can you keep track of the audience reaction? Can you make the audience react to your playing? Can you pick the right types of snippets for the occasion? What is your level of nervousness, can you control it? Can you play and talk at the same time? Can you gloss

over mistakes without being bothered by them?

Another way to practice performing is to teach others, especially youngsters, to play. Teach them how to play the C major scale, or "Chopsticks" or Happy Birthday. Duets are perfect for this.

Playing snippets is effective because most audiences are impressed by the ability to stop and start anywhere in the middle of a piece — only concert pianists can do that, right? Most people assume that the ability to play snippets requires special talent. Start with short snippets, then gradually try longer ones. It's much easier to play snippets mistake free. Once you have done this type of casual snippet performance on 4 or 5 different occasions, you will have a good idea of your performance capabilities. One of the routines you should practice "cold" are snippet playing routines — they need practice too.

There are a few rules for snippet performances. Don't perform a piece you had just learned. Let it stew for at least 6 months; preferably one year. If you had spent 2 weeks learning a difficult new piece, don't expect to be able to play snippets that had not been played at all in those 2 weeks -- be prepared for surprises, such as blackouts. Don't practice the snippets fast on the day on which you might be performing them. Practicing them very slowly will help. Can you still play them HS? HS play can be one type of snippet performance, and you can play them very fast! Make sure that you can MP everything -- that is the ultimate test of your readiness.

In general, don't expect to perform anything well, casual or otherwise, unless you have performed that piece at least three times and, some claim, at least five times. It is certainly not going to be like the best run you made during practice. Without this mental expectation, you can end up disappointed after every attempt at performing and develop psychological fears.

A few mistakes or missed notes go unnoticed in practice, and your assessment of how you sound during practice is more optimistic than the assessment if you had played exactly the same way for an audience. After a practice, you tend to remember only the good parts, but after a performance, you tend to remember only the mistakes. Usually, you are your worst critic; every slip sounds worse to you than to the audience. Most audiences will miss half of the mistakes and forget most of the rest, unless *you* make a big deal out of it.

Classical music is not always the best venue for casual performances. Thus every pianist should learn popular music, jazz, cocktail music, music from fake books, and improvisation. They provide some of the best ways to practice for recitals.

(4) Benefits and Pitfalls of Performances/Recitals: The benefits and pitfalls of performing should determine our daily piano learning programs. Technique is never really acquired until it is demonstrated in a performance. For young students, the benefits are immeasurable. They learn what it means to complete a task, and they learn what "making music" means. Most youngsters (who don't take music lessons, etc.) don't learn

these skills until they go to college; piano students must learn them by their first recital, regardless of age. Then they repeat this (59) Project Management process with every new piece of music they learn. Successful pianists become masters of project management, a skill that is useful everywhere, not just for piano.

Students are never as self-motivated as when preparing for a recital. Teachers who have held recitals know those enormous benefits. Their students become focused, self-motivated, and results oriented; they listen intently to the teacher and really try to understand the meaning of the teachers' instructions. They become deadly serious about eliminating all errors and learning everything correctly -- it is capitalism at its best, because it is *their* performance. Teachers without recitals often end up with students who practice a few times just before lesson day.

Because the psychology and sociology of piano playing is not well developed, there are pitfalls that we must consider. Most teachers are not trained in psychology and expect the students to be able to step up to the piano, sit down, and play without proper training. The most important consideration is nervousness and its impact on the mind, especially for the young. Nervousness can make recitals a frightful experience that requires attention in order to avoid not only unhappy experiences but also lasting psychological damage. At the very least, reducing nervousness will alleviate stress and fright. This subject will be treated more completely in the section on [(56) Origin and Control of Nervousness]. There is active research in the science of performance optimization (Kotier). At this writing one major principle of performance enhancement is based on the concept of "flow" (Csikszentmihalyi), but it has not been applied to piano performance. Thus piano pedagogy is behind other disciplines in understanding and applying advanced concepts in performance, in spite of the fact that piano is a performing art.

There are numerous psychological and sociological implications of recitals and competitions. The judging systems in music competitions are notoriously unfair, and judging is a difficult and thankless job. Thus students entered into competition must be informed of these shortcomings of the "system" so that they do not suffer mental anguish from perceived unfairness and disappointment. There may be 30 contestants, but only one can "win"; from an educational point of view, that is counter productive. It is difficult, but possible, for students to understand that the most important element of competitions is that they participate, not that they win. There is too much emphasis on technical difficulty and not enough on musicality. The system does not encourage communication among teachers to improve teaching methods. It is no wonder that there is a school of thought that favors eliminating competitions. There is no question that recitals and competitions motivate students to try harder; but the present system can certainly be improved by better overall teacher education and better communications among teachers.

(56) Origin and Control of Nervousness

Performance training must include education on stage fright. Even great artists have

stopped performing for periods of time and some of the reasons were related to nervousness. Although good piano teachers always hold recitals of their students and enter them into competitions, they have tended to be poor sociologists or psychologists, concentrating only on piano playing and ignoring nervousness. It is important for any person guiding youngsters through recitals and competitions to learn the fundamentals of what causes nervousness, how to deal with it, and its psychological consequences. Because teachers fail so often, the parents must look out for the social and psychological welfare of their children.

Nervousness is a natural human emotion and arises in critical situations. Therefore, it is normally a performance enhancing reaction. Nervousness makes us concentrate all our energies towards the critical task. Most people dislike nervousness because it is too often accompanied, or is caused, by fear of failure. Therefore, although nervousness is necessary for a great performance, it needs to be kept under control; otherwise, it can interfere with the performance and cause suffering. Performing should be a rewarding experience of communicating through music, not the most terrifying experience of a child's life.

Emotions are basic, primitive, animal reactions, and have evolved to be helpful under normal circumstances. However, under extreme conditions, emotions can get out of control, and become a liability, unless your name is Wolfie or Franz (Freddy apparently didn't qualify, as he was a nervous wreck and disliked public performances; however, he seemed more comfortable in a salon environment). Youngsters, who are too frightened to perform solo, almost always enjoy performing in a group. This shows the importance of the mental perception of the situation.

By the time nervousness becomes a problem, it is usually spinning out of control. A lack of understanding of nervousness also creates fear because of the fear of the unknown. Thus the simple knowledge of what stage fright is, and what generally happens during a performance, can be a calming factor by reducing the fear of the unknown.

How does nervousness grow out of control, and are there ways to prevent it? According to fundamental science, practically anything in our universe grows by a process known as the Nucleation-Growth (NG) mechanism. The NG theory states that an object forms in two stages, nucleation and growth. This theory became popular because it is in fact the way in which the majority of objects in our universe form, from raindrops to cities, stars, humans, etc. Tiny nuclei are always forming and disappearing, but there is a thing called a **critical nucleus** which, when formed, becomes stable -- it does not disappear. In general, the critical nucleus does not form unless there is a supersaturation of the material that aggregate to form it. For the object to grow to its final size, the critical nucleus needs a growth mechanism by which to increase its size. In general, the growth mechanism is different from the nucleation mechanism. One interesting aspect of nucleation is that there is always a barrier to nucleation -- otherwise, everything would have nucleated a long time ago. Growth is a two-way street: it can be positive or

negative.

Let's apply NG theory to nervousness. In everyday life, your sense of nervousness comes and goes, without becoming anything serious. However, in an unusual situation such as a performance, there is a supersaturation of factors that cause nervousness: you must perform flawlessly, you didn't have enough time to practice the piece, there is a big audience out there, etc. However, this still may not cause any problem because there are natural barriers to nucleating nervousness, because the person may not even be aware of nervousness, or might be too busy finalizing the preparations for the recital. But then, a fellow performer says, "Hey, I got butterflies in my stomach!" and you suddenly feel a lump in your throat and realize that you are nervous -- the critical nucleus has formed! This may still not be that bad, until you start to worry that perhaps your piece is not yet ready to perform or the nervousness might interfere with the playing -- these fears cause the nervousness to grow. Thus, asking a performer, "aren't you nervous?", etc., is the worst thing to do. On the other hand, a teacher who ignores nervousness and doesn't teach performance preparation is not doing her job.

It is not a good idea to pretend that nervousness does not exist, especially with youngsters who can more easily suffer lifelong psychological damage. Kids are smart and they can easily see through the pretense, and the need to play along with the pretense can only increase the stress because they must shoulder the burden by themselves and feel alone and abandoned. This is why performance training, in which nervousness is discussed and studied, is so important. For young students, the parents and friends attending the recital need to be educated. Statements like "I hope you aren't nervous!" or "How can you perform without getting nervous?" are almost certain to cause nucleation and growth. Unless you know what you are doing, stay away from such statements! You can help by keeping them busy, giving them simple tasks to do or discussing details of the music, how to adjust the chair, etc.

The nice thing about scientific theory is that it not only describes the process, but also provides solutions. We can attack nervousness at the nucleation stage; if we can prevent nucleation, it will never form a critical nucleus. Merely delaying the nucleation will be helpful because that will reduce the time available for it to grow. Playing easier pieces will reduce the supersaturation of worry. Mock recitals will give you more experience and confidence; both will reduce the fear of the unknown. Generally, you need to perform a piece three or more times before you know whether you can perform it successfully or not; thus performing pieces that had been performed several times will also help. All these factors reduce the supersaturation for nucleation. For someone like Mozart, nervousness never nucleates because there is no supersaturation of factors like fear of mistakes, etc.; instead, he was always eager to show off, which is the opposite of supersaturation. The eagerness to make music for the audience can prevent stage fright.

Nervousness is generally worst before a performance; once you start playing, you are so busy with the task at hand that there is no time to dwell on nervousness, thus

reducing the growth factor. This knowledge helps because it alleviates the fear that things might get worse during the performance. Not dwelling on nervousness is another way of delaying the nucleation as well as slowing the growth stage. Thus it is a good idea to keep yourself occupied while waiting for the recital to begin. MP is useful because you can check your memory and keep yourself occupied at the same time; thus MP is the most important tool for preventing or delaying nucleation and for reducing growth. Playing musically is a surprisingly effective antidote against nervousness; when you can involve your entire brain in the business of creating music, there is little brain resources left to worry about nervousness

Performance training must include lessons on how to react to various circumstances, such as when you make mistakes or have blackouts. For students who tend to have blackouts, have the sheet music ready; just the knowledge that the sheet music is available can reduce blackouts. Placing the music on the piano or nearby can act as a security blanket. A student must always bring the music with them to the recital. It is important, early in a student's career, to play easy pieces that can be performed without nervousness. Even one such experience can provide the existence proof that performing without nervousness is possible. That single experience can influence the performance attitude for life.

Some have claimed that, under a doctor's supervision, medications such as Inderal and Atenolol, or even Zantac will work to calm nerves. Conversely, you can make it worse by drinking coffee or tea, not getting enough sleep, or taking certain cold medications. The best solution is to learn enough about nervousness so that it can be controlled without medication.

In summary, stage fright is nervousness that has spiraled out of control. A certain amount of nervousness is normal and helpful. You can minimize nervousness by delaying its nucleation by keeping busy and reducing its growth by playing musically. MP is the most effective tool for these purposes. It is pure ignorance, and not helpful, to ask "do you get nervous when you perform?" Everyone does, and should. We only need to contain nervousness so that it does not grow out of control. Nervousness is worst just before you begin to play; once you start, you are too busy with the playing to worry about nervousness and this will cause it to shrink. This knowledge can be reassuring, and can accelerate the reduction. There is a wide range of individuals from those who don't get nervous at all, to those who suffer debilitating stage fright. Nervousness needs to be taught in such a way that most students can be in the camp that never gets nervous through performance preparation routines and performance training programs. Having fun with contemporary music such as pop, jazz, and improvisation, is a good way. Playing easy pieces, and practicing with playing snippets in casual events, is another.

(57) During, After the Performance

Some pianists will delay starting by adjusting the bench or some clothing item in

order to have time to double check that the starting tempo, etc., are correct, using MP. On the other hand, since you can MP the music before walking on the stage, many concert pianists can start play very quickly, reducing the time to get nervous. Do not assume that there won't be any mistakes; that assumption can only invite more trouble because you will feel terrible when a mistake does occur. Instead, be ready to react correctly with each mistake, or more importantly, anticipate an impending mistake that you may be able to avoid. It is amazing how often you can feel an impending mistake before it hits, especially if you are good at MP. Recall that during MP, you were surprised that you made the same mistakes and got stuck at the same places as when you were actually playing.

Most students, when they make a mistake or when they anticipate one, get scared and start playing more slowly and softly. This is a formula for disaster. Although hand memory is not something you want to depend on, this is one time you can take advantage of it. Hand memory depends on habit and stimuli; therefore, in order to enhance hand memory, you must play slightly faster and louder. The faster play makes better use of the playing habits, and leaves less time for moving some wrong muscle that might derail you. The firmer play increases the stimuli for the hand memory. Now playing faster and louder are scary things to do during a recital, so you should practice this just as you practice anything else. Learn to anticipate mistakes and to avoid them by using these avoidance maneuvers. Another method of playing through mistakes is to make sure that the melodic line or the rhythm is not broken, even at the cost of missing some less important notes. With practice, you will find that this is easier than it sounds; the best time to practice this is when you are sight reading.

If you have a blackout, don't try to restart from where you blacked out unless you know exactly how to restart. Restart from a preceding section or a following section that you know well -- preferably a following section because mistakes usually cannot be corrected during the recital and you will probably repeat the same blackout. Secure MP will eliminate practically all blackouts, especially if you have absolute pitch. If you decide to replay the blackout part, play slightly faster and louder; not slower and softer.

In a concert hall with good acoustics, the sound of the piano will be absorbed by the hall and you will hear very little of the piano sound compared to your home or practice room. It is obviously important to practice with the recital piano in the recital hall before the event. For a grand piano, if the music stand it up, you will hear almost no sound from the piano in a concert hall with good acoustics; always make sure that the music stand is down. If you need to read music, place it flat over the tuning pin area.

That unfamiliar piano: Some students fret that the recital piano is a huge grand whereas they practice on an old upright. Fortunately, the larger pianos are easier to play than the smaller ones. Therefore the issue of a different piano is usually not something to worry about. Larger pianos have better action, and both louder and softer sounds are easier to produce. Grands are easier to play than uprights, especially for fast, difficult

passages. The only time you have to be concerned about the piano is when the performance piano is decidedly inferior to your practice piano. The worst situation is the one in which your practice piano is a quality grand, but you must perform using a low quality upright that is out of tune. In that case, technically difficult pieces will be difficult to play on the inferior piano and you may need to make adjustments by playing slower, or shortening or slowing down trills, etc.. That's when you really find out how strong you are, as a performer.

A piano in tune is easier to play than one out of tune. Therefore, the recital piano should be tuned just before the recital. Conversely, it is not a good idea to tune the practice piano just before the recital (unless it is badly out of tune) so that it is in better tune than the recital piano.

After the Recital: Review the recital and evaluate your strengths and weaknesses so that the practice/preparation routines can be improved. A few students will be able to play consistently without audible mistakes. Most of the others will make several mistakes every time they play. Some will tend to bang on the piano while others are timid and play too softly. There is a cure for every problem. Those who make mistakes probably have not yet learned to play sufficiently musically and almost always are not using MP. Those who tend to play flawlessly invariably have learned MP, whether they do it consciously or not. Students who play above their skill level always have trouble with recitals; they can try to learn difficult material, but for recitals, students must stay within their skill level.

Recital preparation routines ARE extremely important; make sure you have one and are following it. The most important ones are not to over-practice on recital day, and to play slowly at least once before quitting practice; although this should be done at every practice session, it becomes critically important from about one week before the recital.

Playing several recitals in succession is the hardest thing to do. But if you must, then you will need to recondition the recital pieces immediately following the recital. Play them with little or no expression, medium speed, then slow speed. If certain sections or pieces did not come out satisfactorily during the recital, work on them, but only in small segments. If you want to work on the expression at full speed, do this also in small segments and/or follow it up with slow play.

After such repeat performances (in fact, after every performance), play it slowly as soon as you can, in order to erase the fast play degradation and "reset" the music in your mind. A similar process takes place in a computer: after continuous use, data fragmentation occurs and the memory disk must be "defragged" to restore the data to their proper locations.

(58) Summary of Method (One Page)

1. Learn only musical, performable, compositions; no Hanon, Czerny, exercises, etc., but scales, arpeggios, chromatic scale are necessary, and performable etudes (Chopin, Liszt) are helpful. Certain exercises may be necessary for advanced students.

2. Listen to performances and recordings to improve musicality.

3. Practice Hands Separate, in Segments (Segmental Practice) that overlap (Continuity Rule); switch hands before the working hand becomes tired. Get up to speed quickly. All technical development should be done HS.

4. Practice the most difficult sections first.

5. Memorize first, HS, practice only from memory.

6. Learn Mental Play as soon as you start to memorize, and use it to develop Relative/Absolute Pitch and Play By Ear skills.

7. Use Parallel Sets to diagnose weaknesses and correct them.

8. Practice softly, without pedal, and use staccato practice until satisfactory.

9. Learn how to relax.

10. Play the last repetition of any repeated practice slowly, especially during the week preceding a recital.

11. Play through mistakes to prevent stuttering.

12. Use the metronome to check the rhythm or speed briefly; do not use it for ramping up speed or continuously for any length of time.

13. Use Post Practice Improvement which occurs during sleep.

14. Hand motions: forearm rotation, curled and flat finger positions, thumb over, power thumb, jump rules, glissando motion, quiet hands/fingers, cartwheel motion, finger splits, finger/wrist/hand staccato, many more.

15. Hands Together methods are the same as HS methods (2-14, change HS to HT) until satisfactory. Use outlining.

16. Sight reading rules: look at the sheet music, not the hands; read in phrases, read one or more bars ahead, memorize all common constructs, learn how to practice using mental play only, away from piano.

17. Play old finished pieces cold to strengthen your performance skills. Practice advanced technique using finished pieces.

18. Performance preparation routine: Practice the recital piece ONLY: once at nearly full speed, once at medium speed, and once at slow speed, on recital day. Practicing insecure sections in small segments, below final speed, is permissible; avoid over-practicing. Always play slowly at least once before quitting.

19. Most upright acoustics are obsolete; use digital pianos for beginners; those above intermediate level will need either a higher quality digital or a acoustic grand.

20. Fastest way to become a concert pianist is to learn absolute pitch, mental play, play by ear, and efficient practice methods starting before age four.

CHAPTER TWO
Piano Topics

(59) Project Management

Every time pianists learn a new piece of music, they go through an exercise in **project management (PM)**. Since pianists must learn many pieces and complete each from start to final performance, they become experts in PM. Once they learn PM, it can be applied to anything they do in life, whether they are studying guitar, violin, or flute, or are architects, sculptors, carpenters, gardeners or generals of an armies; Alexander the Great used PM principles to create his empire.

The rules for PM are simple; what makes PM complex is the required knowledge base — as expected, the success depends on knowledge. We discuss here the basic PM framework with a few examples from piano.

Basic Rules

(1) Preparation: A project must have a plan based on knowledge of what is needed to start, execute, finalize, and maintain it after completion. It must have an objective and a time table. It is necessary to first gather all the information needed to complete the project.

Piano: Is this composition for "playing for fun", performing, teaching, or specific technical development? Are all the practice methods for all the difficult sections known? How long will it take to learn this piece?

(2) Start: The start is determined by everything that follows and reflects the plan of action for the project. Therefore, in order to know how to start, you must know how you are going to execute, finalize, and maintain.

Piano: memorize everything, Mental Play, reading, music theory.

(3) Execution:

(i) Never try the impossible; work in manageable chunks -- even easy chunks; the easier, the better. Simplify. Successive chunks should overlap.

Piano: HS & segmental practice, parallel sets, continuity rule.

(ii) Make sure that each chunk is finished before going on to the next one. Practically all chunks of a project support each other; this is one reason why they should be contiguous (continuity rule). Contiguity is most important in projects such as weeding the yard or in warfare.

Piano: continuity rule, get up to faster than final speed HS, completely finish HS before starting HT, completely memorize before you start practicing.

(iii) Every system has knowledge or experience based "tricks" that lead to success. Any education is helpful because education teaches not only knowledge, but also how to

seek knowledge. Know the pitfalls: what not to do.

Piano: HS & segmental practice, parallel sets, hand motions, slow play, staccato practice, relaxation; in short, efficient practice methods. Avoid exercises or falling into the "talent trap", know which intuitive methods are counter-productive.

(iv) The project must pass periodic tests to see if it is progressing according to plan and even the best laid plans often need to be modified or improved.

Piano: mental play, recording your play, lessons with teachers, informal or preliminary performances, start play from anywhere in the piece.

(4) Finish: Most failures occur due to incorrect assumptions, unattainable goals, or insufficient/wrong knowledge base. Education provides the knowledge needed to evaluate your assumptions, knowledge base, etc. To finalize a project, you must have a precise definition of the goal.

Piano: performance at recitals, using finished pieces to further advance technique and musicality. Absolute pitch and genius can be taught.

(5) Maintenance: Worthwhile projects are useful for a long time and require maintenance. The time and resources required for maintenance can exceed those needed to finish the project.

Piano: maintain repertoire, continue improving each piece; periodically check for accuracy of the notes, rhythm, expression. Playing cold. Use finished pieces for improving technique.

(60) Injury, Health

Hand injury is not a major issue for students up to about the intermediate level. For advanced pianists, it is a major issue because the human hand was not made to withstand such extreme use. Injury problems with professional pianists are similar to those of professionals in sports, such as tennis or golf. Because relaxation is an essential component of piano technique, one might think that injury should not occur. Unfortunately, the physical demands of how some advanced pianists practice are such that injuries do occur. Students who use the methods of this book must be aware of the possibility of injury because they will quickly start practicing material that require high technical skills and energy.

Every injury has a cause. Although there are numerous documented accounts of injuries and cures, definitive information on causes and cures for *pianists* has been elusive. The only general cures discussed are rest and a gradual return to playing using stress-free methods.

Example: I had developed a pain in my left palm while practicing piano. My hand doctor immediately diagnosed the cause, **a notch in my tendon**, but could not tell me how I injured my hand or how to cure it because he did not have enough information about my daily activities. He showed me how to feel these notches by pressing on the tendon and moving my finger. I soon figured out that the pressure of my golf grip had

created notches in my tendons. The transverse tendons were pressed against the longitudinal tendons, creating notches in the tendons and these notches moved up and down in my hand during piano playing; the resulting friction caused inflammation and pain after long piano practice sessions. I had been using golf clubs with old, hard grips; so I bought clubs with softer grips and added pads in my golf glove cut out from Dr. Scholl's self-stick foot-pads, and my pain problem disappeared in a few years. However, years of gripping the club too hard has done permanent damage to my hands so that my fingers are not as independent as they should be. I knew nothing about relaxation in those days - relaxation in golf is just as important as in piano.

Fingertips can be injured by playing too hard in the curled finger position. This condition can be temporarily alleviated by properly bandaging the finger tip. The curled finger configuration can cause bruising of the fingertips because there is minimum padding between the bone and skin at the tip and the tip area is small. In the curled configuration, you can also peel the flesh off from under the fingernail if the fingernail is cut too short. Avoid both types of injury by using the flat finger position. There is an extra fold of skin protruding from under the finger nail which acts as a bellows and expands to prevent tearing when this area is stressed. When finger nails are cut too short, this flab can be snipped off, the bellows protection is gone and, when stressed, the nail peels off and gets infected. This infection is extremely painful and difficult to cure because it is impossible to apply antibiotics under the nail.

Most hand injury is of the repetitive stress injury (RSI) type. **Carpal Tunnel Syndrome** (CTS) and tendonitis are common ailments. Anecdotal accounts suggest that surgery usually does not solve the CTS problem and can do more harm than good for playing the piano. In addition, surgery is irreversible. Fortunately, massage therapists have recently solved the problem of curing CTS. Why massage therapists? Because both pianists and massage therapists use the fingers as their main tools of their professions. Therefore, they suffer from the same injuries. However, massage therapists are in a position to experiment and find cures while pianists are not medically trained and have no idea how to even diagnose their ailments. It turns out, fortunately, that pain is felt long before irreversible damage occurs so that the syndrome can be cured if treated as soon as you feel pain. Although pain is usually felt near the wrists, the cause of the pain is not at the wrists but mainly in the arms and neck where large muscles and tendons can exert harmful forces on the tendons running through the transverse ring of tendons at the wrist that bundle all the tendons running to the fingers. This is why surgery at the wrist may not cure the pain and wrist surgery can aggravate the problem because the wrong area was operated upon.

The group with the most advanced methods for CTS is the SET (Structural Energy Therapy,) massage specialists; they start with cranial and then progress to deep tissue treatments of the relevant areas of the head, arms, and body. Cranial is necessary because it gives the quickest relief and the tissue work alone does not cure the problem. Until you

receive treatment, it is hard to believe that the bones of the skull are related to CTS. See the SET site for more details. You can learn what is involved in treating CTS, to what extent it is curable, and how to find the appropriate therapist. There is a simple test for advanced cases of CTS. Stand in front of a mirror and dangle the arms straight down, completely relaxed, and in their "normal" positions. If the thumbs are closest to the mirror, you are OK. If more knuckles are visible (arms turned inwards), you have more advanced CTS. Also, the body stance should be straight. Practically no one has a perfectly straight stance, and it may also be necessary to straighten any inappropriate stance with massage therapy in order to treat the CTS completely. Although massage therapy is a cure, not just a temporary relief, it requires several sessions, can be moderately painful, and may require periodic maintenance.

The asymmetric playing motions of athletes such as golfers and tennis players create asymmetric changes in **bone density**, bone structure and musculature. Right handed golfers will have higher bone densities in their right hips but develop osteoporosis in the left hip in old age; it may be beneficial for RH golfers to practice hitting lefty to reduce injuries/problems caused by asymmetry and to prevent osteoporosis.

Stress reduction methods of piano practice, such as Taubman, Alexander, and Feldenkrais, can be effective both for preventing injury, and for recovering from injury. In general, it is best to keep the playing finger (except the thumb) in line with the forearm as much as possible in order to avoid repetitive stress injuries. Of course, the best preventive measure is not to over-practice with stress. The HS method is especially beneficial because stress is minimized and each hand gets to rest before damage can occur. The body's ability to heal rapidly is amazing; just the ten or twenty seconds of rest between hard workouts can be enough time to heal certain types of damage. The "no pain, no gain" approach is extremely harmful. Piano playing can require tremendous exertion and energy, but it must *never* be painful.

Piano practice can be healthy or unhealthy depending on how you practice. We tend to concentrate too much on the mental benefits of becoming a "talented" musician and forget the importance of physical health. Many students forget to breathe while practicing difficult material; this reduces oxygen flow to the brain when it needs it most, resulting in anoxia and symptoms similar to sleep apnea (organ damage, high blood pressure, diabetes, etc.).

Piano practice is a form of physical activity requiring moderate energy expenditure for both the brain and the whole body and can put pianists in excellent physical shape when performed correctly. There is no sports activity that is harmful to pianists but the hands must obviously be protected by wearing gloves whenever possible.

Never force a sick child to practice piano because of the risk of aggravating the illness and of brain damage, especially if they are running a fever. Under **normal circumstances**, which means plenty of rest and sleep, fever is good because it is one of the weapons the body uses to fight illnesses. According to the literature, brain damage

occurs above fevers of 107 degrees which is rare because a functioning body regulates its temperature. Temperatures over 103 degrees can benefit from medication/treatments to reduce the temperature (for babies, the limits are lower) to alleviate discomfort. Those under 18 years old should not use aspirin to lower body temperature, so always know which medication is best for children.

But dedicated piano students with fixed times of daily practice are not normal. Some people think that a harmless illness, such as a cold, might still allow them to practice piano. After all, there is nothing to do while resting with a cold. It is important for parents to understand that playing the piano involves significant exertion, especially of the brain, and not treat piano as a relaxing pastime when illness strikes. Y**oungsters** with even mild colds should not be made to practice piano, unless the child is willing to do so on his own. Infections do not affect the whole body equally; they settle opportunistically in stressed organs such as the brain during piano practice; therefore, for youngsters practicing piano, the danger fever may be as low as 102 degrees. Fortunately, most people lose the urge to practice the piano even when only mildly sick; this is a signal that they should not practice.

Learning the health consequences of piano practice is important because any activity can be conducted in a healthy or unhealthy way. Stress-free, psychologically sound approach to piano practice can improve a person's health whereas practicing without concern for well-being can cause irreversible damage. Excessive pressure and nervousness from competitions can damage the emotional attitudes towards performances and destroy the love of music. Correct piano practice methods can be a healthy activity as effective as proper diet and exercise and get pianists in excellent emotional and physical shape.

(61) Hearing Loss

Age related **hearing loss** can start as early as age 40 and by age 70, most people have lost some hearing. Ear damage can occur from over-exposure to loud sounds and can also be caused by infections and other causes such as diabetes. The person may lose hearing in the low frequency or high frequency range. This is often accompanied by tinnitus (ringing sound in the ear). Those who lose hearing in the low frequency range tend to hear a low, roaring or throbbing tinnitus, and those who lose hearing in the high frequency range tend to hear a high pitched whine. There is no known cure or effective treatments for either hearing loss or tinnitus. Those who are clinically deaf can benefit greatly from cochlea implants.

A damaged ear can more easily suffer additional damage than a healthy ear. Because damage is painful, those with hearing loss are more sensitive to loud sounds -- even moderately loud sounds that do not bother normal people can be painfully loud because they can cause more damage. Therefore, if there is a hearing impaired person in the room, don't make the mistake of turning up the sound thinking that they will hear it better.

That is why **hearing aid** technology is so difficult – you can't simply amplify all sounds. Soft sounds must be amplified but loud sounds must be attenuated, a process called "compression" in the industry. Compressed sounds, especially music, sound terrible to most people so that patients with even the most expensive hearing aids costing over $10,000.00 do not wear them unless necessary. Those wearing hearing aids for the first time must go through a period of gradual acclimation to the compression; the audiologist gradually increases the compression over a period of weeks or months. Patients with hearing aids wear them in order to understand conversations, not for music which generally sounds better without hearing aids.

The first thing that happens when hearing is impaired is the difficulty of understanding conversations. The most common reaction, and mistake, is to stop communicating. Lack of communications will quickly cause the "communications part" of the brain to atrophy, which is the main reason for wearing hearing aids — to restore communications and **delay the brain atrophy as much as possible**. By the time a person needs a hearing aid, the brain usually has atrophied so that the soft background noises, when amplified by the hearing aids, can flood the brain causing brain fatigue. This is very bothersome because the irritating background noise carries no useful information, giving the user another reason for not wearing it. Clearly, today's hearing aids are not good solutions, at any cost. For those with sufficiently severe hearing loss, cochlea implants appear to be a viable solution, but are expensive and prescribed only for patients that are legally deaf.

When **purchasing hearing aids**, most vendors will provide a 30 day period for testing the devices (look for vendors who provide 60 days because 30 days is too short, and the vendors know it) during which you can return them for a full refund. Test them thoroughly during this period to see if they really help, especially when purchasing the more expensive models costing thousands of dollars. Inexpensive models without adequate compression can hasten hearing loss if the volume is turned up too high.

There is no method for diagnosing tinnitus except from the comments of the patient. The tester provides sample sounds and the patient tells the tester which sound is closest to his tinnitus. For tests and treatments you need to see an ENT (Ear Nose Throat) specialist. For non-pathological cases, ear damage is generally caused by exposure to loud sounds. There is a wide difference in tolerance to loud sounds. However, there is a strong tendency for those exposed to louder sounds to suffer more hearing loss and tinnitus. It is likely that hearing loss by pianists and piano tuners (as well as rock band members, etc., and people who routinely listen to very loud music) is much more widespread than is generally reported.

Tinnitus is present in 100% of people 100% of the time, but is so soft in normal people that it cannot be heard unless the person is in a soundproofed room. The human hearing mechanism "turns up the amplification" when there is no sound. There are many causes of tinnitus, and some may originate in the brain. Tinnitus is almost always an

indication of the onset of hearing loss so that if you notice tinnitus, but are not aware of hearing loss, it is a good idea to see an ENT doctor to get hearing tests to serve as future references, as the hearing loss worsens with time.

For those who do not have audible tinnitus, there is probably no need to avoid loud music, within reasonable limits. Thus practicing the piano at any loudness should be harmless up to about age 30. Those who already have tinnitus should avoid exposure to loud piano. However, tinnitus usually "sneaks up" on you, so that the onset of tinnitus often goes unnoticed until it is too late.

Therefore, everybody should receive tinnitus education and wear ear protection after age 40 - 50 during piano practice, especially if there is any noticeable tinnitus, which is the easiest measure of hearing loss -- louder tinnitus indicates greater hearing loss, so avoid activities that increase tinnitus. Ear protection is initially an abhorrent idea to most pianists but when you consider the consequences, it is definitely worthwhile. Moreover, once you start to use it regularly, you may start to feel sorry for those not wearing protection, because you know how soon they will start to suffer ear damage. Before wearing protection, do everything possible to reduce sound intensity, such as soundproofing the room (adding carpets to hard floors, curtains to hard walls, etc.), voicing the hammers, and generally practicing softly [(25) Staccato Practice, Soft Practice, even loud passages -- which is a good idea even without possibility of ear damage]. Ear damage is cumulative and partly self-healing, so occasional loud sounds can be harmless. Soundproofing a room is easy because you only need to prevent multiple reflections, which can be accomplished by soundproofing only two or three surfaces. An alternative to ear protection is to practice on digitals with the volume turned down.

Ear protectors (noise canceling is not necessary) are readily available from hardware stores because many workers using construction or yard equipment need such protection. For pianists, an inexpensive unit or light headphones will suffice because you need to hear some music. Commercial noise canceling protectors completely surround the ear and provide a better sound barrier; turn off the noise cancellation, and you will still get sufficient protection. Although the sound through the headphones will be different from the original, the human ear adapts quickly and you will get used to the new sound. It is worthwhile to try ear protection just to experience these different sounds. For example, you will realize that the piano makes many strange (mechanical) sounds you never noticed before! For lower quality pianos, ear protection will result in sound simulating a higher quality instrument because the undesirable high harmonics and extraneous sounds are filtered out; that is, sound filters tend to preferentially filter out the more harmful sounds.

The brain automatically processes any incoming data, whether you want it to or not. This is what music is -- the brain's automatic interpretation of sounds. Thus when you wear ear protection, this stimulus is reduced, and a part of the brain's processing power is

freed to do other jobs. You may find that progress is faster when wearing ear protection! In the future, piano students will wear ear protection (or turn the volume down for digital pianos), just as many athletes and construction workers use helmets today. It doesn't make any sense for us to spend the last 30 or more years of our lives without hearing – an important lesson Beethoven taught us.

It may not be an accident that Beethoven became prematurely deaf. **We must practice Beethoven's music with possible ear damage in mind.** His music has some unique characteristics not found in other composers' music, and one of them may be ear damage. Beethoven invented minimalist music [(50) Beethoven's Pathetique, Op. 13, First Movement] which he incorporated into most of his compositions. This type of music hits the same note repeatedly, thus over-stressing that part of the auditory system.

The specific type of piano is also important. Most uprights that do not produce sufficient sound are probably least damaging. Concert grands that transfer energy efficiently into the strings with long sustain probably do not cause as much damage as medium quality pianos in which a large amount of energy is imparted into the initial, percussive bang associated with the hammer striking the strings. Thus the medium size grands (about 6 ft) may be most damaging. In this regard, the condition of the hammer is important, since a worn hammer can produce a much louder initial bang than a properly voiced hammer. This is why worn hammers cause more string breakage than new or well voiced hammers. With old, hardened hammers, probably most pianos can cause ear damage. Thus proper voicing of the hammer may be more important than many people realize, for practicing pianissimo, playing musically, technical development, *and* protecting the ear. If you have to close the lid of a grand in order to play softly, or to reduce the sound to a pleasant level, the hammers probably need voicing.

Some of the loudest sounds are produced by even tiny ear phones used to listen to music. Parents should warn their youngsters not to keep turning up the volume, especially if they subscribe to the culture that plays loud music. Some youngsters will fall asleep with their ear phones blasting; this can be very damaging because ear damage is cumulative. It is a bad idea to give gadgets with ear phones to youngsters -- postpone it as long as possible. Make sure to educate them about ear damage when they start using such devices.

Important: On the other hand, this the time to introduce them to the "right type" of music; you must learn how to give them recordings of music you want them to listen to, and how to play them on their devices. In that case, you may want to give them these listening devices at a younger age. Then they can listen to a lot of good music while walking to school or riding in a car.

Except for some special cases of tinnitus (such as those in which you can alter the sound by moving your jaws, etc.), there is no cure. Large doses of aspirin can cause tinnitus; in that case, stopping its use can sometimes reverse the damage. Small amounts of aspirin taken for cardiac purposes (81mg) apparently do not cause tinnitus, and there

are some claims in the literature that these small amounts may delay the onset of tinnitus. Loud tinnitus can be debilitating because it is present all the time, it only increases with age and some have been driven to thoughts of suicide. Although there is no cure, there are remedies. There are hearing aids that supply sufficient sound so that the brain turns down the amplification; many people believe that the sound masks the tinnitus, but that is not the case. Because the brain automatically turns up the amplification when there is no sound, absolute quietness can cause the tinnitus to become annoyingly loud. Thus a person with loud tinnitus has three hearing problems: (1) hearing loss, (2) the tinnitus masks soft sounds, and (3) the tinnitus prevents the brain from increasing the amplification to hear soft sounds.

Another approach to treating tinnitus is to train the brain to ignore the tinnitus. The brain is amazingly trainable, and part of the reason why tinnitus causes suffering is the inappropriate brain response of the person. The brain has the ability to either concentrate on the sound, thereby driving you crazy, or to ignore it, in which case you won't hear it unless you are reminded of it. Thus the treatment starts with teaching the patient that others have succeeded in living with it with minimal discomfort. Then the patient receives ear training in such a way as to be able to ignore the tinnitus. Fortunately, the brain is quite adept at learning to ignore a constant sound, sometimes by creating its own anti-sound, as in the case with excessive use of the (13) Metronome.

If you read enough stories about tinnitus suffers and hearing loss, you will probably follow the advice to wear ear protection after age 40 - 50 when practicing the piano, at least when practicing loud passages for long periods of time. At the first hint of tinnitus, it is imperative that you start ear protection procedures because once the tinnitus starts, ear deterioration can proceed rapidly with exposure to loud sounds, with significant deterioration every year. Look for an ENT specialist immediately, especially one experienced in tinnitus treatments. Ear protection applies to other members of the household exposed to loud piano practice; therefore, if at all possible, isolate the piano room acoustically from the rest of the house. Most quality (glass) doors will be sufficient. There are a few herbs and "natural" medications that claim effectiveness against tinnitus. These do not work, and the ones that seem to benefit some people have significant side effects.

(62) Teaching

Teaching Babies: Babies can hear before birth. Many maternity wards screen babies immediately after birth in order to identify hearing impaired babies who will need remedial treatments immediately. Hearing impaired babies do not receive auditory stimuli and their brain development will be retarded because **auditory inputs affect practically every part of the brain**. Extra auditory experiences, such as music, will help the brain to develop.

The memory of external sounds is initially empty. Thus any sounds heard at that

stage are special, and all subsequent sounds are referenced to them. Babies (of most species, not only humans) use sound to identify and bond to the parents. Of all the sound characteristics that the baby uses for this identification, **absolute pitch (AP)** [(17) Absolute Pitch, Relative Pitch] is probably a major characteristic, which may explain why every youngster can readily pick up AP and why they lose it later. Some parents expose babies to music before birth to accelerate the babies' development. There is evidence in the literature that babies learn sounds while in the womb (search the internet for the newest reports). For implanting AP, a electronic piano is better than an acoustic because it is always in tune.

Practically every world class musician, athlete, etc., had parents who taught them at an early age; thus "prodigies" are created, not born, and parents exert greater control over "prodigy" production than teachers or brain power. Constantly test the child for hearing, rhythm (clapping hands), pitch (singing), motor control, attention span, what interests them, etc. As soon as they are ready (walking, speech, music, art, math, etc.), they must be taught, supported, and encouraged. There are "tipping points" beyond which they will take off on their own; provide extra support until this point is reached [see nucleation growth theory in (56) Origin and Control of Nervousness].

Babies learn differently from adults because their brains are changing. Adults must be taught; in young children, you only have to awaken the concept in their brains, and provide a supportive environment as their brains take off in that direction. They can quickly advance so far that the parents can't teach them any more. Good examples are **Mental Play (MP)** [(15) Mental Play (MP)] and **AP**. Awaken MP by letting them listen to music and asking if they can sing it back to you. Let them get the idea that there is music in their head, not only the music they hear. Get them musical toys that are in tune. They should listen to music in tune, because off-tune sounds will quickly confuse the AP. Then teach them the scale (teach C, D, E . . ., used by most music schools, and do re mi, as both will be needed), then teach them the C4 octave. At this age, learning AP is automatic and almost instantaneous; when you teach them C4, they will recognize that no other note is C4, because they have no other memory to confuse them. This is why it is so critical to teach them as soon as they are ready. Then teach them relative pitch, such as octaves; then 2-note intervals (child has to identify both notes), then 3 note chords or any 3 random notes played simultaneously -- all the way up to 10 notes, if possible. These musical lessons can be taught between the ages of 2 and 8. This process will be greatly accelerated if someone plays the piano from before their birth. For babies in the womb, sound pitch remains the same in the amniotic fluid so that they can learn AP before birth.

Long before their first piano lesson, parents can show them pictures of enlarged music notes (tadpoles!) and familiarize them with the music staff, where the notes go, and where to find them on the piano. If the parents are not pianists, one parent can take piano lessons with the child; this is a good way to get youngsters started.

Piano Lessons: MP should be taught from the very first lessons (or before, by

parents) in order to train the youngsters to play music in their minds. Teach MP when memorizing new pieces. If this is done at the correct pitch, youngsters will acquire AP after only a few lessons with little effort; in fact, most children who have AP learned it before starting their lessons. Support their MP by providing good music to listen to, and train them to recognize compositions by name and composer. Singing or a musical toy (in tune) is a good way to teach pitch, rhythm, and motor control. As soon as they start piano lessons, MP is further developed by memorizing and creating a memorized repertoire. Be prepared to support them if they immediately start composing **at any age** – provide ways to record their music or teach them dictation. If they start composing at an early age, don't be surprised if they prefer to invent their own music notation — don't ignore this or force them to change to conventional dictation; support them, because they will naturally transition to conventional dictation with time, out of necessity. Formal composition lessons are not needed until the student asks for them, when they feel the need for help to achieve certain musical objectives, such as how to end a piece. This can happen at any time, but generally after their teen years.

If MP is not taught, the students may not even realize that they are doing it, and not fully develop it. Moreover, because they are not aware of what they are doing, they will tend to neglect MP as they get older and their brains get bombarded with other pressing matters. As they neglect the MP, they will lose their AP. Therefore, both MP and AP are easily acquired when young, but both are "use it or lose it" skills.

At this stage, **"play by ear" should also be taught** [(18) Play by Ear (PBE), Composing].

Children should be tested for their readiness to take piano lessons at ages between 2 and 8. The first lessons for beginners, especially children under 7 years old, should be brief, 10 to 15 minutes. Increase the lesson time only as their attention span and stamina increase. If more time is necessary, divide the lesson into sessions with breaks in between ("cookie time", etc.). The same rules apply to practice times at home. You can teach a lot in 10 min.; it is better to give 15 min. lessons every other day (3 days/week) than one hour once a week. After about 15 min., forcing youngsters to practice is useless because they are not paying attention; letting them quit will train them to want to practice more, instead of disliking practice.

Children's brains are faster than adults'; they may appear slow because their memory abilities may not be fully developed [(16) Human Memory Function], but they are capable of understanding complex concepts, especially in music. Youngsters can listen to, and play, Chopin at any age. Do not feed them music just because it is classical or it was written by Bach. Play what the youngsters enjoy, but it is important to expose them to every genre so that they have the knowledge to make intelligent choices. There is controversy about which genres are healthy for brain development. My opinion is that classical and most of pop, and some rock "classics" are good, whereas some types of rock, heavy metal, and atonal music are not, because the classics are generally based on

basic bio-physical principles. Here are some examples from classical music; there are lots more on the internet and youtube.

Most youngsters are ready for many more things than most adults and even teachers realize and once they are ready, the sky is the limit. Therefore, it is a mistake to assume that all kids must be treated as kids. They can be surprisingly advanced in many respects and treating them as kids only holds them back. **Kiddie music exists only in the minds of adults**, and generally does more harm than good.

You can get most youngsters interested in piano by presenting them with a puzzle: can they figure out how to play the eight notes of the C major scale with only five fingers? After struggling with the puzzle for a while, you can show them how to use the thumb. Then you can wow them by playing the scale at faster and faster speeds, many octaves up and down, then with both hands, etc., followed by some music. Using this method at family parties unrelated to piano, I have gotten several youngsters interested, and they are now accomplished pianists.

For at least the first two years of lessons (longer for youngsters) teachers must insist that the parents participate in the teaching/learning process. The parents' first job is to understand the methods that the teacher is teaching. So many practice methods and performance preparation procedures are counter-intuitive that the parents must be familiar with them so that they can avoid countermanding the teacher's instructions. Unless the parents participate in the lessons, they will fall behind after a few lessons and can become a hindrance to the child's progress. Using this book as a textbook to teach both the students and their parents can save the teacher a lot of time. The parents must decide how long the students practice each day, since they are most familiar with the time demands on the students and also know the students' ultimate objectives.

Mental development is the main reason for listening to classics -- the "Mozart Effect", which is highly dependent on the choice of music. The reasoning goes something like this. Assume that the average parent has average intelligence; then there is a 50% chance that the child is smarter than the parents. That is, 50% of parents cannot compete on the same intellectual level as their baby! So, how do parents teach music to babies whose musical brain can quickly develop to much higher levels than their own? By letting them listen to and play the great classics! Let them talk to, and learn directly, from Mozart, Chopin, etc. Music is a universal language; unlike the crazy languages that we speak; music is partly inborn, so babies can communicate in music long before they can say "mama". Therefore, classical music can stimulate a baby's brain long before the parents can communicate with the baby even on the most basic levels. This is why classical music is valuable; too much of today's music aimed at youngsters was composed for commercial values, to create "rock stars", etc., and not for brain development; those should be avoided. Music can benefit or harm the brain depending on how it is used.

Memorizing, Reading, Theory: The teacher must balance the students' memorizing and reading abilities. The Suzuki violin method emphasizes playing from memory at the

expense of reading, especially for youngsters, and this is the best approach for piano also. It is easier to practice reading after you can play reasonably well, just as babies learn to speak before they learn to read. The abilities to memorize, speak, and make music are natural evolutionary traits that we all have; reading is something that was added later as a consequence of our civilization. For example, there are many musical concepts that can not be written down, such as color, touch, playing with authority and confidence, etc.

Reading should be taught from the very beginning, but only enough to read music for learning a new piece. Reading should be encouraged as long as it does not interfere with playing from memory and there should be no pressure to develop advanced reading skills in the beginning. However, the teacher must make sure that this lack of emphasis on reading does not result in a poor reader who automatically memorizes everything and can't read. Parental help is often helpful for monitoring the students' reading ability because the teacher is not always there when the student is practicing. Parents can unwittingly create poor memorizers or poor readers by helping their children out instead of letting them struggle with their weaker skills. Because becoming a poor reader or memorizer happens over a long period of time, there is ample time to detect and correct the trend. If not corrected early, it can become frustratingly difficult to correct. Just like talent, prodigy, or genius, readers and memorizers are not born, they are created.

Especially for beginners, it does not pay to embark upon an intensive reading program just to be able to read because most of it will be quickly forgotten; the only time students permanently learn reading skills is when the need arises. The initial slow reading speed is certainly frustrating to both teacher and student, but it is beneficial and necessary to allow the students to struggle through this slow reading stage; don't help them out by finding the notes for them because, if you do, they will never learn.

Don't forget to teach "play by ear" [(18) Play by Ear (PBE), Composing]! Many classical teachers consider PBE to be a skill for pop or jazz players and not teach it, which is a mistake because it is an essential component of AP, MP, and absolutely necessary for composing.

Practice Routines: The piano lesson should not be a routine in which the student plays the lesson piece and the teacher assigns a new piece. It is the teacher's job, when starting a new piece, to go through it in segments, examining the fingerings, analyzing the music, and basically **bringing the student up to speed during the lesson**, at least HS or in segments. All the practice methods needed to solve technical problems must be covered. The teacher can save the students time by demonstrating all the necessary elements of technique. It should not be left to the student to acquire technique by trial and error. Practicing 30 minutes every 2 or 3 days is the absolute minimum necessary to make any progress. Half an hour every day is adequate for significant progress for youngsters. Serious students need to practice more.

Too many piano lessons are open ended: they are not graded, which is bad because you don't monitor the rate of progress, a major violation of (59) Project Management

practices. The main piano grading system is the ABRSM system: ABRSM: About ABRSM. Every teacher should make use of this system and the parents should gauge their children's progress using it. There is no need to attend the tests for students not intending to progress beyond amateur level, but they should still follow the protocols of the exams to monitor their progress. Alternatively, the teacher should outline a yearly objective, such as adding certain pieces to the student's repertoire, while maintaining all the old finished pieces in playing condition. Thus, the teacher should have a list of each student's repertoire and ask the student to play an old piece as part of the lesson.

Parents must help their children to gather relevant music into their ipods and music libraries, etc., from an early age. This is another reason why lesson pieces should be performable music, not exercises and "technique pieces", because practice time is one of the few remaining times when students can listen to piano music.

Performing: The best way to motivate students to practice, and the best way to teach the art of making music, is to hold recitals. When the students must perform, all the teacher's instructions, the necessary practice time, etc., take on entirely new meanings and urgency. The students become self-motivated. It is a mistake to teach piano without a program of performance because piano is a performing art.

Some teachers fear that many students are afraid to perform and dislike performing. This is often a sign that the teacher does not know performance training. Students must be taught that piano is a performing art and that part of learning piano is to learn how to perform. Of course, every student is different and there is that occasional student who only enjoys playing for themselves, and the teacher must be flexible. The majority of students should be expected to perform and follow a program of yearly recitals.

Formal recitals and music competitions are full of pitfalls and must be approached with care and a lot of planning, see Sherman, Russell,. However, teachers can organize their own recitals using less stressful formats, with tremendous benefits to the students. Competitions have only one first prize winner and everybody else is a loser. Teachers can organize recitals in which there is no first prize winner: the award is the performance regardless of skill level.

Popular, or "fun" music, such as duets, are useful for performance training. Above all, the program must be designed to produce a rewarding atmosphere of accomplishment and not a competitive one where anything short of miraculous perfection, playing the most difficult pieces the student can manage, is a failure. The emphasis must be on music, not finger calisthenics. Under such a system, most students will *volunteer* to play the more difficult pieces, thus reducing the stresses associated with recitals -- give the students a voice in deciding what to play.

It is important to teach a student all about nervousness and stress and not to shove them out on a stage with no preparation in the hope that they will somehow manage on their own. That is analogous to throwing a person into the middle of a deep lake to teach him how to swim — he might end up with a lifelong fear of water.

Performance training must start with the first piano lessons. Various skills, such as recovering from blackouts, preventing blackouts, covering mistakes, sensing mistakes before they occur, snippet playing, starting from arbitrary places in a piece, choice of pieces to perform, audience communication, etc., should be taught. Regular recitals must be scheduled. "Performing" is nothing special, it is an everyday normal situation.

One way to introduce students to performing is to hold recitals among the students themselves and to have them discuss their fears, difficulties, weaknesses, and strengths to get them all acquainted with the main issues. Students will understand the issues better when they actually feel them and then discuss them openly with their peers. The purpose is not so much to reach beyond each student's capabilities, but to find out where each belongs in the hierarchy of excellent to poor performers. Any nervousness they might feel becomes less scary when they realize that everyone experiences the same things, that nervousness is perfectly natural, and that there are various ways to combat them or even take advantage of them -- it is part of the process of becoming a "professional performer". In particular, once they go through the entire process from start to finish of performance training, the whole procedure becomes much less mysterious and frightening.

In a group of students, there is always one that is best at performing. The others can learn by watching and discussing how these good ones cope with each issue. Then there are students who just freeze on a stage – these need special help, such as learning very simple pieces to perform, or given several chances to perform in one recital, or perform with a group or in duets. Avoid forcing students into situations for which they are not prepared.

Recitals should be designed to strengthen performance capability. One of the hardest things to do is to perform the same composition several times on the same day or on successive days. Such repeat performances provide the best training for strengthening performance skills. For teachers or schools with a sufficient number of students (25 or more), the following, used by Combe, is a good scheme. Group the students into beginner, intermediate, and advanced. On Friday, hold a recital of the beginners, with their parents and friends as audience. Beginners should participate in recitals from their first year of lessons, as early as 4 or 5 years of age. At the end of this recital, the advanced students also play, which makes it worthwhile for the audience to attend. On Saturday, the intermediate students play, with their parents and friends as audience; again, the advanced students play at the end. On Sunday, the advanced students hold their recital with a few select students from the other two groups. Their parents and friends are the audience and special guest performers and audiences might be invited. In this way, the advanced students get to perform the same piece three days in a row. The Sunday recital of the advanced students should be recorded and archived, as they make excellent souvenirs. If this type of recital is held twice a year, each advanced student will perform six recitals every year. If these students are also entered into competitions (typically involving an audition, a final, and, if they win, a winner's concert), they will have adequate

performance training, about 9 performances a year.

Teachers with fewer students can arrange for performances at nursing homes, enter their students in state sponsored music programs, or organize recitals with several other teachers.

Example lesson for starting a new student: A text book should be used so that teachers can assign relevant pages to read for the students *and* parents.

Students can be taught from age two. For those younger than age 4, an important component of lessons is listening to all the major compositions (mostly at home) from Bach to all the classics, including concertos and symphonies. No child is "too young" for Chopin! Parents should be encouraged to let the students listen to a list of good music and the teacher should have a set of such music (DVDs, internet sites) ready, see examples of good music (item #16). It is not necessary for the students to sit down and concentrate on the music; it only needs to be part of the student's environment, something the parents play for their own enjoyment, or soft background music during dinner, play, in their ipods, or while doing home work. It is difficult to use classical music as background music (cocktail music is easier) because soft parts are too soft, loud parts are too loud, and exciting sections are too riveting and require mental attention. Youngsters today are finding less time for good music; taking piano lessons is one of the best solutions. **Find a good music channel on TV and always turn it on when nobody is watching it.**

The First Lesson: The first lesson is important because (1) it sets the tone for all following lessons and informs the students and parents what is taught, (2) the student is evaluated during this lesson, and (3) the type of piano available for practice should be discussed.

This lesson can be as long as 2 hours even for youngsters down to age 6 (although subsequent lessons will be much shorter), and should be broken up into three sessions with breaks in between for rest and snacks. For younger students, this lesson will be shorter, but there should be a separate, longer session for the parents. Obviously, the parents must attend and discuss whether they should attend every lesson; this will depend on how busy the parents are, how much music they know, the degree with which they are involved in their children's education, etc. Here are the three sections of the first lesson:

The **beginning session** consists mainly of **discussions** with parents and student. So have comfortable sofas and drinks and snacks ready. The teacher discusses how learning piano raises the effective intelligence and improves memory. Education, musicality, and performance (making music) are the main objectives. The concepts of mental play, absolute pitch, learning tricks, efficient practice methods, play by ear, intuitive methods, (no) exercises, musicality and controlling nervousness are explained briefly. Finally, the benefits of a piano education are explained, such as learning project management, brain development, and preparation for better performance in school, at home, and at work. Methods of teaching talent and genius should be discussed. This may take close to an

hour.

Take a break.

The student is evaluated in the **second part**. Teach the student a well known duet, such as Chopsticks. The teacher first plays the LH part and teaches the student the RH (no accompaniment: student starts G5 and teacher F5). Test the following:

1. Learning rate: can the student learn the RH quickly?

2. Rhythm: explain waltz (Chopsticks); check for rhythm, accuracy.

3. Communication: play softer or louder, faster or slower, see if the student can follow by just listening to your play, without your telling him to follow you -- can you communicate with the student using music alone?

4. Switch hands, so the teacher plays the RH and student learns the LH (with the LH). Then see if he can play HT.

This may take 10 to 15 minutes; then take a break, before the **third part**.

5. If the student can play HT, teacher can play the accompaniment. Now you can immediately show the parents that the student can play both hands and play duet with the teacher in one lesson!

If this is too difficult for the student, then the teacher might play the melody part and teach the student an easy two-finger accompaniment and do 1 to 5 above, or otherwise simplify the student's part so that it is manageable.

Now for some **home work**.

6. Teach C Major scale, using doremi, from middle C, one octave, how to pass the thumb (TU). This is home work to be practiced for the next lesson.

7. Check for pitch capability (relative pitch) by letting student sing the notes of the scale.

8. Check for absolute pitch, easy if you have two pianos. If not, teach C to G on piano, then hum one note to see if student can find it on the piano or tell you the name of the note. Sometimes, this is the first time that the students or parents find out that a student has absolute pitch!

9. Assignment: most students (especially parents) already know the melody to the doremi song from the movie Sound of Music. Give the student the assignment of figuring out how to sing the song using doremi instead of the lyrics. Play the melody several times to make sure that the student knows it. The assignment is that the student should be able to sing it using doremi in the next lesson: do-re-mi,- do-mi-do-mi,-re. . . . . .etc.

If appropriate, discuss what type of piano to use for practice. In general, electronic pianos are best for beginners unless they already have a acoustic piano. Most home acoustic pianos are out of tune and will destroy the students' absolute pitch and are not adequately maintained. By the time the students are good enough to require a acoustic piano, they will need a high quality grand, which is not necessary for beginner students. Therefore, if they have a acoustic piano, discuss piano maintenance and help them find piano tuners, etc..

Finally, the teacher gives the parents an assessment of the student's abilities: learning rate, rhythm, RP, AP, communication, mental maturity, what the students need to learn, what they know.

Subsequent Lessons: Most teachers will have their own teaching routines for subsequent lessons. The most important point is to start right away with meaningful music that can be performed in preparation for the student's first performance. Dates for the year's recitals should be set.

End of Lesson section.

Today, MP is still difficult to teach because this book is the first time that it has been included as a necessary component of piano education, and the teaching protocols have not been established and time tested; the best book on MP is by Richard, Francois L.,. Because MP occurs in the students' minds, it is difficult for the teacher to evaluate it, just as rhythm and counting are difficult to evaluate without a piano unless the students are asked to count vocally or make hand motions. Playing contemporary music, especially improvisation and playing from fake books, is a good way to practice MP and "play by ear", and to learn music theory.

Teachers should communicate constantly with other teachers, exchange ideas, and learn from each other; they must have email and internet connections. There is nothing as potentially damaging to a student as a teacher whose teaching methods are frozen in time. In this information age, there is no such thing as secret methods of teaching piano, and **the financial success of the teacher depends on open communications**. An important topic of communication is the exchange of students. Most students can benefit greatly by having been taught by more than one teacher. Teachers of beginners should pass their students to higher level teachers as soon as they are ready.

Of course, most teachers will try to keep their best students and to teach as many students as they can. One way to solve this problem is for teachers to form groups consisting of teachers with different specialties (beginners, intermediate, advanced, classical vs pop, etc.). Students looking for teachers should look for groups of teachers rather than teachers who operate individually.

Starting teachers often have difficulty finding their first students. Joining a group of teachers is a good way to get started. Also many established teachers have to turn away students because of a lack of time, especially if the teacher has a good reputation. Those teachers are good sources of students. One way to increase the pool of potential students is to offer to go to the students' homes to teach. For at least the first few years of a new teacher, this might be a good approach for increasing the potential student pool.

Piano lessons are not only about music, they are also about growing up; the objective is to produce mature, independent musicians, not perpetual students looking for guidance all their lives.

Piano Teaching Books: Without standardized textbooks, every starting teacher had

to re-invent teaching systems with little guidance. Teaching piano was a Herculean task not for the faint of heart. With a textbook, the teacher and student will know exactly what is taught, how, and why. This will save the teachers time and the teachers can then concentrate on demonstrating technique and teaching musicality. Best of all, students can progress at the fastest rate possible, with every teacher. The certainty of achieving well defined goals will popularize piano playing and provide more secure careers for teachers.

A book *can* contain more information than any single teacher might hope to know and can reference other books and sources of information that lead to unlimited amounts of useful knowledge developed by all teachers. Unfortunately, older books on piano were written by pianists with no training for writing such books and who did not know all the practice methods, and were no more informative than that single teacher. Thus, most piano teachers' claims that "you can't learn piano from a book" had turned out to be true because no textbook for practice methods had been written. Most of the practice methods are now known, so that "you can't learn from a book" only reveals the lack of knowledge of the speaker; it is equivalent to saying "I can't write such a book". **Today, books are necessary for teaching if all students are to progress at the fastest rate possible with every teacher.**

Let me digress to point out that the importance of books is overlooked by practically everybody, not just piano teachers. My own experience is a particularly illuminating example because I am a scientist, to whom books are necessary; yet I, too, am guilty.

(1) In my physics classes in college, there were always a few classmates who understood everything and aced all exams, the "geniuses". I did not realize until after graduation, that these fellows didn't just understand or figure out, on their own, what the rest of us did not know. They just knew where to find the information -- they were reading and learning things beyond what were being taught in the courses! At first, I had thought that finding answers to homework problems in a book was cheating -- what a mistake! The only thing that matters in the real world is that you know the answers; it doesn't matter how you get them. But knowing that there are answers in books isn't enough because you need to develop a system of finding the right material to read, which takes a long time to learn, and reading books can take up a lot of time that you may not have.

(2) I ran into similar problems later in graduate school. Universities often invite famous speakers, such as nobel prize winners, to give lectures on advanced topics, so I attended most of them. They were quite discouraging to me because I could not understand the lectures. Yet there were plenty of people in the audience who asked relevant questions after each lecture, indicating that they understood the material. Again, I found out that they had read the writings of the speaker (and others) on those topics before attending the lectures.

(3) Another example was a fellow researcher at Cornell University who spent several hours almost every morning in the library for years, researching equipment used

in our research. He eventually found ways to improve our instruments and started a company to manufacture them. But this process is difficult; it took him years to achieve his goal.

Conclusion: there are valid reasons for ignoring books: learning from books is not easy, especially for pianists! Yet, **if you want to excel, books are necessary**. What I have done for piano is to conduct the research during my lifetime and assembled the results into one book, readily accessible to every student and teacher.

(63) The Myth of Franz Listz's Teaching Methods

The materials of this book are known best practice methods. The methods have been documented here and their sources are referenced . By contrast, there have been thousands of teachers who claimed to teach the "Franz List Methods" or trace their teaching lineages to Liszt (and therefore to Beethoven: Beethoven - Czerny - Liszt), yet there isn't a single book or reference that defines or describes what that method is! Thus **the implication that a terrific "Franz Liszt Method" of teaching exists has no factual documented evidence**.

There are a dozen Franz Liszt societies and over ten thousand publications on Listz! Numerous books have been written about him (see Taylor, Walker, Listz's Teaching Bibliography,) but the only reference to Listz's technical teachings are a few meager pages in Walker. The only other descriptions of Liszt's methods are lists of Liszt's exercises and etudes with no instructions on how to practice them. There are endless accounts of Liszt's accomplishments and technical prowess, yet there is not one reference on how he learned.

Evidence in the literature indicates that Liszt could not describe how he acquired technique; he could only demonstrate how he played. Because he was a pianist, not a trained analyst, this is understandable; he was a musician and could play or demonstrate, but did not know how to teach or write a manual for learning piano. He only taught students who were already technically proficient. Thus, "going to a teacher who teaches the Liszt Method for learning how to play the piano" makes no sense unless you are already a concert pianist. But all piano students learn piano to become concert pianists, not after they can already play.

Even Liszt's teaching lineage to Beethoven has little meaning because Liszt basically ignored Czerny's methods and the popularity of Czerny as teaching material has been declining now for decades, to the extent that it is often cited as representing what is wrong with the "old, obsolete" teaching methods, (e.g., Whiteside, and this book).

Thus going back to Liszt (or most famous pianists) does not help us to learn piano practice methods. Chopin is an exception because his students documented some of his teaching methods (Eigeldinger, Jean-Jacques,). Bach is an interesting case. As with Liszt, Bach never wrote a treatise on teaching piano because he was a musician, not a writer. Therefore, he embedded piano lessons in his "teaching compositions" such as the

Inventions and the WTC. Thus, if we can "read" his lessons in his music, they can be quite beneficial. Unfortunately, Hanon misread Bach and took us on a 100 year detour in the wrong direction. Thus reading Bach's lessons isn't easy unless you already know them.

My limited survey of teachers who claim to teach the "Liszt Methods" such as Combe and Van Cliburn's mother, reveals that most of them are familiar with similar principles, such as HS practice, chord attack, thumb-over, segmental practice, etc., that are particularly applicable to Bach's teaching compositions. Thus the claim to teach Liszt's method does increase the probability of finding a better teacher.

Until about the year 2000, when efficient practice methods began to replace "talent" and exercises on a wider scale, piano pedagogy had never adequately defined or documented efficient practice methods; they weren't needed when progress was attributed to talent, not to teaching methods. Combe had been teaching efficient practice methods for decades and knew she had a piano revolution in her hands (my conversations with Combe) but, like Bach and Liszt, she lacked the necessary education to manage such a project. Now that this book has been written, progress is guaranteed; however, because of the large number of teachers still teaching the intuitive methods, and the need for the new generation of teachers to complete their ancillary education, this revolution may require another generation of teachers to complete.

(64) Why the Greatest Pianists Could Not Teach

We have historically looked to famous artists for guidance, thinking that if they can do it, they can teach it. Typically, if great pianists were asked how to play a passage, they would sit at the piano and play it out, but couldn't tell you *how* to do it because the language of the pianist is spoken by the hands and the piano. They had no idea how the fingers were moving, or even how they had learned to move the fingers. They had never received any training in teaching.

There are two extremes among the ways to acquire technique. One is the analytical one, in which every detail of the practice method is analyzed. The other is the artist's approach, in which the person imagines a certain musical output and the body responds in different ways until the desired result is obtained. This artist's approach can not only be a quick shortcut, but can also yield unexpected results that may exceed the original idea. It also has the advantage that a "genius" without analytical training can be successful. Teachers love this method because they can teach without knowing anything, and if the student fails, he just isn't talented. Piano is an art and it seemed logical to teach it the artists' way.

The disadvantage is that there is no assurance of success. Technique acquired in this way cannot be taught analytically, except by saying that "you must feel the music this way" in order to play it. Unfortunately, for those who still can't play, this kind of instruction is of no help, except as a demonstration that it can be done. If the analytical

approach can be researched and documented properly, everyone can succeed, just as everyone is expected to graduate from high school.

A possible disadvantage of the analytical, knowledge based approach is that pianists might lose the "talented" label that was a major factor that made piano attractive, commanded respect, and commercially viable. That should not happen because effective teaching methods will produce even better pianists and musicians than before. Truth and honesty should always triumph over fake claims of artistry. But musicians should still learn their musical magic tricks [(65) Creating Geniuses] because that is part of the entertainment.

It is important to *understand* why certain practice methods work; otherwise there is no evidence that the method works and no way to adapt it to a specific student's needs. This requirement of understanding was often outside the expertise of the pianist or teacher because biological, scientific, etc., *knowledge* is generally required. Thus there were fundamental impediments to the development of piano teaching methods: artists and piano teachers were never trained or sufficiently educated to teach. All piano teachers had to invent their own teaching methods, and even after fifty years of teaching, their methods were inadequate because there is only so much that each teacher could learn without higher education. They were never trained in the art of distinguishing the right from the wrong methods so that their teachings always contained some wrong assumptions and methods. Pianists tended to be poor communicators (outside of music) because they had precious little time to communicate with each other. These problems prevented any meaningful development of teaching methods even at conservatories, yet they accepted only advanced students. Without conservatory type teaching, few students attained the advanced levels necessary to be accepted. These obstacles gave piano learning a reputation as something far more difficult than it really was.

The answer to these problems is efficient practice methods that enable students to acquire technique quickly, freeing sufficient time to receive the education needed to understand the piano and to teach. We are entering a new, exciting era of learning piano that can be enjoyed by everyone because learning piano will finally be based on knowledge, not talent. Combe is the first teacher I met that taught practice methods. As her students wrote on one of her birthday cards, "Thank you, Mlle. Combe, for music all our lives!"

(65) Creating Geniuses

The biggest mistake in piano pedagogy in the last two hundred years was the assumption that **talent** is inborn. This meant that talent couldn't be taught. Now we know that proper practice methods can make practically anybody into a "talented" pianist! I saw this all the time at the hundreds of student recitals and piano competitions that I had witnessed. The statement "you won't succeed without talent" means that the speaker does not know how to teach. Fortunately, there is now a growing realization that **genius can**

be taught (Olson).

Knowledge is an amazing thing. We are the same humans we were thousands of years ago yet, today, we build skyscrapers and use the internet because we have new knowledge. Knowledge can replace, or be more powerful than, raw brain power. To see this, suppose we take an average 5th grader today and time-port him back to Egypt 8,000 years ago and that he had written down everything he knows about math. He would have been recorded in history as the greatest mathematical genius that ever lived! Therefore we can create geniuses by teaching genius capabilities. Here are some of the processes that can create geniuses:

(1) It is **important to start young**, when the brain is developing rapidly. Historically, practically all famous geniuses were created by their parents who were already musicians, sports figures, performers, etc., and knew how to teach their very young children. The most extreme example of this success is Jesus, who became god in the eyes of many because his mother claimed an immaculate conception to protect herself and her baby at a time when women who became pregnant before marriage were often stoned to death. Thus Jesus's training to be god started before his birth and, in terms of "professional training", paralleled those of Mozart and other famous musicians, as well as Tiger Woods in golf, the Williams sisters in tennis, and Michael Jackson in entertainment. It can't be just a coincidence that almost all musical geniuses had parents who were musicians. Teachers are not as successful as parents because parents have access to their children 24/7, from before they are born.

(2) Another factor is the unbelievable difference in learning speed between the "right" and "wrong" approaches, which makes students with the "right" approaches appear to be far more "talented". Specifically, babies should be exposed to music from birth in such a way that they acquire **Absolute Pitch** [(17) Absolute Pitch, Relative Pitch] automatically, effortlessly. They should be tested for AP as soon as possible and trained to improve their AP as youngsters. Other important elements to teach for piano are the practice methods, which include: **Mental Play** [(15) Mental Play (MP)], memorization, piano technique, music listening, etc., as outlined in this book. MP picked up as an infant is possibly just as potent as absolute pitch picked up at the same age, something that becomes impossible after the teen years. A toddler can pick up absolute pitch without even trying, and that absolute pitch can be so accurate that no amount of training will come close to it if we tried to learn absolute pitch in later years. Imagine what a similar process in MP might do to a young mind! This early training may be particularly important for cultivating the ability to compose. Thus **play by ear** [(18) Play by Ear (PBE), Composing] must be encouraged at this stage.

(3) One way of measuring genius is the **IQ** (Intelligence Quotient). There are three types IQ that can be raised by learning piano:

(i) The **intrinsic IQ** -- how good the brain is. This is the most difficult IQ to raise, but performing musical feats will exercise the brain in such a way that it works better,

just as exercising will strengthen the muscles and nurture the nervous system. One of the objectives of learning piano is to increase the mental speed and stamina, and to train the brain to work all the time without requiring periods of rest. This will increase blood supply to the brain. Babies are routinely tested for hearing immediately after birth because deafness will retard brain development; thus additional music training will accelerate the development, especially because auditory inputs affect practically every part of the brain.

(ii) The **effective IQ** -- how well the brain is used. A person who uses the brain more effectively will appear smarter. This difference is obvious for piano because pianists can do things on the piano that non-pianists absolutely can not do. Thus it is easy for pianists to raise their effective IQ to much higher levels than their intrinsic IQ, at least, at the piano.

(iii) **Perceived IQ** -- how others judge your IQ. Mozart, Beethoven, etc., have some of the highest perceived IQs. A unique feature of the perceived IQ is that it can be raised far above even the effective IQ. The intrinsic and effective IQs are real -- it is possible to measure them. Perceived IQ is purely "in the eyes of the beholder"; it can be raised to any level by using methods or tricks just as magicians do, to perform "miracles". All accomplished musicians do this routinely. Musicians are magicians with their own bag of tricks. Using music as an algorithm to memorize 5 hours of repertoire is such a trick. Mozart used mental play to read sentences backwards. Learning Absolute Pitch is another. Perceived IQ has no upper limit; religious icons have raised theirs so high that they are perceived to have supernatural powers or even as gods. Every pianist should be aware of these different IQs and cultivate them — it is part of being a musician.

(4) A genius is a person who has **genius skills**. Let's take Mozart as an example and see what these "genius skills" are, and which ones can be taught.

(i) Mozart had absolute pitch (AP). We now know that infants can learn AP effortlessly, and even adults can learn it, but requires more effort. This genius skill can be taught.

(ii) He could memorize practically any amount of music, even hearing it only once. We have developed, and understand, memory methods. If a person has AP, knows memory methods, composes music (knows music theory), and has mental play abilities, this type of memory capability is certainly achievable. Our daughter attended a piano competition in which one of her best friends was competing. She paid special attention because it was her good friend. She had never heard this piece before but, the next day, she played the entire piece for her teacher, and got most of the notes right (but not the fingerings). Therefore, this capability can be taught; Mozart is *certainly* not the only one.

(iii) He could compose an entire composition in his head and write it down, backwards and forwards, from anywhere, even one hand or voice at a time. This is just a case of a highly developed mental play. It was especially easy for Mozart because he used a fixed formula [(67) Mozart's Formula, Beethoven and Group Theory] for

practically all of his compositions. Mental play is definitely teachable, especially because we all do it everyday [(15) Mental Play (MP)].

(iv) He could speak sentences backwards. This is also mental play; all he did was to write the sentence on an imaginary blackboard and read it backwards, so it is easily teachable.

(v) He had technique; he could play anything. We have shown that there are practice methods that can solve technical problems, and many pianists will agree that there are probably many pianists today whose technical abilities are better than Mozart's. Therefore, this is eminently teachable.

(vi) He composed glorious music. This is the only controversial item because it all depends on the definition of "glorious". Certainly, there have been enough composers since Mozart's time so that the ability to compose is not unique to him. In addition, we expect every composer to be different so that it doesn't make sense to compare composers. Therefore, as long as a person composes, this item should also be in the teachable category.

The conclusion is that there is nothing Mozart did that can't be taught!

(5) It is quite probable that Mozart did not become a musician because he was a genius, but he became a genius with a extremely high perceived IQ because of his music training. The ability to compose is a natural consequence of having the genius skills and is therefore not mysterious, even for Mozart.

Music has a powerful effect on the functioning of the brain and its motor control (Sacks, Oliver,). This is one of the reasons why we usually use music when dancing or exercising. The best evidence for this comes from **Alzheimer's** patients who have lost their ability to dress themselves because they cannot recognize each different type of clothing. It was discovered that when this procedure is set to the proper music, these patients can often dress themselves! "Proper music" is music that they heard in early youth or their favorite music. Thus mentally handicapped people who are clumsy when performing daily chores can suddenly sit down and play the piano if the music is the right type that stimulates their brains. Therefore, they may not be musically talented; instead, it may be the music that is giving them new capabilities. Another evidence comes from patients with syndromes that prevent them from communicating with other humans; however, given a computer, they can suddenly communicate because computer communications are always exactly identical whereas human speech is not. To them things that are not identical are totally different, which makes it difficult to communicate with other humans. Therefore, auditory inputs can give the brain capabilities that it does not normally have. If music can produce such profound effects on the handicapped, imagine what it could do to the brain of a budding genius, especially during the brain's early development in childhood.

Conclusion: Creating geniuses is the process of teaching genius skills at the appropriate time which is "as young as possible", before age four in most cases. The

known genius skills are: mental play, absolute pitch, play by ear, and efficient practice methods. These skills in turn enable secondary genius skills such as great memory, technique, sight reading, and composing/improvising. What is so amazing is that the four genius skills can all be taught, yet were seldom taught because of the wrong belief that they were inborn talents. Why did such wrong beliefs persist for two hundred years? Because geniuses had to be taught at a young age by parents before they started lessons, and therefore it appeared to the teachers as if those skills were inborn and therefore not teachable. Even the ability to compose is a consequence of having mental play, absolute pitch, and play by ear. **There is no known process for musical geniuses to be created biologically at birth but we know how they can be created by teaching.**

(66) Scientific Approach to Piano Practice

I had wondered for most of my life why nobody can agree on the definition of the scientific method. This dilemma was embarrassing because I am a scientist. I have finally solved that riddle! The definition of anything depends on (1) the person defining it, (2) the person for whom it is intended and (3) the purpose for which the definition was created. For example, to a cook in a diner, an omelet is something he makes and sells; to a customer, it is something to eat for breakfast. Except for scientific terminology defined for specific purposes, relatively few definitions have universal applicability. Therefore, no matter how you define anything, someone is going to find it objectionable, in addition to the fact that defining anything correctly for any specific set of circumstances is difficult enough.

Science, in its broadest sense, is the study of the universe (or truth) and is therefore infinitely complex. Such a definition is of no use to a person trying to learn piano. The definition needed in this book is one which explains the relevance of science to piano practice. To that end, the definition I chose seems most appropriate: **"a scientific method is any method that works every time for everybody".** That is, you don't need to be a scientist to use science – in fact, *everyone* uses scientific methods *every day*, especially in developed countries.

For scientists, science is infinitely complicated. For everybody else, you can't live without science because science simplifies everything: life would be much harder without electricity, phones, cars, television, inexpensive foods, etc., all products of scientific progress. Without science, there won't even be a piano to play because the piano is one of the most science intensive mechanical machines ever created. I have interacted with plenty of scientists including Nobel laureates; nevertheless, piano tuners are some of the best practicing physicists I have ever met because, without understanding physics, no piano tuner will be able to tune, regulate, and maintain pianos.

One misunderstanding I encountered is that science is too difficult for artists. This boggles the mind. The mental processes that artists go through in producing the highest levels of music or other arts are at least as complex as those of scientists contemplating

the origin of the universe. One remark I hear too often goes something like "I'm not smart enough for science", which only reveals a lack of understanding of what science is. Not studying science, because the person is not smart enough, is like saying that he is not smart enough to go to school. The reality is that going to school is the fastest way to become smarter. Everyone studies science to empower themselves, to be able to do things they couldn't do before, to solve problems and to simplify life.

Science is empowerment. Although smart scientists are needed to advance science, everyone benefits from science, especially the less gifted. Thus another way of defining science is that it simplifies difficult tasks and makes previously impossible tasks possible.

Science is easier than art because in art, you depend on mental leaps whereas in science, you go one small step at a time. What many pianists do not know is the extent to which the greatest musicians used science to compose [(67) Mozart's Formula, Beethoven and Group Theory, (48) Chopin's Fantaisie Impromptu, Op. 66, Polyrhythms]. There is widespread belief that people are born with different interests or abilities in art or science; however, the majority of people can be artists or scientists depending on their exposure to each field, especially in early childhood. Genius can be taught [(65) Creating Geniuses].

Experience has shown that the scientific method works best if certain guidelines are followed. Major components of the scientific method are:

(i) Definitions: Without the precise definitions presented throughout this book (HS practice, parallel sets, thumb over, etc.), most of the discussions would become cumbersome and ambiguous. With the right definitions, complex concepts can be discussed concisely and accurately.

(ii) Research: In scientific research, you perform experiments, get the data, and document the results in such a way that others can understand what you did and can reproduce the results. Unfortunately, that is not what had been happening in piano teaching. Liszt never wrote down his practice methods and probably never even analyzed them. A tremendous amount of research had been conducted by all the great pianists, the past geniuses. Unfortunately, very little of that had been documented; piano pedagogy was not scientific.

(iii) Documentation: It is an incalculable loss that Bach, Chopin, Liszt, etc., did not write down their practice methods; today, they are mostly buried in their compositions. Those composers probably did not have sufficient resources or training to undertake such an unfamiliar task as analysis and documentation. An important function of documentation is the elimination of errors. Once an idea is written down, we can check for its accuracy and remove any errors and add new findings. **Documentation is used to create a one-way street in which the material can only improve with time.**

It is necessary to communicate with all other specialists doing similar work and to discuss new research results. In this respect, the piano world has been woefully inadequate; most books on piano playing don't even have references and they rarely build

on previous works. The book reviews in this book note if there are references; books without references are not scientific because every such book has to re-invent the wheel every time. It is the reason why piano pedagogy made no progress for 200 years until the recent mad dash towards documentation enabled by the internet. Documentation now provides hope that piano pedagogy can catch up to other developed fields of education. Without documentation, teaching methods can develop forwards as well as backwards, as shown by Hanon, who set us back 100 years.

(iv) Theory: Scientific results must always lead to some theory or principle that can be verified by everybody. Explanations like "it worked for me," or "I've taught this for 30 years" or even "this is how Liszt did it" aren't good enough. If a teacher had been teaching the procedure for 30 years, he should have had plenty of time to figure out why it works, but it didn't work out that way in piano because scientific principles were not followed. The explanations are often more important than the procedures they explain. For example, HS practice works because it simplifies a difficult task. Once this principle of simplification is understood, you can start looking for more things like that, such as shortening difficult passages or outlining. The nicest property of theory is that we don't need to be told every detail about how to apply the method -- we can fill in the details from our understanding of the method. There is no standard method that applies to everybody, because everybody is different, and understanding is needed to design the right practice method for each individual.

More research will produce some amazing scientific discoveries in music. The inefficient, time-consuming practice routines of the past had prevented musicians from getting the necessary education outside of music for understanding and learning music. Perhaps the greatest discoveries in music will come from brain studies and neuroscience. Music conservatories must take the initiative to research music scientifically and apply knowledge-based methods of teaching. We still do not understand the biological changes that accompany the acquisition of technique and how the human (especially the infant) brain develops. Understanding these will allow us to directly address them instead of having to repeat something 10,000 times. Neuroscientists today know more about the musical brain than conservatory professors (Levitin). Instead of assuming that you must be a genius to be a musician, we must research how to make musicians into geniuses. Evolution of science in the last 200 yrs has been nothing short of miraculous, and better education of pianists will surely yield similar results. Musicians must take advantage of the advances achievable using scientific methods, that have enabled us to perform miracles daily, in hospitals, factories, and homes, that even writers of the bible could not have imagined.

(67) Mozart's Formula, Beethoven and Group Theory

There is an intimate, if not absolutely essential, relationship between mathematics and music. At the very least, they share a large number of the most fundamental

properties in common, starting with the fact that the equal tempered chromatic scale is a simple logarithmic equation and that the basic intervals are ratios of the smallest integers that allow the brain to keep track of tonics in chord progressions [(68) Theory, Solfege]. Every musician is naturally curious whether mathematics is involved in the creation of music. In composition theory, mathematical symmetry transformations have been a major compositional device since before Bach (Solomon, Larry,). This is not surprising because math applies to practically everything; math is simply a device for describing anything quantitatively. One way to investigate this relationship is to study the works of the greatest composers from a mathematical point of view. Here are a few examples.

Mozart's Formula (Eine Kleine Nachtmusik, Serenade K525)

Professor Robert Levin of Harvard (Levin, Robert,:) lectured on "Mozart's Fingerprints: A Statistical Analysis of his Concertos" concerning a "specific and sophisticated hierarchy of musical motives that underlies the Mozart concerto form" in December of 1977 at a Bell Laboratories Research Colloquium, at Murray Hill, NJ. I have to thank Brian Kernighan (co-author of "The C Programming Language") for locating the records to this lecture which was still stored in his computer after more than 30 years!

Prof. Levin lectured on a hierarchy of musical motives that were so specific as to be potentially useful for authenticating Mozart's compositions. On the one hand, I was disappointed with the lecture because of my ignorance of music theory; I was expecting an easily understandable musical structure. On the other hand, Prof. Levin awakened my awareness of structure in music, and led me to examine structure in Mozart's music.

If you take just one atom, carbon, you can change the atomic microstructure and get anything from hard, brilliant diamonds to lubricating graphite to light weight golf club shafts, to superconductors, and even buckyballs with amazing properties and uses. It is the differences in the repetitive microstructure of the carbon atoms that gives these materials such different properties, and my expertise was in examining these microstructures.

It was no surprise, therefore, that I immediately recognized the repetitive structure of Mozart's music. For those not accustomed to dealing with structure in music, this repetitive structure is not easily recognizable because it appears to have no obvious relevance to the melodic progression. I have tested this recognition with my musical colleagues and it took most of them a while to recognize this structure as a part of the music. This lack of recognition has historically impeded the pursuit of this microstructure because, for musicians, it seems so trivially simple that it does not deserve attention. One of the best examples of this is the slow movement of Mozart's Piano Concerto No. 21, which is generally considered to be non-repetitive because the incredible emotional content hides the repetitions.

Repetition, of course, is key to almost all music. The time signature governs the

entire piece, so that formal rhythm is 100% repetitive. Mozart's music uses mostly a single repetition (2 units in a row). Bach uses repetitions extensively, but is not mainly confined to a single type like Mozart's. In the Inventions, Bach uses 2 repetitions most frequently (3 units in a row – see Invention #8). Repetitions on larger scales are also important, as Slenczynska, Ruth, (P. 49) wrote: "play all repeats marked by the composer" - instructions from a seasoned pianist, because the repetitions are there for specific purposes.

These types of repetitive structures are well known among composers, and articles on music analysis and composition are starting to discuss them in greater detail (Brandt). Discussions of pitch sets and symmetry transformations similar to those discussed here have appeared in the literature (Bernard, Solomon).

My structural analysis revealed that Mozart composed practically *all* of his music, from when he was very young, according to a single formula that expanded his music by over a factor of ten. Whenever he composed a new melody that lasted one minute, he knew that his final composition would be at least ten minutes long. Sometimes, it was a lot longer, because the main part of his formula is a multiplication by a factor of two; so that the multiplication after 10 minutes makes the music 20 minutes long, then 40, etc.!

The first element of his formula was to repeat a "motif". These motifs are very short -- only a few notes, much shorter than you would think of a musical melody — we always think of melodies, not motifs. We see the Taj Mahal, but the individual marble blocks are invisible. These short motifs simply disappear into the melody because they are too short to be recognized; certainly a conscious construct by the composer to hide them.

The motif would then be modified two or three times to produce what the audience perceives as a melody. These modifications consisted of the use of various mathematical and musical symmetries such as inversions, reversals, harmonic changes, clever positioning of ornaments, etc., as shown below. These repetitions would be assembled to form a section and the whole section would be repeated. The first repetition provides a factor of two, the various modifications provide another factor of two to six (or more), and the final repetition of the entire section provides another factor of two, or 2x2x2 = 8 at a minimum. In this way, he was able to write huge compositions with a minimum of thematic material.

Because of this pre-ordained structure, he was able to write down his compositions from anywhere in the middle, or one voice at a time, since he knew ahead of time where each part belonged. And he did not have to write down the whole thing until the last piece of the puzzle was in place. He could also compose several pieces simultaneously, because they all had the same structure.

This formula made him appear to be more of a genius than he really was, because he could compose so much music, write it down backwards and forwards, compose it entirely in his mind, etc. This naturally leads to the question: how much of his reputed

"genius" was simply an illusion of such machinations? This is not to question his genius -- the music takes care of that! However, many of the magical things that these geniuses did were the result of relatively **simple devices that we can learn**.

Knowing Mozart's formula makes it easier to dissect and memorize his compositions. The first step towards understanding his formula is to be able to identify the motif and analyze his modifications and repetitions. They are not simple repetitions; Mozart used his genius to modify and disguise the repetitions so that they produced music and so that the repetitions will not be recognized.

Another aspect of his compositions is the economy with which he expresses complex ideas; as an example, let's examine the famous melody in the Allegro of his **Eine Kleine Nachtmusik**. This is the melody that Salieri played and the pastor recognized in the beginning of the movie, "Amadeus". That melody is a repetition posed as a question and an answer. The question is a male voice asking, "Hey, are you coming?" And the reply is a female voice, "Yes, I'm coming!" The male statement is made using only two notes, a commanding fourth apart, repeated three times, and the question is created by adding two rising notes at the end (this appears to be universal among most languages -- questions are posed by raising the voice at the end). The response is a female voice because the pitch is higher, and is again two notes, this time a sweeter minor third apart, repeated (you guessed it!) three times. It is an answer because the last three notes wiggle down. The efficiency with which he created this construct is amazing. What is even more incredible is how he disguises the repeated pairs of notes so that when you listen to the whole thing, you would not recognize the repetitions, but hear a single melody.

Let's look at another example, the **Sonata #11 in A, K331** (or K300i - the one with the Rondo Alla Turca ending). The basic unit (motif) of the beginning theme is a quarter note followed by an eighth note. The first introduction of this unit in bar 1 is disguised by the addition of the 16th note. This introduction is followed by the basic unit, completing bar 1. Thus in the first bar, the unit is repeated twice. He then translates the whole double unit of the 1st bar down in pitch and creates bar 2. This is the same device used by Beethoven at the start of his 5th symphony where he gives you the "fate" motif and then repeats it at a lower pitch. The third bar is the basic unit repeated twice. In the fourth bar, he again disguises the first unit by use of 16th notes. Bars 1 to 4 are then repeated with minor modifications in bars 5-8. From a structural viewpoint, every one of the first eight bars is patterned after the first bar. From a melodic point of view, these eight bars produce two melodies with similar beginnings but different endings. Since the whole eight bars is repeated, he has basically multiplied his initial idea embodied in the first bar by 16! If you think in terms of the basic unit, he has multiplied it by 32. But then he goes on to take this basic unit and creates incredible variations to produce the first part of the sonata, so the final multiplication factor is even larger. He uses repetitions of repetitions. By stringing the repetitions of modified units, he creates music that sounds like a long

melody.

In the second half of this exposition, he introduces new modifications to the basic unit. In bar 10, he first adds an ornament with melodic value to disguise the repetition and then introduces another modification by playing the basic unit as a triplet. Once the triplet is introduced, it is repeated twice in bar 11. Bar 12 is similar to bar 4; it is a repetition of the basic unit, but structured in such a way as to act as a conjunction between the preceding three related bars and the following three related bars. Thus bars 9 to 16 are similar to bars 1 to 8, but with a different musical idea. The final two bars (17 and 18) provide the ending to the exposition.

With these analyses as examples, you should now be able to dissect the remainder of this sonata. You will find that the same pattern of repetitions is found throughout. As you analyze more of his music you will need to include more complexities; he may repeat three or even four times, and mix in other modifications to hide the repetitions. He is a master of disguise; the repetitions and other structures are not obvious when you listen to the music without analyzing the structure.

Mozart's formula certainly increased his productivity. Yet he may have found certain magical (hypnotic? addictive?) powers to repetitions of repetitions and he probably had his own musical reasons for arranging the moods of his themes in the sequence that he used. That is, if you further classify his melodies according to the moods they evoke, it is found that he always arranged the moods in the same order. The question here is, if we dig deeper and deeper, will we find more of these simple structural/mathematical devices, stacked one on top of each other, or is there more to music? Almost certainly, there must be more, but no one has yet figured it out, not even the great composers themselves -- at least, as far as they have told us. Thus the only thing we mortals can do is to keep digging.

For further analysis of this Sonata (#11, K331), see Scoggin, Nancy,, P. 224.

Mozart is not the inventor of this formula and similar formulas were used widely by composers of his time. Some of Salieri's compositions follow a very similar formula; perhaps this was an attempt by Salieri so emulate Mozart. In fact a large fraction of all music is based on repetitions. The beginning of Beethoven's 5th symphony discussed below is a good example and the familiar "chopsticks" tune uses "Mozart's formula" exactly as Mozart used it. Therefore, Mozart simply exploited a fairly universal principle of music composition.

The simplest form of Mozart's formula appears in the famous "Twinkle, Twinkle, Little Star" song where the motif is a single note which is repeated. This tiny melody embodies most of the basic rules of composition, and was composed before Mozart was born. Since Mozart undoubtedly heard it as a child, it is possible that he started composing by adopting it as a model, and eventually used it for almost all of his compositions. This hypothesis explains why Mozart used this formula from his earliest composing days — it is the first melody most youngsters hear at an early age. Mozart

may have initially based his compositions on this formula and, as he developed it, discovered that he didn't need anything else, especially because it enabled him to compose everything in his head without having to write anything down.

Beethoven & Group Theory (5th Symphony, Appassionata, Waldstein)

The use of mathematical devices is deeply embedded in Beethoven's music. Therefore, Beethoven is the best place to dig for information on the relationship between mathematics and music. I'm not saying that other composers did not use mathematical devices. Practically every musical composition has mathematical underpinnings and every famous composer has used incredible mathematical devices to compose. However, Beethoven stretched everything to extremes and such extremes are most useful because the underlying principles can be identified with certainty.

We all know that Beethoven never studied advanced mathematics, yet he used **group theory** type concepts to compose this famous symphony (Bernard, Jonathan W.,, and search "group theory" or "symmetry in music" on the internet). In fact, he used what crystallographers call the Space Group of symmetry transformations! Group Theory governs many advanced technologies, such as quantum mechanics and nuclear physics that are the foundations of today's technological revolution. At this level of abstraction, a crystal of diamond and Beethoven's 5th symphony are one and the same! I will now explain this.

The Space Group that Beethoven used has been applied to characterize crystals, such as silicon and diamond, and is the basis for analyzing useful properties of crystals. It's like the physicists needed to drive from New York to San Francisco and the mathematicians handed them a map! That is how we perfected the silicon transistor, which led to integrated circuits, the computer, and the internet. So, what is the Space Group? And why was this Group so useful for composing this symphony?

Mathematicians found that groups consist of Members and Operations, such that if you perform an operation on a member, you get another member of the *same* group. A familiar group is the group of integers: -1, 0, 1, 2, 3, etc. One operation for this group is addition: 2 + 3 = 5. Note that the application of the operation + to members 2 and 3 yields another member of the group, 5. Since operations transform one member into another, they are also called Transformations. A member of the Space Group can be anything in any space: an atom, a frog, or a music note. The atom and frog reside in our 4-dimensional space-time. The music note operates in any musical dimension such as pitch, speed, or loudness. The Operations of the Space Group relevant to crystallography are (in order of increasing complexity) Translation, Rotation, Mirror, Inversion, and the Unitary Operation. These are almost self explanatory (translation means you move the member some distance in that space) except for the Unitary Operation which basically leaves the member unchanged. However, it is subtle because it is not the same as the equality transformation, and is therefore always listed last in textbooks. Unitary Operations are

generally associated with the most special member of the group, which we might call the Unitary Member. In the integer group noted above, this member would be 0 for addition and 1 for multiplication (5+0 = 5x1 = 5); this demonstrates that figuring out the unitary operator is not simple.

Let me demonstrate how you might use this Space Group, in ordinary everyday life. Can you explain why, when you look into a mirror, the left hand becomes a right hand (and vice versa), but your head doesn't rotate down to your feet? The Space Group tells us that you can't rotate the right hand and get a left hand because left-right is a mirror operation, not a rotation. Note that this is a strange transformation: your right hand becomes your left hand in the mirror; therefore, the wart on your right hand will be on your left hand image in the mirror. This can become confusing for a symmetric object such as a face because a wart on one side of the face will look strangely out of place in a photograph, compared to your familiar image in a mirror. Although the right hand becomes a left hand, a mirror cannot perform a rotation, so your head stays up and the feet stay down. Curved mirrors that play optical tricks (such as reversing the positions of the head and feet) are more complex mirrors that can perform additional Space Group operations, and group theory will be just as helpful in analyzing images in a curved mirror.

The solution to the flat mirror image problem appeared to be easy because we had a mirror to help us, and we are so familiar with mirrors. The same problem can be restated in a different way, and it immediately becomes much more difficult, so that the need for group theory to help solve problems becomes more obvious. If you turned a right hand glove inside out, will it stay right hand or will it become a left hand glove? I will leave it to you to figure that one out (hint: use a mirror).

Let's see how Beethoven used his intuitive understanding of symmetry transformations to compose his 5th Symphony. That first movement is constructed using a short **fate motif** consisting of four notes. The first three are repetitions of the same note. Since the fourth note is different, it is called the surprise note and Beethoven's genius was to assign the beat to this note. This motif can be represented by the sequence 555**3**, where **3** is the surprise note and the bold indicates the accent. This is a pitch based space group; Beethoven used (and was aware of) a space with at least three dimensions: pitch, time, and volume. I will consider only the pitch and time dimensions in the following discussions.

Beethoven starts his 5th Symphony by first introducing a member of his group: 555**3**. After a momentary pause to give us time to recognize his member, he performs a translation operation: 444**2**. Every note is translated down. The result is another member of the same group. After another pause so that we can recognize his translation operator, he says, "Isn't this interesting? Let's have fun!" and demonstrates the potential of this operator with a series of translations that creates music. In order to make sure that we understand his construct, he does not mix other, more complicated, operators at this time.

Recall, above, that Translation is the simplest operator.

In the ensuing series of bars, he successively incorporates the Rotation operator, creating **3**555, and the Mirror operator, creating **7**555. Somewhere near the middle of the 1st movement, he finally introduces what might be interpreted as the Unitary Member: 555**5**. Note that Beethoven simply repeats these groups of 4 identical notes, which is the Unitary Operation on a unitary member, and is introduced last! Recall that the Unitary transformation is the most complex.

In the final fast movements, he returns to the same group, but uses only the Unitary Member, and in a way that is one level more complex. The whole motif is repeated three times. What is curious is that this is followed by a fourth sequence -- a surprise sequence 7654, which is not a member. Together with the thrice repeated Unitary Member, the surprise sequence forms a Supergroup from the original group. He has generalized his group concept! The supergroup now consists of three members and a non-member of the initial group, which satisfies the conditions of the initial group (three repeats and a surprise).

Thus, the beginning of Beethoven's Fifth Symphony, when translated into mathematical language, reads like the first chapter of a textbook on group theory, almost sentence for sentence!

Group theory is one of the highest forms of mathematics. Beethoven presents the material in the correct order as they appear in textbooks. He even demonstrates the generality of the concept by creating a supergroup from the original group. Incredible.

Beethoven was particularly fond of this four-note theme, and used it in many of his compositions, such as in (51) Beethoven's Appassionata, Op. 57, First Movement. Being the master that he is, he carefully avoids the pitch space for the Appassionata and uses time (tempo) space and volume space (bars 234 to 238). This is further support for the idea that he had an intuitive grasp of spaces in group theory and consciously distinguished between these spaces. It seems to be a mathematical impossibility that this many agreements of his constructs with group theory happened by accident, and is virtual proof that he was experimenting with these concepts. What is truly amazing is that **Beethoven figured all this out long before mathematicians or physicists realized their importance**, before Group Theory was born as a branch of mathematics!

Why was this construct so useful in this symphony? It provides a uniform platform on which to hang his music. The simplicity and uniformity allow the audience to concentrate only on the music without distraction. It also has an addictive effect. These subliminal repetitions (the audience is not supposed to figure out that he used this particular device) can produce a large emotional effect. It is like a magician's trick -- it has a much larger effect if we do not know how the magician does it. It is one of many tricks with which Beethoven controlled the audience without their knowledge. Just as Beethoven had an intuitive understanding of this group type concept, we may all feel that some kind of pattern exists, but are unable to figure it out. Mozart accomplished a similar

effect using repetitions. Can you recognize the repetitions in this 5th symphony similar to Mozart's?

Perhaps the most important factor is the concept of space; when you stay in one space and conduct transformations in that space, the brain can follow it more easily, just as starting in one key and conducting chord progressions along the circle of fifths makes it easy for the brain to keep track of tonics [(68) Theory, Solfege].

Knowledge of these group type devices is useful for playing his music, because it tells us exactly which tool Beethoven is using to create his music. Another example of this can be found in the 3rd movement of his **Waldstein sonata**, where the entire movement is based on a 3-note motif represented by 15**5** (the first CG**G** at the beginning). This initial theme is repeated throughout the movement and becomes increasingly insistent as the movement progresses. By then, the audience is addicted to it and does not even notice that it is dominating the music.

Music is a form of mathematics and the great composers explored and exploited this relationship, as we just saw with Beethoven. Most basic theories of music can be expressed mathematically: harmony is a series of ratios, and harmony gives rise to the chromatic scale, which is a logarithmic equation [(68) Theory, Solfege, (76) Chromatic Scale, (77) Circle of Fifths, Temperaments]. Most music scales are subsets of the chromatic scale, and chord progressions are the simplest relationships among them. Music and mathematics are inseparably intertwined, especially within the human brain and its automatic functions, and a knowledge of these relationships can be useful, as demonstrated by every great composer. Math can only become more useful in music as mathematical understanding of music expands and as artists learn to take advantage of it. Art is a shortcut way of using the human brain to achieve results not achievable in any other way. Scientific approaches to music deal with simpler aspects of music that can be treated analytically and is especially useful for eradicating incorrect concepts: science supports art. It is wrong to say that music is not math; art should be free to explore anything the artist desires, and excluding math not only handicaps the artist, but directly contradicts the works of the greatest artists.

(68) Theory, Solfege

Music Theory (Scoggin) today is a set of rules that were reverse-engineered from existing music. It is detailed and complex, and is very useful for musicians. It is an established field of music and is outside the scope of this book. Here, we address the question of why the brain follows these musical rules, specifically for the piano. There are studies on related subjects; see Patel, Aniruddh D.,.

The brain automatically processes all sensory inputs. It commits them to memory for later use and processing, uses them to figure out if anything dangerous or interesting is about to happen, where sound is coming from, etc.; innumerable actions so automatic that, for the vast majority of them, we are not even aware of what the brain is doing.

Recognition of music is the result of such automatic brain actions; but, what are they?

The (76) Chromatic Scale is **logarithmic("log")** and the auditory system operates on a log frequency system so that both the cochlea, where the frequencies are detected, and the brain, where they are analyzed, have log structures. Unlike the eye, where the optical frequencies are calibrated on an absolute scale using quantum mechanical transitions (so that everybody sees the same colors), the auditory frequency scale is uncalibrated. Therefore, the only way for the brain to process auditory information is to calculate ratios between frequencies. On a log scale, ratios are easily recognized because ratios are distances on the log scale — that's the principle behind the slide rule. (On a log-linear plot, ratios are fixed distances.) That is why intervals are important in music and explains why the brain likes harmony — because the brain can recognize frequencies that are harmoniously related. Each harmony is a fixed type of sound and does not produce time dependent beats as do dissonant sounds.

The fact that harmonies are recognized by the brain indicates that the brain works with frequency ratios. The chromatic scale contains all the important harmonic intervals (fifths, fourths, etc.) and has the same log structure as the auditory system, allowing the brain to process music written using it; thus the chromatic scale is a functional replica of the cochlea. The piano is a replica of the cochlea which is copied into the brain and enables the brain to compute ratios of frequencies using logarithms as is done with slide rules. The piano is just a slide rule that enables the brain to compute ratios of frequencies that harmonize!

The *infinite* number of notes of the chromatic scale is particularly simple in log space because any note in that infinity can be reached by using only the twelve notes of the octave. **Thus it is the simple and tractable nature of processing music in the brain that distinguishes music written in the chromatic scale from other sources of sound.** By using a logarithmic scale and a system of recognizable harmonies, we have reduced an intractable set of the infinity of notes into an easily tractable twelve notes of the octave! However, it produces only a subset of music because music can be produced by banging a stick on a hollow log.

Harmonic music is a product of the attempt by the brain to keep track of frequencies by computing ratios of frequencies in logarithmic space. If the brain can not keep track of frequencies, it has no way of processing frequency information except by memorizing huge amounts of auditory inputs. We now have an explanation of why harmonic music is so special to the brain — it can memorize and process frequencies in music with a minimum of effort by using log computations.

Thus our ability to enjoy music is inborn. The chromatic scale, although a purely human invention, turns out to be a functional replica of the log nature of the auditory system. This gives rise to the theory that the brain prefers the *simplest* inputs that it can handle, which can explain many properties of music that previously had no clear explanations and provides new insights into what music is:

(1) harmonies are ratios of frequencies that are easily recognized and computed in log space,

(2) repetitions of motifs are special, because of their simplicity,

(3) the most popular melodies are also the simplest,

(4) repetitive rhythms simplify the memory process,

(5) music using the chromatic scale is an acquired taste, but is readily acquired because both the chromatic scale and the auditory systems are logarithmic,

(6) chord progressions are the simplest relationships between scales in log space; the progression creates tension because, with each progression, the brain must keep track of an additional tonic,

(7) returning to the starting tonic is satisfying because it frees the brain from having to remember the tonic changes,

(8) dissonances are unpleasant because the brain has no way of processing them,

(9) music appreciation is partly inborn because it is part of the automatic brain processing of audio inputs,

etc.

This theory does not explain why we *enjoy* music. A possible explanation is that any auditory input is automatically processed by the brain as good or bad. Suppose that 90% is interpreted as bad and 10% as good; the composer simply chooses the good 10% to compose his music. Once the good ones are identified, it should be possible to find out why they are good. Of course there is nothing stopping composers from using the "bad" sound combinations and still write music, just as hot peppers and bitter melons are eaten by humans.

Everybody agrees that music is a language. The alphabet of musical language contains such components as the chromatic scale, loud, soft, fast, slow, legato, staccato, etc.. But these are not single letters as in the language alphabet, but are entire spaces of their own. Every space has its own set of symmetries, and that explains why symmetry transformations are important in music, and why Beethoven used group theory and its symmetry transformations, to compose [(67) Mozart's Formula, Beethoven and Group Theory]. Because the piano can reach the largest volume of this language space, it is the most dominating instrument in the musical universe.

A chord is a group of intervals with the same tonic; this makes the tonic a special frequency and explains why music follows chord progressions: chord progressions are the simplest ways with which the brain can keep track of frequencies, by remembering the tonics. When plotted on log-linear plots, the chromatic scale forms a straight line, and all harmonizing intervals appear at fixed distances from the tonic, making it easy for the brain to recognize intervals (harmonies) no matter where they appear on this straight line (relative pitch). This explains why anyone who appreciates music can easily learn relative pitch.

Because the brain is keeping track of frequencies during chord progressions, the

progression must return to the originating chord for the music to end; otherwise, the brain feels that something is incomplete: it has to remember both the starting and ending tonics, whereas if the music returns to the original chord, it has to remember only one tonic, or even none at all, depending on how it is keeping track of tonics.

Conclusion: a theory based on the logarithmic structure of the cochlea and brain, and automatic brain computations in log space using ratios, can explain many major characteristics of music, such as why harmonies are pleasant and why dissonances are not, and the chord progression rules.

As with learning to read, it is a good idea to learn as much theory (Scoggin, Nancy.,) as possible with each piece of music you learn. Teachers must pay special attention to theory lessons contained in every lesson piece because this is the best way to teach theory so that the lessons will be retained for life -- students are automatically reminded of the theory every time they play the piece.

Solfege is mainly for singers and composers. It consists of increasingly complex series of exercises involving different scales, intervals, time signatures, rhythms, accidentals, etc, for voice/music training. It also covers pitch recognition and dictation. It teaches universal music lessons, that are indispensable for advanced pianists, such as scale structures, learning absolute pitch [(17) Absolute Pitch, Relative Pitch], dictation, etc. Without solfege, budding pianists who feel the urge to compose will be handicapped, unable to figure out where to start, how to write it all down. There is no shortage of books and internet sites that can get you started, such as: http://www.vocalist.org.uk/books_for_singers.html . Solfege books are available in stores or over the internet and is best started in a group class environment.

(69) Disadvantages of Learning Piano

Are there **disadvantages** to learning piano? The biggest disadvantage is lack of **education**. A youngster learning piano seriously must make the decision between education in language, economy, science, mathematics, information technology, engineering, etc., etc., and his love of music. It is no surprise that many rational, intelligent youngsters opt out of music. Every parent and potential musician must address this issue because the decision can lead to a life of unnecessary hardships even if the music part is reasonably successful, or a successful life in other fields.

Today, an accomplished pianist is frequently in an untenable situation in which he is viewed as "talented" or even "genius", yet is under-educated. Thus interviews and books by accomplished musicians often become self-serving vehicles ("talented musician") with no meaningful content (under-educated), because a rounded education is needed for meaningful discussions on today's topics of interest. How did this happen? Because the inefficient teaching methods do not leave enough time for aspiring pianists to learn anything else but piano. Most conservatories specialize only in music and have negligibly

small departments providing non-music education. The answer lies in improved teaching methods that free sufficient time for pianists to study other fields. **IQ** and education are inseparable just as technique and music are inseparable. World IQ in developed nations is rising about 1 point per decade because of advancing education, whereas piano pedagogy has been stagnant for 200 years.

It is no surprise that learning piano can raise the IQ if done properly, but can lower the IQ and prevent the students from getting their much needed education, if done improperly, such as practicing mindless repetitive exercises. Education in other fields is necessary for learning piano skills. This means standardized textbooks and teaching methods, and application of scientific methods of pedagogy, something which has been recognized since the beginning of piano teaching, but has not been successfully executed (e.g., Whiteside - P. 249, Prokop - P. 246, etc.). **We must transition from emphasis on talent to emphasis on education which works because it is the most** *honest* **approach to learning piano.** Claiming talent without the necessary knowledge is not honesty because "talent" has historically led to numerous incorrect assumptions and teachings.

A related disadvantage is **economic**. It is generally recognized that a music career does not pay as well as other careers. This is even more reason why musicians must make every effort to receive education in other fields. There are a few musicians whose earnings are astronomical but, for the majority, their best option is a multi-expertise career, not solely music. Thus a more technically oriented, multi-disciplinary approach to music education directed towards increasing the efficiency and cost-effectiveness of music pedagogy is the best approach instead of sweeping everything under the "talent" rug, which has gotten most musicians nowhere for hundreds of years. Once the talent rug is removed, piano teachers will be accountable for their students' progress and will need to learn more effective teaching methods. There is the hope that, with enough good teachers, interest in piano might increase sufficiently to improve the economics.

Even the efficient practice methods of this book come with some disadvantages. These methods make things too easy; thus students who grew up with these methods do not have the experience of struggling with difficult material. But when they get to conservatories, they suddenly face difficult problems with which they must struggle and don't know how to handle them. The efficient methods are based on simplifying everything into easy bits and learning them quickly. At advanced levels, you may need to learn the bigger units quickly: the ability to cope with difficult problems that take a long time to solve must be practiced. This book gives you a great head-start, but it is only a beginning.

(70) Grand, Electronic, Upright Pianos

Grand, Upright, or Electronic? Grands become necessary at advanced levels (four to six years of lessons). Because advanced material cannot be played on lower quality pianos, the students can't even practice them. There are great pianists who became

technically advanced practicing mostly on uprights, so it is possible, but difficult. There is no evidence that you need a grand for initial technical development, although a few piano teachers will insist that any serious student must practice on a grand. An argument can be made in favor of uprights, at least for beginners, because they are more difficult to play and may be better for early finger development. They may be superior even for intermediate students because uprights are less forgiving and require greater technical skill to play. For students up to intermediate level, any differences among uprights and grands are inconsequential compared to other factors such as student motivation, quality of teachers, practice methods, and proper piano maintenance.

The most important factor for acoustics (grands and uprights, as distinguished from electronic [digital] pianos) is maintenance. Acoustics require maintenance at least once a year. Too many acoustics are under-maintained because their owners do not know what maintenance is needed, which makes it too difficult to practice pianissimo and musicality, acquire technique, or learn absolute pitch. Digitals do not require maintenance.

Electronic Pianos: Today's (2015) best electronic pianos are still inferior to good grands for sound and tone control, but are improving rapidly. The best electronics are now competitive with grands for technical development. Most inexpensive speakers can not compete with the soundboard of a grand and future electronics will surely come with better speaker systems. Uprights do not provide sufficient advantages for technical development to warrant their use over quality electronics that are readily available, comparatively inexpensive, and require no maintenance. Today's electronics will last about ten years under constant, daily use, at which point the actions tend to become sticky and noisy. Another reason for upgrading to a new electronic every five to seven years is that the newer models are cheaper and better. Because the quality of the action is the main problem with electronics, the best way to test one is by playing fast trills.

Because electronic pianos have some unique advantages, most serious pianists now own both an acoustic and an electronic. Here are some reasons:

(i) For less than the price of an average new upright, you can buy a new electronic piano with all the features you need: weighted 88 keys, 128 polyphony, headphone, volume control, touch control, organ, string, voice, harpsichord, metronome, recording and midi/analog out, transposition, different tunings (temperaments), and canned accompaniments. Many electronics provide even more, but these are common features you can expect. The argument that a acoustic piano is a better investment than an electronic is false because, except for collectors' items, no acoustic is a good investment, especially when the initial cost and depreciation are so high for new instruments. The maintenance costs of acoustics are substantial, since they require tuning, voicing, and regulation at least once a year, plus periodic repairs.

(ii) The electronics are always in tune. Very young children exposed sufficiently to perfectly tuned pianos acquire absolute pitch automatically, although most parents never

discover this because the children are never tested and, if it is not discovered and maintained, it is lost during the teen years. The acoustic piano begins to go out of tune the minute the tuner leaves your house, and some notes will be out of tune most of the time. Because too many acoustic pianos are inadequately maintained, the fact that the electronics are always in tune is a big advantage.

(iii) You can use headphones or adjust the volume so that you can practice without disturbing others. The ability to turn down the volume is also useful for reducing ear damage when practicing loud passages: an important factor for anyone at *any age*. Although younger pianists can tolerate loud sounds, by the time they start hearing tinnitus and losing their hearing at age 50, it is too late — hearing loss will quickly accelerate thereafter with age. Protecting the ears starting as early as age 20 is the best way to avoid such a fate.

If you are an advanced player, even an electronic will create considerable "playing noise" (with the volume turned off) that can be quite loud to anyone nearby and these vibrations can transmit through the floor to rooms under the piano. Therefore it is a mistake to think that the sound from an electronic (or an acoustic with "silent" feature) can be completely turned off.

(iv) Electronics are more portable than acoustics. Although there are light keyboards with similar features, it is best for piano practice to use the heavier electronics so that they do not shift while playing loud, fast music. Even these heavier electronics can be easily carried by two persons, and will fit in many cars.

(v) Variable touch weight is more important than many people realize. However, you have to know what "touch weight" means before you can use it to advantage. In general, the touch weight of electronics is a little lighter than that of acoustics. This lighter weight was chosen for two reasons: to make it easier for keyboard players to play these electronics (keyboards are even lighter), and to make them easier to play compared to the acoustics. The disadvantage of the lighter weight is that you may find it more difficult to play a acoustic after learning on an electronic. The touch weight of acoustics is heavier because it is expensive to make acoustics lighter. One advantage of heavier weight is that you can feel the keys of a acoustic while playing, without inadvertently depressing some wrong notes. However, this can also lead to careless playing with some inadvertent finger motions because you can accidentally hit a key of a acoustic without making any sound. You can practice getting rid of these uncontrolled motions by practicing on an electronic and choosing a light touch weight so that any inadvertent strike will produce a sound. Many who practice only on acoustics don't even know that they have such uncontrolled motions until they try to play on an electronic, and find out that they are hitting a lot of extra keys (and buttons!). The light touch is also useful for acquiring difficult technique quickly. Then, if you need to play on a acoustic later on, you can practice with increased weight on the electronic after you acquire the technique. This two-step process is usually faster than trying to acquire technique at a heavy key setting.

(vi) Recording piano music is one of the most difficult things to do using conventional recording equipment. With an electronic piano, you can do it with the push of a button. You can easily build up an album of all the pieces you learned. Everyone should cultivate a habit of recording every finished piece from the very beginning of lessons. Too many students never record their performances, which is the main reason for excessive nervousness and difficulties during performances.

(vii) Most pianists who follow good practice methods and become proficient when young will end up composing their own music. Electronic pianos are helpful for recording your compositions so that you don't need to write them down, and for playing them in different instruments, as appropriate for each composition. With some additional software or hardware, you can even compose entire symphonies and play every instrument yourself. There is even software that will transcribe (though imperfectly) your music onto sheet music. On the other hand, there is nothing like a quality grand to help you compose – the sound from a great piano somehow inspires the composing process. Therefore, if you are a professional composer, most electronics will be inadequate for inspiration although they will suffice for mundane composition chores.

(viii) If you can acquire technique rapidly, there is nothing stopping you from broadening your horizon beyond classical music and playing popular music, jazz, blues, etc. You will appeal to a wider audience if you can mix music genres and will have more fun. The electronic piano can help by providing the accompaniments, drums, etc., for those types of music. Electronics are more easily transportable for gigs that can become a significant activity depending on the genre.

(ix) The above is only the beginning; electronics will improve in leaps and bounds *every year*. One interesting development is piano modeling (Pianoteq), instead of the sampling used by most manufacturers. Good sampling requires tremendous amounts of memory and processing power, which can slow down the piano response. It is also limited by the original piano used for the sampling. Modeling is more versatile, requires much less memory and software, and enables features such as partial soft pedal, controlling the hammer shank flex or letting you play Chopin's Pleyel.

(x) We should all move towards WT (Well Temperaments) and away from ET [Equal Temperament that is universally accepted today, see (77) Circle of Fifths, Temperaments]. Once you decide to use WT, you will need several of them. Learning to discern and bring out key color is a most valuable skill as an advanced musician. ET is the worst tuning for this because key color absolutely disappears. With electronic pianos, you can get most of the useful temperaments by flicking a switch.

The touch weight of a piano is not a simple matter of adding or subtracting lead weights to the keys to change the force required to depress them. The touch weight is a combination of the down weight, the inertia of the keys and hammers, and the force required to produce a certain volume of sound. The **down weight** is the maximum weight that the key will support before it will start to move down. This is the weight that is

adjusted using lead weights, etc. The down weight of all pianos, including the "weighted key" electronics, is standardized at about 50 grams and varies little from piano to piano regardless of touch weight, although it is slightly lighter (10-20%) in weighted key electronics than most acoustics. The non-weighted keyboards are much lighter.

When playing a piano, this 50 gram weight is a small fraction of the force required to play -- most of the force is used to produce the sound. In acoustic pianos, this is the force needed to impart velocity to the hammer. In electronics, it is the electronic reaction to the key motion and a fixed mechanical resistance. In both cases, you also have to overcome the inertia of the mechanism in addition to supplying the force for producing the sound. Electronics have a smaller inertial component because they have only the inertia of the keys whereas the acoustics have the additional inertia of the hammer mechanism; this makes the acoustics less sensitive to inadvertent hitting of the keys. Therefore, you will feel the most difference between acoustics and electronics when playing fast or staccato and little difference when playing slow legato.

The **touch weight** is the effort required to produce a certain volume of sound and has little to do with down weight. For acoustics, touch weight is determined mostly by hammer mass and voicing (hardness of the hammer). There is only a narrow range of hammer masses that is ideal because you want heavier hammers for larger sound but lighter ones for faster action. The touch weight can be adjusted by the piano technician by hammer voicing, rather than by changing the down weight. For electronic pianos, touch weight is controlled in the software by switching to the sound of a softer hammer for heavier touch weight and vice versa, which simulates a acoustic grand; there is no mechanical change to the down weight of the keys or other inertial components. Thus if you switch to the heaviest key weight, you might feel that the sound is somewhat muffled and if you switch to the lightest weight, the sound might be more brilliant. In electronic pianos, it is easier to change the touch weight without adversely affecting the sound because there is no hammer to adjust. The maximum dynamic range of most electronic pianos is limited by the speakers, so that the dynamic range of acoustic grands is larger.

You can demonstrate this subjective judgment of key weight by turning the volume down using the electronic piano and trying to achieve the same loudness. We conclude that there are small differences in the touch weight between grands and electronics, with the grands tending to be heavier, but those differences are not sufficient to cause major problems when switching from one to the other. The fear that practicing on an electronic will make it difficult to play on a grand is unfounded; in fact, it is more likely to be easier, although it may take a few minutes of playing on the grand to get used to it. One exception is acoustics that are out of regulation, such as compacted hammers — they are much harder to play than electronics. Unfortunately, too many acoustics are under-maintained, making them difficult to play. Many teachers think that practicing on digitals doesn't work because the students can't play the same pieces on acoustics, but the fault lies in the acoustics, not the digitals, because those acoustics were not properly

maintained. Therefore, students who learn on digitals should practice on acoustics as often as possible, because there are differences, and it takes some time to learn how to play the acoustics.

Electronics provide the sound via software so that reproducing the touch weight of grands exactly is difficult. Yamaha "solved" this problem by inserting an actual grand mechanism into their electronic (AvantGrand model), which more than doubles the cost of the electronic, but retains all the advantages of the electronic. Because the hammers do not produce the sound by hitting strings, the feel is not *exactly* the same. But the eventual question we should consider is "Should an electronic emulate an acoustic exactly, or should the electronic eventually have its own properties that can be superior to the best acoustics?" Right now, the exact emulation is important because concert pianists must still perform on acoustics and nobody can predict if electronics will ever replace good acoustics. That time may eventually come because (1) the electronics are improving so rapidly, (2) a vast majority of pianists will start learning on electronics, and (3) with better speakers, etc., there will soon come a time when a pianist can overpower any orchestra when playing a concerto, whereas today, even the best acoustic in the world cannot overpower a large orchestra. For some "pop" concerts, digitals are already replacing acoustics.

Half size and three-quarter size electronic pianos should be cost effective to produce. They can be sold or rented to piano teachers and schools that rent them to the youngest students for extra income, given financial terms that guarantees positive cash flow for everybody. Today, the availability of pianos for small, young, fingers is a major limiting factor. Small pianos will benefit instrument makers financially because they will increase the number of good pianists that will need full sized pianos.

Some pianists have asked their tuners to increase the down weight (with the hope of increasing finger strength), but this throws the piano out of regulation and is bad for technical development (velocity, musicality).

If you are a beginner purchasing your first piano, an electronic is the obvious choice, unless you can afford a quality grand and have space for it. Even in that case, you will probably want an electronic piano also because the cost of the electronic will be negligible compared to the grand, and it gives you so many features that the grand does not have.

Uprights: Acoustic uprights are less expensive than grands, they take up less space, and for small rooms, large grands may produce too much sound so that they cannot be played full blast with the lid open without hurting or even damaging the ears, not only of the pianist, but also everyone in the house. The electronics have these same advantages plus many more. Owners of uprights too often neglect hammer voicing entirely because this neglect results in more sound. Since uprights are essentially closed instruments, the neglect of voicing is less noticeable. Uprights also tend to be less expensive to maintain,

because expensive repairs are not worthwhile and are not performed. Of course, there are quality uprights that are competitive with grands in feel and sound quality, but they cost as much as grands.

Among uprights, spinets are the smallest and generally the least expensive pianos; most do not produce satisfactory sound, even for students. The small height of spinets limits the string length, which is the main limitation on sound output. In theory, the treble should produce satisfactory sound (there is no limitation on string length even for spinets), but most spinets are weak in the treble because of poor quality of construction; therefore, be sure to test the highest and lowest notes if you are evaluating a spinet – simply compare it with a larger piano. Console or larger uprights can be good student pianos. Old uprights with poor sound are generally not salvageable, no matter what their size. Do not place an upright too close to a wall; this will deaden the sound. To position the piano, place it very close to the wall; then play middle C while pulling the piano away from the wall, until you get maximum sound.

Uprights have been "obsoleted" by the electronics and there is no reason to buy a new upright, although some piano teachers and most piano stores might suggest otherwise. Many piano teachers have not had enough experience with electronics and are more accustomed to the feel and sound of the uprights and tend to recommend acoustics as "real pianos", which is a mistake. The difficulty of purchasing a quality upright, the problems encountered with having it properly "prepped" before and after delivery (see following section), and the need to keep it regulated and in tune, are not worth the slight difference in touch or tone, if any.

The rule concerning uprights is simple: if you already have one that is playable, there is no reason to get rid of it until you buy an electronic or a grand; if you don't have a piano, there is no compelling reason to buy an upright. Students above intermediate level will want a grand piano because the most technically difficult music is harder to play on most uprights and inexpensive electronic keyboards. Because of decreasing demand and profits, manufacture of uprights may cease in the near future.

Grands: The advantages of most grands are: greater dynamic range (loud/soft), open structure allowing the sound to escape freely (which provides more control and expression), richer sound, faster repetition, smoother action (use of gravity instead of springs), a "true" soft pedal [(40) Soft Pedal: Hammer Voicing], better sound (easier to tune accurately) and more impressive appearance. An exception is the class of "baby" grands (less than about 5'-2") whose sound output is usually unsatisfactory and are not true grands. A few companies are beginning to produce baby grands with acceptable sound, so for these very new pianos, don't write them off without testing them. Larger grands can be classified into two main classes, the "student grands" (those below about 6 to 7 ft), and the concert grands. The concert grands provide more dynamic range, better sound quality, superior action, and more tonal control.

As an example of this "quality versus size" issue, consider the Steinway pianos. The baby model, model S (5'-2"), is essentially a decorative furniture and very few produce sufficient quality sound to be considered playable and are inferior to many uprights. The next larger size group consists of models M, O, and L (5'-7" to 5'-11"). These models are similar and are excellent student pianos. However, advanced pianists would not consider them to be true grands because of poorer sustain, too much percussive sound, and notes with too much harmonic content. The next model, A (6'-2"), is borderline, and B(6'-10"), C(7'-5"), and D(9') are true grands. One problem with evaluating Steinways is that the quality within each model is variable. On average, there is a significant improvement in sound quality and output with each increase in size.

Grands require hammer voicing more frequently than uprights; otherwise, they become too "brilliant" or "harsh", at which point most owners will end up playing the grand with the lid closed. With compacted hammers, it is impossible to play, and therefore practice, PP. Many homeowners ignore voicing entirely because they know nothing about it. The result is that such grands produce too much and too harsh sound, and are therefore played with the lid down. There is nothing technically wrong with playing a grand with the lid closed; however, some purists will express dismay at such practice, and you are certainly throwing away something wonderful for which you made a significant investment. Performances at recitals almost always require the lid to be open, resulting in a more sensitive piano. Therefore you should always practice with the lid open before a performance even if you normally practice with it closed. In a large room, or in a recital hall, there is much less multiple reflection of the sound so that you do not hear the deafening roar that can result in a small room.

A concert hall will absorb the sound from the piano so that, if you are accustomed to practicing in a small room, you will have difficulty hearing your own playing. If the music stand is raised, it will intercept the sound and you may not be able to hear your own playing at all!

One of the biggest advantages of grand pianos is the use of gravity as the return force of the hammer. In uprights the restoring force for the hammer is supplied by springs. Gravity is always constant and uniform across the entire keyboard whereas non-uniformities in the springs and friction can create non-uniformities in the feel of the keys of an upright. **Uniformity of feel is one of the most important properties of well-regulated, quality pianos,** because it is impossible to play PP if the feel is not uniform.

Many students who practice on uprights or digitals are intimidated by the appearance of huge grands at recitals and competitions, but these grands are easier to play than uprights. One fear that these students have concerning these grands is that their actions may be heavier. However, touch weight is something that is adjusted by the technician regulating the piano and can be adjusted to any number regardless of whether the piano is an upright or a grand.

Advanced students will of course find it easier to play demanding pieces on grands

than uprights, mainly because of the faster action and uniformity. Good grands can save you a lot of time when acquiring advanced skills. The main reason for this is that it is easy to develop bad habits when struggling with difficult material on uprights. Challenging material can be more difficult on electronic pianos (and impossible on models without proper touch weight) because they are less forgiving of minor unintended motions of the fingers. Some advanced pianists purposely practice on electronics for this reason, because you need better technique to play on less forgiving pianos.

Some people with small rooms agonize over whether a large grand would be too loud in such a space. Loudness is usually not the most important issue, and you always have the option of closing the lid to different degrees. The maximum loudness of the medium and large grands is not that different, and you can play softer with the larger grands. It is the multiple sound reflections that are most bothersome. Multiple reflections can be easily eliminated by a carpet on the floor and sound insulation on one or two walls. There is no need to insulate all walls because you just need to prevent multiple reflections so that even just one wall can make a big difference. If the piano fits into a room, then it is usually acceptable from the sound point of view.

(71) Purchasing & Piano Care

Buying digital pianos is simple, whereas buying acoustics can be a nightmare. For digitals, all you need to know is your price range, the desired features, and perhaps the manufacturer. Useful internet reviews are available for comparison. You don't need a piano technician to evaluate the piano. All established manufacturers, such as Yamaha, Roland, Korg, Technic, Kawai, Kurzweil, and Casio produce digitals of uniformly good quality. The quality is so consistent that you can buy them online and assemble them yourself. The main disadvantage of digitals at this writing is that they are not equipped with sufficiently good audio systems, but this can be remedied by also buying a good audio system because its price has become affordable.

Purchasing a acoustic piano: Buying a acoustic piano can be a trying experience whether you are knowledgeable about pianos or not, and whether buying new or used. Many piano stores will rent the piano with an agreement to apply the rental to the purchase price if it is eventually purchased. In that case, make sure that to negotiate for the best purchase price before discussing the rental. After agreeing to a rental, there will be little negotiating power on price. At most dealers, it is difficult to test the piano by playing it because it is too expensive to keep every model properly tuned and regulated all the time. Thus buying a acoustic piano is a hit-or-miss proposition and a stressful and time-consuming experience. For mass produced pianos such as Yamaha or Kawai, the quality of their new pianos is more uniform because most of the "prep" is done at the factory. The sound quality of the more expensive "hand made" pianos can vary considerably so that buying these pianos is more difficult.

"Hand made" does not mean good. It has come to mean "more expensive" and they

have a wider distribution of quality: good ones are very good, and bad ones are terrible. Thus the prices of the few good ones are bid up excessively, which tends to raise the prices of even the bad ones because many customers do not know how to test a piano and just pay by brand name. This has started a death spiral of ever fewer good acoustics at ever increasing prices on the one hand, and a healthy competition among rapidly improving digitals at decreasing prices. So few acoustics are sold now that the number of piano technicians keeps decreasing, making the acoustics less affordable, resulting in fewer sales. Already, uprights are starting to go extinct. The numbers of piano restorers and tuners have been decreasing at alarming rates for decades. Because the average age of the remaining workers is increasing, this trend is expected to continue. The most telling sign of this death spiral is the difficulty of finding exact prices of any new quality acoustic, whereas the prices of the digitals are openly advertised everywhere. A few digital manufacturers, such as Yamaha, have kept their prices higher by using exclusive distributors, but this practice will not be sustainable. The list prices of the acoustics are artificially jacked up and the true sale price is always bargained down, which adds to the difficulty of buying one.

Good used acoustic pianos are difficult to find in piano stores or even at piano restorers because playable pianos sell first and most dealers are left with inventories of inferior ones. Obviously, the best acoustics are to be found among the private sales and where the prices are lower. The uninitiated will need to hire a piano tuner/technician to evaluate the used pianos in private sales, especially because you will need a tuner even after the purchase; however, this can get expensive if the locations are far away or if you need to test many pianos. The best place to find bargains is the classified section of newspapers at large metropolitan areas. Most such advertisements are placed on Friday, Saturday, and especially on Sunday. You will also need a lot of patience because good private sales are not always there when you need them. However, the wait can be worthwhile because the same piano will cost half as much (or less) at a private sale compared to the store or restorer. Their costs are high because of the high cost of selling each piano and the small number of sales. There is a steady demand for good, reasonably priced pianos. This means that it is not easy to find bargains at widely accessible sites, such as the internet piano markets, because good pianos sell quickly. Conversely, such sites are excellent places to sell, especially if you have a good piano.

The price of pianos can be roughly classified according to whether they are worth rebuilding. Those worth rebuilding cost at least twice as much when new. Practically all uprights and all mass produced grands (Yamaha, Kawai, etc), are not rebuilt because it is impossible: the rebuilding trade and necessary parts are non-existent. However, their qualities are very consistent so that you don't have to worry about getting a lemon. Pianos worth rebuilding are Steinway, Bösendorfer, Bechstein, Mason and Hamlin, Knabe, and a few others.

Only a few name brand pianos "hold their value" when kept for many years. The

rest quickly lose their value so that trying to sell them years after purchase (new) is not worthwhile. "Hold value" means that their resale value will keep up with inflation; it does not mean that you can sell them for a profit. Thus if you bought a piano for $1,000 and sold it 30 years later for $10,000, you have made no profit if inflation is 10X during those 30 years. In addition, you will incur the cost of tuning and maintenance of $2000 to $6000 for this example. It is cheaper to buy a brand new 7 ft Yamaha grand every 30-40 years than to buy a new Steinway M and completely restore it every 30-40 years; therefore, the choice of which piano to buy does not depend on economics but on what type of piano you want.

For more details on how to buy a piano, consult Fine's book (Fine, Larry,). Even with the most famous brands, a newly purchased piano will immediately lose 20% to 30% of its purchase price upon delivery, and will in general depreciate to half of the price of an equivalent new piano in about 5 years. As a rough "rule of thumb" a used piano will cost about half the price of the new one of the same model in a piano store and about 1/3 at a private sale.

The main problems with buying new acoustic pianos are the proper prep work before delivery and follow-up tunings after delivery. Too often, they are delivered without adequate prep work under the excuse that it can be done after delivery. But work after delivery is expensive, so stores minimize them, even if the new owner is knowledgeable and demands that the work be done. A buyer who knows little about pianos can end up with a piano in unsatisfactory condition. You can't always blame the stores because most of them operate on very thin margins. Even for buying new pianos, it is a good idea to enlist the help of a piano tuner whom you will need anyway after the purchase. The electronic pianos do not have any of these problems.

Steinways are most respected because well made units are very good. Unfortunately, their quality varies widely because they are hand made and picking out a good one is a difficult task. Although you may hear tales of concert pianists testing many units before picking one for it's terrific sound, the process is actually one of picking one with the lowest number of undesirable properties. And the final quality of sound is highly dependent on how the technician adjusted the sound, something about which most concert pianists know very little.

Piano Care: All new acoustic pianos need at least a year of special care and tuning after purchase, in order for the strings to stop stretching and the action and hammers to equilibrate to the conditions in the house. Most piano dealers will try to minimize the cost of servicing the new pianos as explained above. In this regard, among the less expensive models, Yamaha, Kawai, Petroff, and a few others may be easier to buy because most of the prep work is completed at the factory. A new piano will need about 4 tunings the first year in order to stabilize the stretching of the strings.

All pianos require maintenance in addition to regular tuning. In general, the better the quality of the piano, the easier it is to notice the deterioration caused by normal wear

and tear, and therefore the more maintenance it should receive. That is, more expensive pianos are more expensive to maintain. Typical maintenance chores are: leveling the keys, reducing friction (such as polishing the capstans), eliminating extraneous sounds, re-shaping the hammers and voicing them (needling), checking the innumerable bushings, adjusting the jack, back-check and let-off, etc.; they are all lumped into the term "regulation".

Voicing the hammer is probably the most neglected maintenance procedure. Worn, hard, hammers can cause string breakage, loss of musical control, and difficulty in playing softly. It also ruins the tonal quality of the piano, making it harsh and unpleasant. Many tuners do not have sufficient training at voicing; in that case you may have to look for a voicing specialist, such as piano restorers. If the action is sufficiently worn, it may need a general regulation job, which means restoring all parts of the action to their original specifications; it can be cost effective to simply install a new action.

If the bass wire-wound strings are rusted in old pianos, this can deaden those notes. Replacing these strings is worthwhile if those notes are weak and have no sustain. The upper, non-wound strings generally do not need replacing even if they appear rusted. However, for extremely old pianos, all the strings can be so stretched out that they have lost all elasticity. Such strings are prone to breakage and cannot vibrate properly, produce a tinny sound, and should be replaced.

Acoustic pianos need to be tuned at least once a year and preferably twice, during the fall and spring, when the temperature and humidity are midway between their yearly extremes. Many advanced pianists have them tuned more frequently. In addition to the obvious advantages of being able to create better music and to sharpen your musicality, there are many compelling reasons for keeping the piano tuned. One of the most important is that it can affect your technical development. **Compared to an out-of-tune piano, a well-tuned piano practically plays itself** -- you will find it surprisingly easier to play. Thus a well maintained piano can accelerate technical/musical development. An out-of-tune piano can lead to flubs and memory problems. Many important aspects of expression such as color can be brought out only on well-tuned pianos. Since we must always pay attention to practicing musically, it does not make sense to practice on a piano that cannot produce music. This is one of the reasons why I prefer Well Temperaments (with their crystal clear harmonies) to the Equal Temperament, in which only the octaves are clear. Higher quality pianos have a distinct edge because they not only hold the tuning better, but can also be tuned more accurately. Lower quality pianos often have extraneous beats and sounds that make accurate tuning impossible.

Pianists who always practice on a piano in tune will have a difficult time playing on one that is out of tune. The music doesn't come out, they make unexpected mistakes, and have memory blackouts. This holds true even if they know nothing about tuning and can't even tell if a particular note is out of tune. For pianists unfamiliar with tuning, the best way to test the tuning is to play a piece of music. Good tuning is like magic to *any*

pianist. By playing a piece of music, most pianists can readily hear the difference between a poor tuning and an excellent one, even if they cannot tell the difference by playing single notes or intervals. Therefore, along with technical development, every pianist must learn the benefits of good tuning. It may be a good idea to play an out-of-tune piano once in a while in order to know what to expect in case you are asked to perform on one with questionable tuning.

(72) Using the Subconscious Brain

We are only beginning to study the many sub-brains we have and the different ways to use them. We have at least a **conscious** and a **subconscious** part. Most people are unskilled at using the subconscious, but the subconscious is important because (1) it controls the emotions, including nervousness, (2) it functions 24 hrs a day whether you are awake or asleep, (3) it can do some things that the conscious cannot do, simply because it is a different kind of brain, and (4) for half the human population, the subconscious should be statistically smarter than the conscious; it doesn't make sense not to use this part of the brain. The subconscious is associated with all the zillions of automatic processes that the brain conducts every moment, including our responses to music.

The subconscious controls emotions in at least two ways. The first is a rapid, fight or flight reaction -- generation of instant anger, fear, etc. When such situations arise, you must react faster than you can think, so the conscious brain must be bypassed by something that is hardwired and preprogrammed for immediate reaction. We might even classify this as another part of the brain – the part that automatically processes incoming information instantly, whether the input it visual, auditory, touch, smell, etc. Thus the subconscious itself has many components.

The second subconscious function is a slow, gradual recognition of deep or fundamental situations, that can be too complex for the conscious to handle. Feelings of depression during a midlife crisis might be a result of the subconscious: it has had time to figure out all the negative situations that develop with age and the future begins to look less hopeful. When trying to evaluate such a future situation, the conscious brain would have to list all the possibilities, evaluate each, and try to remember them. The subconscious functions differently. It evaluates various situations in a non-systematic way; how it picks a particular situation for evaluation is not under conscious control; that is automatically controlled by every day events. It is as if the subconscious stores its conclusions in "emotion buckets": for each emotion, there is a "bucket", and every time the subconscious comes to a conclusion, say a happy one, it deposits the conclusion in a "happy bucket". The fullness of each bucket determines the emotional state. This explains why people often can sense what is right or wrong, or good or bad, without knowing exactly what the reasons are ("sixth sense"). Thus the subconscious affects our lives much more than most of us realize. It may control how we feel about piano music or our desire

to practice.

The subconscious affects nervousness. This knowledge is important because it is scary if you start getting nervous and don't know what is going to happen. Knowing that it is the subconscious brain evaluating a situation requiring special attention and that certain inputs to the brain can calm the subconscious, can help.

Are there ways to communicate with the subconscious? The events in daily life determine which are important factors and the subconscious gravitates towards them. These important ideas lead to important conclusions and when a sufficient number of such conclusions piles up, the subconscious will contact you. This explains why, all of a sudden, an unexpected intuition will flash through your conscious mind. Any idea that is important, or any puzzle or problem that you had tried to solve with great effort, is automatically a candidate for consideration by the subconscious. Thus thinking hard about an idea is one way to present the problem to the subconscious. In order to solve a problem, the subconscious must have all the necessary information. Therefore it is important to do all the research and gather as much information about the problem as you can.

In college, this is how I solved many homework problems that my smarter classmates could not solve. They tried to just sit down, do their assignments, and hoped to solve these difficult problems. Problems in school assignments are such that they are always solvable with the information given in the classroom or textbook. Thus, you only need to assemble the right parts to come up with the answer, unless the teacher wants you to do some outside research. What I did, therefore, was not to worry about being able to solve any problem immediately but to think about it intensely and make sure that I have studied all the course material. If I could not solve the problem right away, I knew that the subconscious would go to work on it. The most effective procedure was not to wait until the last minute to try to solve such problems – the subconscious needs time. Some time afterwards, the answer would suddenly pop up in my head, often at strange, unexpected times. They most frequently popped up in the early morning, when my mind was rested and fresh; perhaps the subconscious works best during sleep, when the brain is not preoccupied with conscious work. Thus, you can learn to present material to the subconscious and to receive conclusions from it. In general, the answer would not come if I intentionally asked my subconscious for it, but would come when I was doing something unrelated to the problem. This is because when you consciously ask the subconscious, the conscious brain interferes and leads you down the wrong path (that's why the conscious couldn't solve the problem in the first place).

You can also use the subconscious to recall something you had forgotten. First, try to recall it as hard as you can, and then abandon the effort. After some time, the subconscious will often recall it for you. Try this when you can't recall the name of a composition, composer, acquaintance, etc.

We do not yet know how to talk directly with the subconscious. And these

communication channels are very different for each person, so everyone must experiment to see what works best. Clearly, you can improve communications with it as well as block the communication channels. Many of my smarter friends in college became frustrated when they found out that I had found the answer when they couldn't, and they knew they were smarter. That type of frustration can stall the communications within the brain. It is better to forget about the problem and engage in sports, see a movie or do other things you enjoy, and the subconscious will do a better job because it needs the freedom to follow its own ideas. If you practice a difficult piano passage hard, but get no satisfactory results, and you run out of new hand motions, etc., see if the subconscious can give you new ideas when you practice the next time – part of PPI may be the work of the subconscious!

(73) New Discoveries of this Book

I made some discoveries while writing this book that are not discussed in the literature. I list them here; some are not new discoveries but enhancements to existing material.

1. Mental Play must be taught as a component of piano lessons.
2. Memory methods must be taught and music is an algorithm for memory.
3. Memory resides in a memory field and recall is mediated by the overlap of memory fields similarly to quantum mechanical probabilities calculated from the overlap of wave functions. We don't lose memory, we just can't recall them.
4. The concept of Parallel Sets is generalized and catalogued; they are at once a diagnostic tool and a method for solving technical problems.
5. Bach's Inventions are based on Parallel Sets and contain lessons on practice methods.
6. Gravity is the basic force in the Arm Weight Method because man evolved under gravity; piano playing forces are designed to equal gravity.
7. Disadvantages of Hanon type exercises have been presented; technique is acquired most efficiently by learning performable music. Exercises are assigned by teachers who do not know how to teach.
8. Correct practice methods are frequently counter-intuitive; piano learning methods must be knowledge based, not talent based.
9. Most (all?) babies, exposed to music at the correct pitch from birth, will acquire absolute pitch automatically, without even trying.
10. How to control nervousness must be taught, using Mental Play, memory methods, efficient practice methods, and emphasizing musicality instead of technical difficulty.
11. Genius can be taught (mental play, absolute pitch, play by ear and efficient practice methods) and is most effective at the youngest ages; the ability to compose is a natural consequence of this process.

12. There are simple microstructures in music such as the use of repetitive small motifs of just a few notes ((67) Mozart's Formula, Beethoven and Group Theory).

13. The beginning of Beethoven's 5th symphony (and Appassionata, 1st movement, bars 235-239) is based on "group theory", and was written before mathematicians "discovered" group theory.

14. The starting "arpeggio" of Beethoven's Appassionata is a schematized, inverted form of his main theme starting at bar 35. This "arpeggio" is played in double octaves to increase the "stretch" see (xi) in [(79) Tuning Tools and Skills].

15. The first movement of Beethoven's Appassionata is composed almost entirely of modified forms of the fate motif of his 5th symphony, including the trills. This movement is a piano version of that symphony.

16. Beethoven composed "immortal music" by combining so many elements into every bar that it is impossible for the listener to figure out what all the elements are, when played at full speed. This makes his music effectively infinitely complex.

17. Beethoven invented minimalist music and used it extensively as one component of his effectively infinitely complex music.

18. The two speeds for the fast sections (first and third) of Chopin's Fantaisie Impromptu, Op. 66, straddle the vibration/sound transition, suggesting that Chopin heard this effect. Therefore, the first part must not be played too fast.

19. The auditory system detects frequencies using a logarithmic scale, mathematically identical to the chromatic scale. The brain maps this scale (a virtual piano) and recognizes harmonies because ratios of frequencies in logarithmic space are simple distances on this map. The brain uses these ratios (distances) to keep track of tonics and chord progressions. The piano is a computer in logarithmic space, like the slide rule. A large part of musical language is inborn because it is part of the automatic brain processing of audio inputs.

(74) Topics for Future Research

Any treatment of any field must provide a list of future research topics to advance the field. The topics listed below and the discoveries of the preceding section provide subjects for research, such as thesis topics at conservatories.

(1) Mental Play needs to be developed into a full blown curriculum, containing such sub-topics as absolute pitch, composition, brain training and stamina, memory/recall, performance training, controlling nervousness and practice methods away from the piano.

(2) Controlling nervousness must be developed into a curriculum. Research into the physiology and medical treatments of nervousness are needed. Using practice recitals and teaching "fun" music, etc., should be investigated for performance training.

(3) A systematic approach to efficient practice methods is the best way to teach piano. Therefore we need to know the minimum set of necessary practice methods with a

systematic teaching procedure that all teachers are expected to know.

(4) Which teaching methods used today are incorrect? How do you counteract intuitive tendencies in students, their parents, and teachers? When are exercises helpful, when are they a waste of time?

(5) We need a list of genius tricks we can all learn and separate them from true genius skills that are inborn.

(6) Babies are now tested for hearing at birth. Why not teach all babies absolute pitch by playing the appropriate music? We need statistics on how many babies will learn AP this way and at what age they begin to lose it if it is not maintained.

(7) What is the logarithmic structure in the cochlea, and how is the chromatic scale mapped in the brain?

(8) The chromatic scale is a human invention, but the brain seems to interpret the chromatic transition (semitone) as special, as evidenced by its widespread use in "romantic" classical music. What is the explanation for this effect?

(9) I have hypothesized that human memory is stored in "memory fields" in various areas of the brain and memory recall is determined by the overlap of these fields. Can these fields be imaged? Can this hypothesis be tested?

(10) Why is music such a good memory algorithm? The logarithmic nature of the chromatic scale and the relationship between logarithms and chord progressions may provide some leads.

(11) Lower bench height is advantageous because it makes flat finger positions, etc., easier. The beset bench height needs to be investigated.

(12) What are the physical bases of warming up and conditioning? Can we attach battery operated muscle stimulaters to keep the fingers in permanently warmed up condition without actually playing the piano?

(13) We need to know the physical basis of fast trills because trills are the ultimate momentum mode of play, and are difficult to analyze. Programming a robotic arm to trill should provide the answers. Or a scientifically trained pianist who can trill might be the fastest, cheapest way. Or we might take electronic measurements of the muscles of a pianist trilling. We need to define the momentum mode more clearly.

(14) We should "read" Bach's music to tease out his practice methods, and match them with the minimum set of efficient practice methods.

(15) Bach seems to have attempted to exhaustively study various fundamental musical concepts. Parallel sets is one example [(46) Bach Used Parallel Sets to Compose His Inventions]. Keys (scales) and key colors are another. Are there others? Did he try to exhaust all possible tonal musical constructs of the twelve notes of the octave? The number of possible combinations are 12! (factorial) times the factorial of the number of notes in several bars, etc., can this number be estimated? Then we must consider which ones are musical and how this number is affected by the length of the composition. If he succeeded, where is it, and anything we compose can be found somewhere in Bach's

music. This topic is important because of the possibility that we have already exhausted just about everything that can be composed using tonal constructs and that, to find more fertile grounds of composition, we must go outside of tonal music. Is this the cause of the rise of atonal music? Or is atonal music just an advanced form of acquired taste?

(16) There is little question that microstructure in music is important. But what are the relationships between the microstructures that create the music? Part of the answer seems to lie in the fact that harmonies and certain chord progressions follow the simplest mathematical relationships that are especially easily processed in the human auditory system based on the logarithmic nature of auditory processing. This theory also explains why dissonances and certain chord progressions are unpleasant (because there is no simple way to process them in the brain). Can we discover another structure beyond the microstructure that creates the music?

(17) Microstructural analysis should be conducted with all important classics. With enough statistics from a sufficient number of such analyses, we may be able to discover composing principles used by the greatest composers.

(18) Only a small number of Beethoven's music was analyzed here and they proved to have similar microstructures. If similar microstructures are found in other Beethoven compositions (the Waldstein definitely is one), it will verify that he and probably many other composers (Mozart, certainly), consciously used this device (one or a small number of motifs for an entire movement).

(19) Is Beethoven's music damaging to the ear? His music contains some of the loudest passages in music because they contain simultaneous components that compete with each other. Perhaps the most damaging part may be the loud minimalist music he uses, in which he repeats one note many times, producing fatigue in that part of the ear. This question is relevant because Beethoven suffered hearing loss by the time he wrote his 5^{th} symphony.

(20) Mathematics in music must be investigated because it is such a fertile field.

(21) Even Chopin may not have been able to produce the second sound, but he almost certainly noticed that, at the higher speed, the multiplication effect of polyrhythmic music disappears. It would be interesting to use a computer with sufficient accuracy to produce the second sound and compare the music below and above the threshold.

(22) We should study the economic feasibility of half and three-quarter sized pianos. In grand pianos, the actions can be easily swapped, without having to build an entirely new piano.

CHAPTER THREE
Tuning Your Piano

(75) Introduction to Tuning

Too many pianists are unfamiliar with how the piano works and what it means to tune in the **temperaments**, or what it means to voice or regulate the piano. This is especially surprising because piano maintenance directly affects the ability to make music and acquire technique. There are many concert pianists who do not know the difference between Equal and Well temperaments while some of the compositions they play formally require one or the other.

Just as electronic pianos are always in tune, acoustic pianos must soon become permanently in tune, for example, by using the thermal expansion coefficient of the strings to electronically tune the piano (see Gilmore, Self-Tuning Piano; self-tuning acoustics have the added advantage that you can change the temperament by pushing a button). Today, practically all home pianos are out of tune almost all the time because it starts to go out of tune the moment the tuner leaves your house or if the room temperature or humidity changes. Future pianos will always be in tune. The problem of needing frequent hammer voicing must also be solved. You might suddenly realize that it was the piano, not you, that limited technical development and musical output; worn hammers will do it every time!

This chapter has all the information needed to learn how to tune your own piano. *Piano Servicing, Tuning, and Rebuilding*, by Arthur Reblitz, is a helpful reference. The hardest part of learning to tune is getting started. For those fortunate enough to have someone teach them, that is obviously the best route. Try the suggestions in this chapter and see how far you can get. That's basically how I learned, by reading books and experimenting.

Even some concert pianists do not know enough to tell their tuners what they need. Tuners can hear piano sounds that most people, even pianists, don't notice. Those who practice tuning will become sensitized to the sounds of out-of-tune pianos. It will probably take about a year to start feeling comfortable with tuning, assuming that you have the time to practice for several hours at least once every one or two months, as the piano goes out of tune.

It is important to be able to communicate with your tuner for proper tuning and maintenance because proper maintenance directly impacts the ability to acquire technique and the tuner knows nothing about your specific needs. Too many students have difficulties with playing pianissimo because the hammers are worn/compacted and the actions are so out of regulation that playing pianissimo is *impossible*. These students will

never be able to even practice pianissimo! Musical expression and tone control also become impossible if the piano is out of tune. These under-maintained pianos are responsible for the perception that piano practice is ear torture. An out-of-tune piano is a major cause of flubs and bad habits, and can destroy your absolute pitch even if you had acquired it as a young child. Every pianist will be mazed at how much easier it is, to play a well tuned piano.

Another factor is that you generally have no choice of a piano when asked to perform. You might encounter anything from a wonderful concert grand, to spinets, to (horrors!) a cheap baby grand that was neglected since it was purchased 40 years ago. Your understanding of what you can/cannot do with each of these pianos should be the first input into deciding what and how to play.

Once you start practicing tuning, you will quickly understand why someone vacuuming the floor, kids running around, the TV or HiFi blaring away, or pots clanging in the kitchen is not conducive to accurate, quality tuning. Why a quick, $70 tuning is no bargain compared to a $150 tuning in which the tuner reshapes and needles the hammers. Yet when owners are queried about what the tuner did to their pianos, they have no idea. A complaint I frequently hear from owners is that, after a tuning, the piano sounds dead or terrible. This happens when the owners do not have a proper reference from which to judge the piano sound. They were incorrectly influenced by their past history; they had become accustomed to the sound of detuned pianos with compacted hammers. When the tuner restores the sound, they don't like it because they had not developed the skills to play a properly tuned piano. The owner will need to know a minimum of tuning technicalities in order to judge whether the tuner did a good job. Concert pianists aren't just fussy piano owners; it is those pianists that fuss over their pianos that develop into concert pianists.

Piano tuning does not require good ears, such as absolute pitch, because all tuning is accomplished by comparison with a reference using beats between two frequencies, starting with the reference frequency of a tuning fork. In fact an absolute pitch ability may interfere with the tuning for some people. Therefore, the only hearing skill you need is the ability to hear and differentiate between the various beats when two strings are struck. This ability develops with practice and is not related to knowledge of music theory, musicality, or "good ears".

(76) Chromatic Scale

In music, pitch space is limited by how we produce sound, such as by voice (a few octaves only) or by musical instruments (pianos have only 88 notes), and by our ability to write the music on sheet music. Although violins, etc., can produce an infinite number of notes (frequencies), violin music is written mostly using the finite number of notes of the chromatic (piano) scale. Here, we explain why we are **confined to the chromatic scale** and why, out of the infinity of notes that the human ear can hear and that the violin can

produce, we throw away 99.999999 . . . . % - an *infinity* - of available pitch space.

Although many musical instruments can produce an infinity of notes, there is no way to notate this infinity so that someone else can reproduce your composition.There are a few exceptions such as the violin glissando (slide), vibrato, etc. Even for these "exceptions", there is no way to notate exactly how to execute them. But, aren't we severely limited by using such a small number of notes and throwing away an infinity?

Animals do not need to notate their songs or produce their music using keyboards. Therefore, they sing a completely different type of music. Having an infinity of notes has its advantages; this may be how a baby penguin can distinguish its parents from thousands of other penguins nearby, by their voices. Thus the piano, with its comparatively minuscule number of notes, has an inordinately huge influence on human music. Does this loss of an infinity of notes restrict us musically?

Mathematicians are well aware of, and have solutions to, this problem of finite bandwidth; it is called **"completeness"**, which measures the accuracy with which any notation approximates the real thing. Completeness in music asks the question, "given a specific composition, how well does this music notated using this scale, approximate the composition?" The answer is that it is sufficiently complete in a large number of cases; that is, the chromatic scale can approximate any music fairly accurately. No better system has yet been found; this is analogous to digital photography where you do not need an infinite number of pixels to take a picture, although any real object has an effectively infinite (very large) number of pixels (photons hitting the camera).

But the main reason why we are confined to the chromatic scale is harmony, not completeness. A scale must also contain all the major intervals so that a maximum number of notes will then harmonize with each other, making it possible for the brain to keep track of tonics and chord progressions [see (68) Theory, Solfege for a theoretical explanation]. Unlike vision, the frequency of sound is not calibrated on an absolute scale in the brain. Absolute pitch (perfect pitch) is a memory; not everybody has it and it can change with time. The use of intervals is the only way in which the brain can compare frequencies and the chromatic scale contains all the intervals that the brain needs, as we now show.

The brain's requirement of harmony leads to the piano octave, that must include as many intervals as possible. We need the third, fourth, fifth, sixth, and octave. Starting from C4, we have now placed E4, F4, G4, A4, and C5, a total of 6 notes into the C major scale (all white keys). In order to allow transpositions, two more full tones (white keys) and the black keys need to be added so that the chromatic octave consists of 12 equal semitones. This is made possible by a fortuitous mathematical coincidence that when the octave is divided into twelve semitones, it also contains *all* the harmonizing intervals to a very good approximation (but not *exact*, see below).

This requirement to include all the necessary intervals explains why the tonic (C in this case), is the most important note in a scale: it is involved with every interval, and

tells us how the brain finds the tonic – by harmonizing every note to it. Thus, after you play a few notes of a scale, the brain figures out the tonic because it is the only note related to all the others by harmony. The prominence of the tonic also explains how the brain keeps track of chord progressions by referencing each new tonic to the tonic of the first scale used, and why the music must return to that starting scale at the end of the composition; otherwise the brain is left "hanging", having to remember one or more tonics instead of none.

Harmony allows more than one note to be played simultaneously without creating dissonances. The sounds are so scrambled in dissonances that the brain can not figure out what it is which explains why the brain prefers harmonies; however, they don't just sound good — they provide the only mechanism by which the brain can keep track of the frequencies of sound. That is why music with harmony is easier to listen to than music without, and why harmony is the basis of most music, even when only one note is played at a time.

Therefore, harmony, completeness, and practicality are three main reasons for the existence of the chromatic scale. The properties that all intervals are ratios and that the frequency doubles with each ascending octave are properties of a mathematical function called the logarithm. That is, the chromatic scale is a logarithmic scale which the brain can use for detecting and processing frequencies. The ear evolved a logarithmic detection mechanism (Psychoacoustics,) so as to hear a large frequency range. This logarithmic nature makes it easy to construct a musical instrument that accommodates the entire frequency range of the human ear. If the chromatic scale were linear (not logarithmic), we would need a piano keyboard over half a mile wide!

There is another useful property of a logarithmic scale: scales can be transposed. Starting with any note on the chromatic scale, you can construct another scale with exactly the same interval ratios as C major, without having to add or subtract notes. Although we take transpositions for granted, it is possible only because of the logarithmic nature of the chromatic scale.

The chromatic scale is arbitrarily pegged at A = 440 Hz so that every musician can harmonize with each other. This means that no one is born with absolute pitch; it must be learned. Unlike the auditory system, the visual system is calibrated on an absolute scale based on quantum mechanical chemistry, so that every normal person is born with absolute vision — red is red to everybody, and it never changes with age.

Three octaves of the chromatic scale are shown in Table 3.1. Each successive frequency change in the chromatic scale is called a semitone and an octave has 12 semitones. Black keys on the piano are shown as sharps, e.g. the # on the right of C represents C#; all the semitones are shown only for the highest octave. The major intervals and the integers representing the frequency ratios for those intervals are shown above and below the chromatic scale, respectively. The number associated with each interval, e.g. four in the 4th, is the number of white keys, inclusive of the two end keys,

for the C-major scale and has no further mathematical significance. The frequency ratios (bottom row) are the desired ratios for perfect harmony, not the exact numbers from the chromatic scale, as explained below. The missing integer 7 is also explained below.

TABLE 3.1 Frequency Ratios of Intervals in the Chromatic Scale

Octave	5th	4th	Maj.3rd	Min.3rd		
CDEFGAB	CDEF	GAB	C # D #	E F #	G#A#B	C
1	2	3	4	5	6	8

The ratio of the frequencies of any two adjacent notes of the chromatic scale, called a semitone, is always the same. There are 12 semitones in an octave and each octave is a factor of two in frequency. Therefore, the frequency change for each semitone is given by

$$\text{Semitone}^{12} = 2, \text{ or}$$
$$\text{Semitone} = 2^{1/12} = 1.05946..... \quad \text{Eq. (3.1)}$$

Eq. (3.1) defines the chromatic scale and allows the calculation of the frequency ratios of intervals in this scale. How do these intervals compare with the frequency ratios of the ideal intervals (bottom row) of Table 3.1? The comparisons are shown in Table 3.2 and demonstrate that the intervals from the chromatic scale are extremely close to the ideal intervals.

TABLE 3.2: Ideal versus Equal Tempered Intervals

Interval	**Freq. Ratio**	**Eq. Temp. Scale**	**Error**
Minor 3rd	6/5 = 1.2000	$\text{Semitone}^3 = 1.1892$	-0.0108
Major 3rd	5/4 = 1.2500	$\text{Semitone}^4 = 1.2599$	+0.0099
Fourth:	4/3 = 1.3333	$\text{Semitone}^5 = 1.3348$	+0.0015
Fifth:	3/2 = 1.5000	$\text{Semitone}^7 = 1.4983$	-0.0017
Octave:	2/1 = 2.0000	$\text{Semitone}^{12} = 2.0000$	+0.0000

The errors for the 3rds are the worst, over five times the errors in the other intervals, but are still only about 1%. Nonetheless, these errors are audible, and some piano aficionados have generously dubbed them "the rolling thirds" while in reality, they are unacceptable dissonances. It is a defect that we must live with, if we are to adopt this

scale (there is no better choice). The errors in the 4ths and 5ths produce beats of about 1 Hz near middle C, which is barely audible in most pieces of music; however, this beat frequency doubles for every higher octave.

It is a mathematical accident that the 12-note chromatic scale produces so many interval ratios close to the ideal ratios. Only the number 7, out of the smallest 8 integers (Table 3.1), results in a totally unacceptable dissonance. The chromatic scale is based on a lucky mathematical accident in nature! No wonder early civilizations believed that there was something mystical about this scale. Increasing the number of keys in an octave does not result in much improvement of the intervals until the numbers become quite large, making that approach impractical.

Note that the frequency ratios of the 4th and 5th do not add up to that of the octave (1.5000 + 1.3333 = 2.8333 vs. 2.0000). Instead, they add up in logarithmic space because (3/2)x(4/3) = 2. In logarithmic space, multiplication becomes addition; that is why when you add a fourth to a fifth on the piano, you get an octave. Why might this be significant? The geometry of the cochlea has a logarithmic component. Analyzing ratios of frequencies therefore becomes simple because instead of multiplying or dividing two frequencies, you only need to add or subtract their logarithms. For example, if C3 is detected by the cochlea at one position and C4 at another position 2mm away, then C5 will be detected at a distance of 4 mm, exactly as in the slide rule calculator. Therefore, intervals are simple to analyze in a logarithmically structured cochlea.

Although we are not born with absolute pitch, we are born to recognize harmonies because of the logarithmic auditory system; another consequence is that the ear hears a large difference in pitch between 40 and 42.4 Hz (a semitone or 100 cents), but hears almost no difference between 2000Hz and 2002.4 Hz (about 2 cents), for the same difference of 2.4 Hz. Because the chromatic scale is logarithmic, and the brain is equipped to compute in logarithms, everyone can recognize relative pitch (unlike absolute pitch, for which the brain has no absolute calibration). The only way to acquire absolute pitch is to remember it in memory.

Eq. 3.1 is not the way in which the chromatic scale was historically developed. Musicians first started with intervals and tried to find a music scale with the minimum number of notes that would produce those intervals. The requirement of a small number of notes is obvious since it determines the number of keys, strings, holes, etc. needed to construct a musical instrument. This minimum number turned out to be 12 notes per octave.

When we play intervals, we are performing mathematical computations in logarithmic space on a mechanical computer called the piano, as was done in the 1950's using the slide rule. Thus the logarithmic nature of the chromatic scale has more consequences than just providing a wide frequency range. It is also related to how the brain identifies, processes and interprets music [(68) Theory, Solfege]. When you play a piano, a similar mathematical process takes place in the brain!

(77) Circle of Fifths, Temperaments

A **temperament** is a set of interval relationships that defines a specific chromatic scale. The temperament for Eq. 3.1 is called **Equal Temperament (ET)** because every semitone is the same — they are all equal. The harmonies in ET are not perfect, as shown in Table 3.2 [see (76) Chromatic Scale]. No matter what tempering scheme you use, these errors cannot be eliminated. But ET has the advantage that you can transpose freely because every scale is the same. Temperament is not an option but a necessity; we must choose a temperament in order to accommodate the mathematical difficulties discussed below. Most musical instruments based on the chromatic scale must be tempered. For example, the holes in wind instruments and the frets of the guitar must be spaced for a specific tempered scale. The violin is a devilishly clever instrument because it avoids all temperament issues by spacing the open strings in fifths. If you tune the A(440) string correctly and tune all the others in fifths, these others will be close, but not tempered. You can still avoid temperament problems by fingering all notes except one (the correctly tuned A-440). In addition, the vibrato is larger than the temperament corrections, making temperament inaudible. Paganini may have (secretly) tempered all his open strings so that he could do things other violinists could not.

Tempering is required because (1) none of the intervals are perfect except for the octave and (2) a chromatic scale tuned to one scale (e.g., C-major with perfect intervals) does not produce acceptable intervals in other scales. If you wrote a composition in C-major and then transposed it, or effected a chord progression, terrible dissonances will result. Tempering schemes were therefore devised to minimize these dissonances by minimizing the de-tuning from perfect intervals in the most important intervals and shifting most of the dissonances into the less used intervals. This tended to concentrate the errors into one interval which came to be known as "the wolf".

It might come as a shock to some that the piano is a fundamentally flawed instrument! The piano gives us every note, but locks us into one temperament; on the other extreme, the violin is free of temperament restrictions, but we must finger every note. Many attempts have been made to find better scales than the chromatic scale, mainly by increasing the number of notes per octave using guitars, organs, etc., but none of these scales have gained acceptance. It is relatively easy to increase the number of notes per octave with a guitar-like instrument because all you need to do is to add strings and frets. Recent schemes being devised involve computer generated scales in which the computer adjusts the frequencies with every key change, called adaptive tuning (Sethares, William A.,).

There is healthy debate about which temperament is best musically. ET was known from the earliest history of tuning. There are definite advantages to standardizing to one temperament, but that is probably not desirable in view of the diversity of opinions on music and the fact that much music now exist, that were written with specific

temperaments in mind, such as Bach's WTC. Therefore we must explore the different temperaments.

The Circle of Fifths: The most basic concept needed to understand temperaments is the circle of fifths. Start with C4 and go up in 5ths. After two 5ths, you will go outside the C4-C5 octave. Now go down one octave so that you can keep going up in 5ths and still stay within the C4-C5 octave. Do this (up in 5ths and down in octaves to stay in the C4-C5 octave) for twelve 5ths, and you will end up at C5! That is why it is called a circle. Not only that, but every note you hit when playing the 5ths is a different note. This means that the circle of fifths hits every note once and only once, a key property useful for tuning every note of the scale and for studying scales mathematically. This works for any note, not just C.

Since a fifth and a fourth add up to an octave, a **Circle of Fourths** accomplishes the same results as a circle of fifths.

Pythagorean, Equal, Meantone, and "Well" Temperaments. Historical developments are central to discussions of temperament because mathematics was no help; practical tuning algorithms could only be invented by the tuners of the time. Pythagoras is credited with inventing the Pythagorean Temperament at around 550 BC, in which the chromatic scale is generated by tuning in perfect 5ths, using the circle of fifths. Unfortunately, the twelve perfect 5ths in the circle of fifths do not make an exact factor of two. Therefore, the final note you get is not exactly the octave note but is too high in frequency by what is called the "Pythagorean comma", about 23 cents (a cent is one hundredths of a semitone). Since a 4th plus a 5th make up an octave, the Pythagorean temperament results in a scale with perfect 4ths and 5ths, but the octave is dissonant. It turns out that tuning in perfect 5ths leaves the 3rds in bad shape, another disadvantage of the Pythagorean temperament. Now if we were to tune by contracting each 5th by 23/12 cents, we would end up with exactly one octave and that is one way of tuning an Equal Temperament (ET) scale. The ET scale was already known within a hundred years or so after invention of the Pythagorean temperament. Thus ET is not a "modern temperament" (a frequent misconception).

Following the introduction of the Pythagorean temperament, all newer temperaments were efforts at improving on it. The first method was to halve the Pythagorean comma by distributing it among two final 5ths. One major development was Meantone Temperament, in which the 3rds were made just (exact) instead of the 5ths. Musically, 3rds play more prominent roles than 5ths, so that meantone made sense, because during its heyday music made greater use of 3rds. Unfortunately, meantone has a wolf worse than Pythagorean.

The next milestone is represented by Bach's Well Tempered Clavier in which music was written with "key color" in mind, which was a property of Well Temperaments (WT). These were non-ET temperaments that struck a compromise between meantone and Pythagorean. This concept worked because Pythagorean tuning ended up sharp, while

meantone is flat. In addition, WT presented the possibility of not only good 3rds, but also good 5ths. The simplest WT (to tune) was devised by Kirnberger, a student of Bach. But it has a terrible wolf. "Better" WTs were devised by Werckmeister and by Young (which is almost the same as Valotti). If we broadly classify tunings as Meantone, WT, or Pythagorean, then ET is a WT because ET is neither sharp nor flat. In piano industry today, WT is used to mean "non-ET".

The violin is tuned Pythagorean, so the 5ths are just. Since the 3rds can always be fingered just, it has all the advantages of the Pythagorean, meantone, and WT, with no wolf in sight! In addition, it has a complete set of frequencies (infinite) within its frequency range. Little wonder that the violin is held in such high esteem by musicians.

Since about 1850, ET became universally accepted because of its musical freedom and the trend towards hiring tuners to tune the piano. ET is the most difficult temperament to tune, requiring professional tuners. All the other temperaments are generically classified as "historical temperaments", which is a misnomer because ET was known before some WT's were invented. Many WTs are easy to tune, and most harpsichord owners had to tune their own instruments, which is why they used WT. This historical use of WT gave rise to the concept of key color in which each key, depending on the temperament, endowed specific colors to the music, because of the small de-tunings that create "tension" and other effects. After listening to music played on pianos tuned to WT, ET tends to sound muddy and bland. Thus key color can enhance music. On the other hand, there is always some kind of a wolf in the WTs that can be annoying.

For playing most of the music composed around the times of Bach, Mozart, and Beethoven, WT works best. The great composers were acutely aware of temperament. You will see a dramatic demonstration of WT if you listen to the last movement of Beethoven's Waldstein played in ET compared to WT. This movement is heavily pedaled, emphasizing the harmony, a wonderful effect Beethoven intentionally built into this movement, that mostly disappears in ET.

From Bach's time to about Chopin's time, tuners and composers seldom documented their tunings and we have precious little information on those tunings. At one time, in the early 1900s, it was believed that Bach used ET because, how else would he be able to write music in all the keys unless you could freely transpose from one to the other? Some writers even made the preposterous statement that Bach invented ET! Such arguments, and the fact that there was no "standard WT" to choose from, led to the acceptance of ET as the universal tuning used by tuners, to this day. Standardization to ET also assured tuners of a good career because ET was too difficult for anyone but trained tuners to tune accurately.

As pianists became better informed and investigated the WTs, they re-discovered key color. In 1975, Herbert Anton Kellner concluded that Bach had written his music with key color in mind and that Bach used a WT, not ET, as generally assumed at that time. But which WT? Kellner guessed at a WT which most tuners justifiably rejected as

too speculative. Subsequent search concentrated on well known WTs such as Kirnberger, Werckmeister, and Young. They all produced key color but still left open the question of what Bach used. In 2004, Bradley Lehman proposed that the strange spirals at the top of the cover page of Bach's "Well Tempered Clavier" manuscript represented a tuning diagram (see Larips.com,), and used the diagram to produce a WT that is fairly close to Valloti. Bach's tunings were mainly for harpsichord and organ, since pianos as we know them today didn't exist at that time. One requirement of harpsichord tuning is that it be simple enough so that it can be done in about 10 minutes on a familiar instrument, and Lehman's Bach tuning met that criterion. Thus we now have a pretty good idea of what temperament Bach used. Bach was interested in key color, so that he could not have used ET which is colorless in the sense that all keys have the same color.

It is generally accepted by piano tuners that the best WT is Young. If you want to hear what a clear harmony sounds like, try Kirnberger, which has a large number of just intervals.

We now see that picking a WT is not only a matter of solving the Pythagorean comma, but also of gaining key color to enhance music – in a way, we are turning a disadvantage into an advantage. The price we pay is that composers must learn key color, but they have naturally done so in the past. It is certainly a joy to listen to music played in WT, but it is even more fascinating to *play* music in WT. Key color has become irrelevant today because of the universal adoption of ET. The availability of different temperaments with digitals may re-awaken interest in key color as an element of advanced pianism.

Chopin is an enigma in this regard because he loved the black keys and used keys far from "home" (home means the specific scale used to "set the bearings" during tuning, see below, usually C major). He probably found the black keys easier to play because they stick out, so that the fears many students feel when they see all those sharps and flats in Chopin's music is not justified. Chopin used one tuner who committed suicide, and there is no record of how he tuned. Because Chopin used the "far out" keys, some of his compositions will hit the wolf if the piano is tuned to WT. Thus ET may be the best temperament for Chopin, especially because he created his own sounds instead of depending on pure harmony.

Conclusions: We should get away from ET because of the joy of playing clear harmonies with WT; if we must pick one WT, it should be Young; otherwise, it is best to have a choice of WTs, as we can with electronic pianos. If you want to hear pure harmonies, try Kirnberger. The WTs will teach us key color which not only enhances the music, but also sharpens our sense of musicality. ET may be the best for Chopin.

(78) Polishing Capstans, Hammer Voicing

Polishing the Capstans: They may need polishing if they have not been cleaned in several years. Press down on the keys slowly to see if you can feel a friction in the action. See Reblitz, Arthur, for how to access the actions. For piano parts names see [(81) Grand

Piano Action Diagram]. To get to the capstans, lift the action off the keys by unscrewing the screws that hold the action down for the grand. For uprights you generally need to unscrew the knobs that hold the action in place; make sure that the pedal rods, etc., are disengaged.

Then the keys can be lifted out after removing the key stop rail. Make sure that all the keys are numbered so that you can replace them in the correct order. This is a good time to remove all the keys and clean any previously inaccessible areas as well as the sides of the keys. You can use a mild cleaning agent such as a cloth dampened with Windex for cleaning the sides of the keys.

See if the top, spherical contact areas of the capstans are tarnished. If they do not have a shiny polish, they are tarnished. Use any good brass/bronze/copper polish (such as Noxon) to polish and buff up the contact areas. Reassemble, and the action should now be much smoother.

Hammer Voicing. A common problem seen with many pianos is compacted hammers. The condition of the hammer is much more important to the proper development of piano technique and for cultivating performance skills, than many people realize. Numerous places in this book refer to the importance of practicing musically. But you can't play musically if the hammer can't do its job, a critical point that is overlooked even by many tuners (often because they are afraid that the extra cost will drive customers away). Therefore, if you ask the tuner to tune the piano, he will in general not voice the hammers; you must discuss hammer voicing with him. For a grand piano, a sure sign of compacted hammers is when you find the need to close the lid in order to play soft passages. Another sure sign is that you tend to use the soft pedal to help you play softly. Compacted hammers either give you a loud sound or none at all. Each note tends to start with an annoying percussive bang that is too strong, and the sound is overly bright. It is these percussive bangs that are so damaging to the ear. A properly voiced piano enables control over the entire dynamic range and produces a more pleasing sound.

Let's first see how a compacted hammer can produce such extreme results. How do small, light hammers produce loud sounds by striking with relatively low force on strings under such high tension? If you were to try to push down on the string or try to pluck it, you will need quite a large force just to make a small sound. The answer lies in an incredible phenomenon that occurs when tightly stretched strings are struck at right angles to the string. It turns out that the force produced by the hammer at the instant of impact is theoretically infinite! This nearly infinite force is what enables the light hammer to overcome practically any achievable tension on the string and cause it to vibrate.

Here is the calculation for that force. Imagine that the hammer has struck the string and is at its highest point (grand piano). The string at this point in time makes a triangle with its original horizontal position (this is just an idealized approximation, see below). The shortest leg of this triangle is the length between the agraffe and the impact point of the hammer. The second shortest leg is from the hammer to the bridge. The longest is the

original horizontal configuration of the string, a straight line from bridge to agraffe. Now if we drop a vertical line from the hammer strike point down to the original string position, we get two right triangles back-to-back. These are two extremely skinny right triangles that have very small angles at the agraffe and at the bridge; we will call these small angles "theta"s.

The extra tension force F (in addition to the original string tension) produced by the hammer strike is given by f = Fsin(theta), where f is the force of the hammer. It does not matter which right triangle we use for this calculation (the one on the bridge side or on the agraffe side). Therefore, the extra string tension F = f/sin(theta). At the initial moment of the strike, theta = 0, and therefore F = infinity! This happens because sin(0) = 0. Of course, F can get to infinity only if the string cannot stretch and nothing else can move. What happens in reality is that as F increases towards infinity, something gives (the string stretches, the bridge moves, etc.) so that the hammer begins to move the string and theta increases from zero, making F finite (but still much larger than your finger force).

This force multiplication explains why a small child can produce quite a loud sound on the piano in spite of the hundreds of pounds of tension on the strings. It also explains why anyone can break a string just playing the piano, if the string is old and has lost its elasticity. If the string cannot stretch, theta remains close to zero, thus increasing F. This situation is greatly exacerbated if the hammer is also compacted so that there is a large, flat, hard groove that contacts the string. In that case, the hammer surface has no give and the instantaneous "f" in the above equation becomes very large. The result is a broken string.

The above calculation is a gross over-simplification and is correct only qualitatively. In reality, a hammer strike initially throws out a traveling wave towards the bridge, similarly to what happens when you grab one end of a tight rope and flick it. The way to calculate such waveforms is to solve certain differential equations that are well known. The computer has made the solution of such differential equations a simple matter and realistic calculations of these waveforms can now be made routinely.

The above calculation shows that it is not the transverse vibration energy of the string, but the tensile force on the string, that is responsible for the piano sound. The energy imparted by the hammer is stored in the entire piano, not just the strings. This is analogous to the bow and arrow -- when the string is pulled, all the energy is stored in the bow, not the string. All of this energy is transferred via the tension in the string.

The compacted hammer produces not only a louder sound (because of the force multiplication just described) but also a brighter sound because it contains higher harmonics. The higher harmonics form because the impact occurs in a shorter time; when things happen faster, the string generates higher frequency sounds.

Because the same amount of energy is dissipated in a shorter amount of time for the compacted hammer, the initial percussive sound level can be much higher than for a properly voiced hammer. Such short sound spikes can damage the ear. Common

symptoms of such damage are tinnitus (ringing in the ear) and hearing loss at high frequencies. Piano tuners, when they must tune a piano with such worn hammers, would be wise to wear ear plugs. It is clear that voicing the hammer is at least as important as tuning the piano, especially because we are talking about potential ear damage. The damage is not immediately noticeable because it happens too fast, but it is cumulative.

The two important procedures in voicing are hammer re-shaping and needling. When the flattened strike point on the hammer exceeds about 1 cm, it is time to re-shape the hammer. Note that you have to distinguish between the string groove length and flattened area; even in hammers with good voicing, the grooves may be over 5 mm long. In the final analysis you will have to judge on the basis of the sound. Shaping is accomplished by shaving the "shoulders" of the hammer so that it regains its previous rounded shape at the strike point. It is usually performed using 1 inch wide strips of sandpaper attached to strips of wood or metal with glue or double sided tape. You might start with 80 grit garnet paper and finish it off with 150 grit garnet paper. The sanding motion must be in the plane of the hammer; never sand across the plane. There is almost never a need to sand off the strike point; leave about 2 mm of the center of the strike point untouched.

Needling is not easy because the proper needling location and needling depth depend on the particular hammer (manufacturer) and how it was originally voiced. Especially in the treble, hammers are often voiced at the factory using hardeners such as lacquer. Be careful: needling mistakes are irreversible. Because of the way in which the hammer is manufactured, the stress on the felt is largest at the strike point. Therefore, if this point is needled too much, the hammer will split into two and will need to be replaced (see Reblitz, Arthur,, P. 197). Unfortunately, it is almost impossible to find a replacement hammer exactly like the old one. Deep needling is usually required on the shoulders just off the strike point. Very careful and shallow needling of the strike point area may be needed. The tone of the piano is extremely sensitive to shallow needling at the strike point, so that you must know exactly what you are doing. When properly needled, the hammer should allow you to control very soft sounds as well as produce loud sounds without harshness. You get the feeling of complete tonal control. You can now open your grand piano fully and play very softly! You can also produce those loud, rich, authoritative tones.

(79) Tuning Tools and Skills

For additional information on tuning, see Howell, W. D.,, Fischer, J. C.,, Jorgensen, Owen H.,, or Reblitz, Arthur, in the Reference section and Zach's Piano Supplies and Tuning Tools, Parts, for tuning tools and piano parts.

Tools. We shall learn aural tuning -- tuning by ear. All professional tuners must be good aural tuners even if they use electronic tuning aids. Professional tuners nowadays use electronic tuning aids, but we will not consider them here because everyone must

learn aural tuning first. You will need:

(1) the larger rubber muting wedges for grands and the smaller ones with wire handles for uprights, four of each type,

(2) felt muting strips, about 4 ft long, 5/8 inch wide. They are used to mute the two side strings of the 3-string notes in the octave used to "set the bearings", see below. They also come as ganged rubber wedges but these don't work as well. The strips also come in rubber, but rubber does not mute as well and is not as stable as felt (they can move or pop out while tuning). The disadvantage of the felt strip is that it will leave a layer of felt fiber on the soundboard after you are finished, which will need to be vacuumed out (not easy). You can buy these by mail order or you can ask your tuner to buy them for you.

(3) A tuning lever (also called a tuning hammer) with an extendable handle, a head that attaches to the tip of the handle, and an interchangeable socket that screws into the head. It is a good idea to have a piano tuning pin which you can insert into the socket using a vise grip so that you can screw the socket into the head firmly. Otherwise, if you grab on the socket with the vise grip, you can scratch it up. If the socket is not firmly in the head, it will come off during tuning. Most pianos require a #2 socket, unless your piano has been re-strung using larger tuning pins. The standard head is a 5 degree head, which is the angle between the socket axis and the handle. Both the heads and sockets come in various lengths, but "standard" or "medium" length will do.

(4) Two tuning forks, A440 and C523.3. Tap the tip of the fork firmly against a muscular part of the knee and test the sustain. It should be audible for 10 to 20 seconds when placed close to the ear. Whistles are not sufficiently inaccurate. Ear muffs are necessary for protection, since ear damage is a tuner's occupational hazard. It is necessary to hit the keys hard (pound the keys -- to use a tuners' jargon) in order to tune properly as explained below, and the sound intensity from such pounding can damage the ear, resulting in premature hearing loss and tinnitus.

Preparation. Prepare for tuning by removing the music stand so that the tuning pins are accessible (grand piano). Tuning is accomplished by first "setting the bearings": tuning one center octave, which is then copied to all other strings. For setting the bearings, mute all the side strings of the triplet strings within the "bearings octave" (C4 - C5) using the muting strip so that when any note within the muted area is played, only the center string will vibrate. Close to two octaves may need to be muted; think through the entire tuning algorithm first to determine the highest and lowest notes to mute. Use the rounded end of the wire handle of the upright rubber mute to press the felt into the spaces between the outer strings of adjacent notes.

Getting Started. The first things to learn are what not to do, in order to avoid destroying the piano, which is not difficult. If a string is tightened too much, it will break. These initial instructions are designed to minimize problems from amateur mistakes. Plan ahead in case you break a string. A broken, even when left for long periods of time, is no disaster to a piano. Find a tuner you can call before conducting the first practice sessions.

Once you know how to tune, string breakage is rare except for very old or abused pianos. The tuning pins are turned by such small amounts during tuning that the strings almost never break.

The most important consideration for a beginner tuner is to preserve the condition of the pinblock. The pressure of the pinblock on the pin is enormous. Now you may never have to do this, but if you were to hypothetically turn the pin 180 degrees very rapidly, the heat generated at the interface between pin and pinblock would be sufficient to burn the wood and turn it into charcoal. Clearly, all rotations of the pin must be conducted in slow, small, increments. If you need to remove a pin by turning it, rotate only a quarter turn (counter clock-wise), wait a moment for the heat to dissipate from the interface, then repeat the procedure, etc., until the pin feels loose.

I will describe everything assuming a grand piano, but the corresponding motion for the upright should be obvious. There are two basic motions in tuning. The first is to **turn** the pin so as to either pull or release the string. The second is to **rock** the pin back towards you (to pull on the string to increase tension) or rock it forwards towards the string, to decrease tension. The rocking motion, if done to extreme, will enlarge the hole and damage the pinblock. The hole is elliptical at the top surface of the pinblock because the string is pulling the pin in the direction of the major axis of that ellipse. Thus a small amount of backwards rocking does not enlarge the ellipse because the pin is always pulled into the front end of the ellipse by the string. Also, the pin is not straight but bent elastically towards the string by the pull of the string. The rocking motion is used to move the string by extremely small amounts. A small forward rocking, within the elasticity of the wood, is harmless. Use the rotation whenever possible, and use the rocking motion only when absolutely necessary for that tiny, final adjustment. For the highest octave, the motion needed is so small that the rocking method will be necessary.

Start with the strings in the C3-C4 octave. Lower notes are harder to tune because their beat frequencies are too low, and the higher notes are difficult because the amount of pin rotation needed to tune is small. Choose G3 as the practice note and number the strings. Each note in this region has three strings. Starting from the left, number the strings 123 (for G3), 456 (for G3#), 789 (for A3), etc.

Play G3 and note if it is in perfect tune, or makes beats, indicating that it is out of tune. Our first exercise, below, is to tune G3 and to compare the result with the sound before tuning. Place a large wedge between strings 3 and 4 in order to mute string 3 so that when you play G3, only strings 1 and 2 can vibrate. Place the wedge about midway between the bridge and agraffe.

There are two types of tuning: unison and harmonic. In unison, one string is tuned identically to another. In harmonic tuning, one string is tuned to a harmonic of the other, such as thirds, fourths, fifths, and octaves. The three strings of each note are tuned in unison, which is easier than harmonic tuning, so let's practice that first.

(i) Engaging and Manipulating the Tuning Lever. If the tuning lever has

adjustable length, pull it out about 3 inches and lock it in place. Hold the end of the handle of the tuning lever with the RH and the socket with the LH and engage the socket over the pin. Orient the handle so that it is approximately perpendicular to the strings and pointing to your right. Lightly jiggle the handle with the RH and push the socket down with the LH so that it is securely engaged, as far down as it will go. From day one, develop a habit of jiggling the socket by holding the end of the handle between the thumb and forefinger (RH fingers 1 & 2) so that it is securely engaged. At this point, the handle is probably not perfectly perpendicular to the strings; choose the socket position that is closest to perpendicular.

Now find a way to brace the pinky side of the RH on the piano so that you can apply firm pressure on the lever by holding its end with thumb and forefinger. Grab the tip of the handle with the thumb and one or two fingers, and brace the hand on the wooden piano frame or brace the pinky against the tuning pins depending on what is directly under the handle. If the handle is closer to the plate (the metal frame) over the strings, you can brace the hand against the plate. Do not grab the handle like you hold a tennis racket and push-pull to turn the pin -- this will not give enough control, until you become an accomplished tuner. Practice these bracing positions making sure that you can exert controlled, constant, powerful pressure on the handle, but do not turn any pins yet.

The lever handle must point to the right (three o'clock position) so that when it is turned towards you (the note goes sharp), you counteract the force of the string and free the pin from the front side of the hole (towards the string). This allows the pin to turn more freely because of the reduction in friction. When the handle is turned away from you (tuning flat), both you and the string are trying to turn the pin in the same direction. Therefore the pin would turn too easily, except for the fact that both your push and the string's pull jam the pin against the front of the hole, increasing the friction and preventing the pin from rotating too easily. Thus by placing the handle on the right side, both the sharp and flat tunings meet with some resistance and is easy to control.

If the handle were placed pointing to the left (nine o'clock position), you run into trouble for both the sharp and flat motions. For the sharp motion, both you and the string jam the pin against the front of the hole, making it doubly difficult to turn the pin, and damaging the hole. For the flat motion, the lever lifts the pin off the front edge of the hole and reduces the friction. In addition, both the lever and string are turning the pin in the same direction. Now the pin turns too easily.

The lever handle must point to the left for **uprights**. Looking horizontally at the tuning pins, the lever should point to 9 o'clock for uprights. In both grands and uprights, the lever handle is on the side of the last winding of the string.

Professional tuners do not use these lever positions. Most use 1-2 o'clock for grands and 10-11 o'clock for uprights and Reblitz recommends 6 o'clock for grands and 12 o'clock for uprights. In order to understand why, let's first consider positioning the lever at 12 o'clock on a grand (it is similar at 6 o'clock). Now the friction of the pin with the

pinblock is the same for both the sharp and flat motions. However, in the sharp motion, you are going against the string tension and in the flat motion, the string is helping you. Therefore, the difference in force needed between sharp and flat motions is much larger than the difference when the lever is at 3 o'clock, which is a disadvantage. However, unlike the 3 o'clock position, the pin does not rock back and forth during tuning so that when you release the pressure on the tuning lever, the pin does not spring back -- it is more stable -- and you can get higher accuracy.

The 1-2 o'clock position is a good compromise that makes use of both of the advantages of the 3 o'clock and 12 o'clock positions. Beginners do not have the accuracy to take full advantage of the 1-2 o'clock position, so my suggestion is to start with the 3 o'clock position, which should be easier at first, and transition to the 1-2 o'clock position as your accuracy increases. When you become good, the higher accuracy of the 1-2 o'clock position can speed up your tuning so that you can tune each string in a few seconds. At the 3 o'clock position, you will need to guess how much the pin will spring back and over-tune by that amount, which takes more time. Clearly, exactly where you place the lever will become more important as you improve.

(ii) Setting the Pin. It is important to "set the pin" in order for the tuning to hold. If you look down on the pin, the string comes around the right side of the pin (grands -- it is on the left for uprights) and twirls around it. Therefore rotating the pin cw (clockwise), will tune sharp and vice versa. The string tension is always trying to rotate the pin ccw (counter clock-wise, or flat). Normally, a piano de-tunes flat with use. However, because the grip of the pinblock on the pin is so strong, the pin is never straight but is always twisted.

If it is rotated cw, the top of the pin will be twisted cw with respect to the bottom. In this position, the top of the pin wants to rotate ccw (the pin wants to untwist) but can't because it is held by the pinblock. But remember that the string is also trying to rotate it ccw. The two forces together can be sufficient to quickly de-tune the piano flat when something loud is played.

If the pin is turned ccw, the opposite happens -- the pin will want to untwist cw, which opposes the string force. This reduces the net torque on the pin, making the tuning more stable. In fact, you can twist the pin so far ccw that the untwisting force is much larger than the string force and the piano can then de-tune itself sharp as you play. Clearly, you must "set the pin" correctly in order produce a stable tuning, as we shall do below.

(iii) Tuning Unisons. Now engage the tuning lever on the pin for string 1. We will tune string 1 to string 2. The motion you will practice is: (1) flat, (2) sharp, (3) flat, (4) sharp and (5) flat (tune). Except for (1), each motion must be smaller than the previous one. As you improve, you will add or delete steps as you see fit. We are assuming that the two strings are almost in tune. While tuning, follow two rules: (a) never turn the pin unless you are simultaneously listening to the sound, and (b) never release the pressure

on the tuning lever handle until that motion is complete.

One common mistake beginners make is to place the lever on the wrong tuning pin. Since turning the pin does not cause any audible change, they keep turning it until the string breaks. One way to avoid this is to always **start by tuning flat** (which reduces the tension) and to **never turn the pin without listening to the sound**.

Start with motion (1) flat: keep playing the note every second or two with the LH so that there is a continuous sound, while pushing the end of the lever handle away from you by holding the fat tip of the lever firmly with the thumb and 2nd finger and pushing with the thumb. Don't lift the key completely, as this will stop the sound; play with a quick up-and-down motion so that there is no break in the sound. The pinky and the rest of your RH should be braced against the piano. The required motion of the lever is a few millimeters. First, you will feel an increasing resistance, and then the pin will start to rotate. Before the pin begins to rotate, you should hear a change in the sound. As you turn the pin, listen for string 1 going flat, creating beats with string 2; the beat frequency increasing as you turn. Stop at a beat frequency of 2 to 3 per second. The tip of the tuning lever should move less than one cm. Remember, never rotate the pin when there is no sound because you will immediately lose track of where you are with respect to how the beats are changing. Always maintain constant pressure on the lever until that motion is completed.

What is the rationale behind the above 5 motions? Assuming that the two strings are in reasonable tune, you first tune string 1 flat in step (1) to make sure that in step (2) you will pass the tuning point. This also protects against the possibility that you had placed the lever on the wrong tuning pin; as long as you are turning flat, you will never break a string.

After (1) you are flat for sure, so in step (2) you can listen to the tuning point as you pass through it. Go past it until you hear a beat frequency of about 2 to 3 per second on the sharp side, and stop. Now you know where the tuning point is, and what it sounds like. The reason for going so far past the tuning point is that you want to set the pin, as explained above.

Now go back flat again, step (3), but this time, stop just past the tuning point, as soon as you can hear any incipient beats. The reason why you don't want to go too far past the tuning point is that you don't want to undo the "setting of the pin" in step (2). Again, note exactly what the tuning point sounds like. It should sound perfectly clean and pure. This step assures that you did not set the pin too far.

Now conduct the final tuning by going sharp (step 4), by as little as you can beyond perfect tune, and then bringing it into tune by turning flat (step 5). Note that your final motion must always be flat in order to set the pin. Once you become good, you might be able to do the whole thing in two motions (sharp, flat), or three (flat, sharp, flat).

Ideally, from step (1) to final tune, maintain the sound with no pause, and always exert pressure on the handle; never letting go of the lever. Initially, you may have to

practice this motion-by-motion. When you become proficient, the whole operation will take only a few seconds.

Until you develop "tuning muscles" you will tire quickly and may have to stop briefly to recover. The constant hand/arm pressure, and the mental and auditory concentration required to focus on the beats, can be quite a strain and can quickly cause fatigue. You will need to develop "tuning stamina" gradually. Most people do better by listening through one ear than through both, so turn your head to see which ear is better.

A common mistake beginners make is to listen for beats by pausing the tuning motion. Beats are difficult to hear when nothing is changing. If the pin is not being turned, it is difficult to decide which of the many things you are hearing is the beat that you need to concentrate on. What tuners do is to keep moving the lever and listening to the changes in the beats. Therefore, slowing down the tuning motion doesn't make it easier. The beginner is between a rock and a hard place. Turning the pin too quickly will result in all hell breaking loose and losing track of where you are. Turning too slowly will make it difficult to identify the beats. Therefore work on determining the range of motion you need to identify the beats and the right speed with which you can steadily turn the pin to make the beats come and go. In case you get hopelessly lost, mute strings 2 and 3 by placing a wedge between them, play the note and see if you can find another note on the piano that comes close. If that note is lower than G3, then you need to tune it sharp to bring it back, and vice versa.

Now that you have tuned string 1 to string 2, reposition the wedge so that you mute 1, leaving 2 and 3 free to vibrate. Tune 3 to 2, then remove the wedge and see if the G is now free of beats. You have tuned one note! If the G was in reasonable tune before you started, you haven't accomplished much, so find a note nearby that is out of tune and see if you can "clean it up". Notice that in this scheme, you are always tuning one single string to another single string. In principle, if you are really good, strings 1 and 2 are in perfect tune after you finish tuning 1, so you don't need the wedge any more. You should be able to tune 3 to 1 and 2 vibrating together. In practice this doesn't work until you become really good, because of a phenomenon called sympathetic vibration.

(iv) Sympathetic Vibrations. The accuracy required to bring two strings into perfect tune is so high that it is a nearly impossible task except for the most highly trained tuner. In practice, it is easier because when the frequencies approach within a certain interval called the "sympathetic vibration range", the two strings change their frequencies towards each other so that they vibrate with the same frequency. This happens because the two strings are not independent, but are coupled to each other at the bridge. When coupled, the string vibrating at the higher frequency will drive the slower string to vibrate at a slightly higher frequency, and vice versa. The net effect is to drive both frequencies towards the average frequency of the two. The size of the sympathetic vibration range depends on the strength of the coupling and is quite significant for the piano, about 0.3 cent. The sympathetic vibration range is like a black hole for beats; when beats approach

the sympathetic vibration range, it gets sucked in and disappears; therefore tuners never hear beats slower than that at the edge of the sympathetic vibration range.

When two strings are tuned in unison, you have no idea whether they are in perfect tune or merely within the sympathetic vibration range (unless you are an experienced tuner). Now if you were to try to tune a third string to the two strings in sympathetic vibration, the third string will bring the string closest to it in frequency into sympathetic vibration. But the other string may be too far off in frequency. It will break off the sympathetic vibration, and will sound dissonant. The result is that no matter where you are, you will always hear beats -- the tuning point disappears! It might appear that if the third string were tuned to the average frequency of the two strings in sympathetic vibration, all three should go into sympathetic vibration. This does not appear to be the case unless all three frequencies are in perfect tune. If the first two strings are sufficiently off, a complex transfer of energy takes place among the three strings. Even when the first two are close, there will be higher harmonics that will prevent all beats from disappearing when a third string is introduced. In addition, there are frequent cases in which you cannot totally eliminate all beats because the two strings are not identical.

In theory, this three-string problem may be analogous to the three-body problem in physics, which has no unique solution although two-body problems always have unique solutions. The fact that a good tuner can tune one string to two does not invalidate this physics analogy because there are special configurations of three-body problems that have unique solutions.

Therefore, a beginner will become totally lost, if he were to try to tune a third string to a pair of strings. Until you become proficient at detecting the sympathetic vibration range, always tune one string to one; never one to two. In addition, just because you tuned 1 to 2 and 3 to 2, it does not mean that the three strings will sound "clean" together. Always check; if it is not completely "clean", you will need to find the offending string and try again.

Note the use of the term "clean". With enough practice, you will soon get away from listening to beats, but instead, you will be looking for a pure sound that results somewhere within the sympathetic vibration range. This point will depend on what types of harmonics each string produces. In principle, when tuning unisons, you are trying to match the fundamentals. In practice, a slight error in the fundamentals is inaudible compared to the same error in a high harmonic. Unfortunately, these high harmonics are generally not exact harmonics but vary from string to string. Thus, when the fundamentals are matched, these high harmonics create high frequency beats that make the note "muddy" or "tinny". When the fundamentals are de-tuned ever so slightly so that the harmonics do not beat, the note "cleans up". Reality is even more complicated because some strings, especially for the lower quality pianos, will have extraneous resonances of their own, making it impossible to completely eliminate certain beats. These beats become troublesome if you need to use this note to tune another one.

Experienced tuners can keep track of these extraneous beats and tune around them.

(v) Making that Final Infinitesimal Motion. We now advance to the next level of difficulty. Find a note near G5 that is slightly out of tune, and repeat the above procedure for G3. The tuning motions are now much smaller for these higher notes, making them more difficult. In fact you may not be able to achieve sufficient accuracy by rotating the pin because even a small rotation will pass the tuning point for both going flat and sharp. We need to learn a new skill. This skill requires you to pound on the notes, so put on your ear muffs or ear plugs.

Typically, you would get through motion (4) successfully, but for motion (5) the pin would either not move or jump past the tuning point. In order to make the string advance in smaller increments, press on the lever at a pressure slightly below the point at which the pin will jump. Now strike hard on the note while maintaining the same pressure on the lever. The added string tension from the hard hammer blow will advance the string by a small amount. Repeat this until it is in perfect tune. It is important to never release the pressure on the lever and to keep the pressure constant during these repeated small advances, or you will quickly lose track of where you are. When it is in perfect tune, and you release the lever, the pin might spring back, leaving the string slightly sharp. You will have to learn from experience, how much it will spring back and compensate for it during the tuning process.

The need to pound on the string to advance it is one reason you often hear tuners pounding on the piano. It is a good idea to get into the habit of pounding on most of the notes because this stabilizes the tuning. The resulting sound can be so loud as to damage the ear, and one of the occupational hazards of tuners is ear damage from pounding. Use of ear plugs is the solution. When pounding, you will still easily hear the beats even with ear plugs. You can minimize the pounding force by increasing the pressure on the lever. Also, less pounding is required if the lever is parallel to the string instead of perpendicular to it, and even less if you point it to the left. This is another reason why many tuners use their levers more parallel to the strings than perpendicular. Note that there are two ways to point it parallel: towards the strings (12 o'clock) and away from the strings (6 o'clock). As you gain experience, experiment with different lever positions as this will give you many options for solving various problems. For example, with the most popular 5-degree head on your lever, you may not be able to point the lever handle to the right for the highest octave because it may hit the wooden piano frame. Practice tuning unisons above G5 using pounding.

(vi) Equalizing String Tension. Pounding is also helpful for distributing the string tension more evenly among all the non-speaking sections of the string, such as the **duplex scale** section, but especially in the section between the capo bar and the agraffe. There is controversy as to whether equalizing the tension will improve the sound. There is little question that the even tension will make the tuning more stable. However, whether it makes a material difference in stability may be debatable, especially if the pins

were correctly set during tuning. In many pianos, the duplex sections are almost completely muted out using felts because they might cause undesirable oscillations. In fact, the over-strung section is muted out in almost every piano. Beginners need not worry about the tension in these "non-speaking" sections of the strings. Thus heavy pounding, though a useful skill to learn, is not necessary for a beginner.

My personal opinion is that the sound from the duplex scale strings does not add to the piano sound. In fact, this sound is inaudible and is muted out when they become audible in the bass. Thus the "art of tuning the duplex scale" is a myth although most piano tuners (including Reblitz!) have been taught to believe it by the manufacturers, because it makes for a good sales pitch. There is no way to tune the duplex scale because you can't hear it, but it makes sense to equalize the string tension by pounding in order to stabilize the tuning. The duplex scale is needed to allow the bridge to move more freely, not for producing new sound. Obviously, the duplex scale will improve the quality of the sound because it optimizes the impedance of the bridge, but not because it produces any sound. The facts that the duplex scale is muted out in the bass and is totally inaudible in the treble prove that the sound from the duplex scale is not audible.

Even in the treble, where the duplex scale is inaudible, it is "tuned" in the sense that the **aliquot bar** (located between the hitch pin and bridge) is placed at a location such that the length of the duplex part of the string is approximately at a harmonic length of the speaking section of the string in order to optimize the impedance ("aliquot" means fractional or harmonic). If the sound from the duplex scale were audible, the duplex scale would have to be tuned as carefully as the speaking length. However, for impedance matching, the tuning need only be approximate, which is what is done in practice. If the duplex scale is inaudible, what is the aliquot bar for? I believe it is for reducing the coupling between adjacent strings, which narrows the sympathetic vibration range, thus improving the tuning.

Some manufacturers have stretched this duplex scale myth to ridiculous lengths by claiming a **second duplex scale** on the pin side. Since the hammer can only transmit tensile strain to this length of string (because of the rigid Capo bar), this part of the string cannot vibrate to produce sound. Consequently, practically no manufacturer specifies that the non-speaking lengths be tuned.

The disconnect between the designers and sales people is truly unbelievable! The duplex scale and aliquot bars do improve the sound, but not because they vibrate but because they improve the acoustic impedance and control the string coupling.

(vii) Rocking It in the Treble. The most difficult notes to tune are the highest ones. Here you need incredible accuracy in moving the strings and the beats are difficult to hear. Beginners can easily lose their bearing and have a hard time finding their way back. The required motions are so small that you will need the pin rocking motion to tune. Since the motion is so small, rocking the pin does not damage the pinblock. To rock the pin, place the lever parallel to the strings and pointing towards the strings (away from

you). To tune sharp, pull up on the lever, and to tune flat, press down. First, make sure that the tuning point is close to the center of the rocking motion. If it is not, rotate the pin so that it is. Since this rotation is much larger than that needed for the final tuning, it is not difficult, but remember to correctly set the pin. It is better if the tuning point is front of center (towards the string) because the tuning will be more stable, but bringing it too far forward would risk damaging the pinblock when you tune flat. Rocking to tune flat can damage the pinblock because the pin is already jammed up against the front of the hole. Practice tuning unisons in the highest octave.

(viii) Rumblings in the Bass. The lowest bass strings are second in difficulty (to the highest notes) to tune. These strings produce sound composed mostly of higher harmonics. Near the tuning point, the beats are so slow and soft that they are difficult to hear. Sometimes, you can "hear" them better by pressing your knee against the piano to feel for the vibrations than by trying to hear them with your ears, especially in the single string section. You can practice unison tuning only down to the last double string section. See if you can recognize the high pitched, metallic, ringing beats that are prevalent in this region. Try eliminating these; often, you need to de-tune slightly in order to eliminate them. If you can hear these high, ringing, beats, it means that you are well on your way to becoming a tuner. Don't worry if you can't even recognize them at first-- beginners are not expected to. The lowest single string section can only be tuned using harmonic tuning.

(ix) Harmonic Tuning. Once you are satisfied with the ability to tune unisons, start practicing tuning octaves. Take C4 and C5 and mute out the upper two strings of each note by inserting a wedge between them. Tune the upper note to the one an octave below, and vice versa. This is called harmonic tuning because you are tuning the higher note to a harmonic of the lower note. As with unisons, start near middle C, then work up to the highest treble, and then practice in the bass. Repeat the same practice with 5ths (C4 - G4), 4ths (C4 - F4), and major 3rds (C4 - E4), which you will need during the tuning process.

(x) Tempering. After you can tune perfect harmonics, try de-tuning to see if you can hear the increasing beat frequency as you deviate very slightly from perfect tune. Try to identify various beat frequencies, especially 1bps (beat per second) and 10bps, using 5ths. You will need these skills later for tempering.

(xi) What is Stretch? Harmonics in piano strings are never exact because real strings attached to real ends do not behave like ideal mathematical strings. This property of inexact harmonics is called inharmonicity. The difference between the actual and theoretical harmonic frequencies is called stretch. Experimentally, it is found that most harmonics are sharp compared to their ideal theoretical values, although there can be a few that are flat.

According to one research result (Young, Robert W.,, 1952), stretch is caused by the stiffness of strings. Ideal mathematical strings have zero stiffness. Stiffness is an extrinsic

property -- it depends on the dimensions of the wire. If this explanation is correct, then stretch must also be extrinsic. Given the same type of steel, the wire is stiffer if it is fatter or shorter. One consequence of this dependence on stiffness is an increase in the frequency with harmonic mode number; i.e., the wire appears stiffer to harmonics with shorter wavelengths. Stiffer wires vibrate faster because they have an extra restoring force, in addition to the string tension — fatter wires are harder to bend. This inharmonicity from stiffness has been calculated and agrees with measured stretch to within several percent so that this single mechanism appears to account for most of the observed stretch.

These calculations show that stretch is about 1.2 cents for the second mode of vibration at C4 and doubles about every 8 semitones (the first mode is the lowest, or fundamental frequency, one cent is one hundredth of a semitone, and there are 12 semitones in an octave). Stretch is smaller for lower notes, especially below C3, because the wire wound strings are quite flexible. Stretch increases rapidly with mode number and decreases even more rapidly with string length. In principle, stretch is smaller for larger pianos and larger for lower tension pianos if the same diameter strings are used. Stretch presents problems in scale design since abrupt changes in string type, diameter, length, etc., will produce a discontinuous change in stretch. Very high mode harmonics, if they happen to be unusually loud, present problems in tuning because of their large stretch -- tuning out their beats could throw the lower, more important, harmonics audibly out of tune.

Since larger pianos tend to have smaller stretch, but also tend to sound better, one might conclude that smaller stretch is better. However, the difference in stretch is generally small, and the tone quality of a piano is largely controlled by properties other than stretch.

In harmonic tuning you tune, for example, the fundamental or a harmonic of the upper note to a higher harmonic of the lower note. The resulting new note is not an exact multiple of the lower note, but is sharp by the amount of stretch. What is so interesting is that a scale with stretch produces "livelier" music than one without! This has caused some tuners to tune in double octaves instead of single octaves, which increases the stretch.

The amount of stretch is unique to each piano and, in fact, is unique to each note of each piano. Modern electronic tuning aids are sufficiently powerful to memorize the stretch for all the notes of individual pianos. Tuners with electronic tuning aids can also calculate an average stretch for each piano or stretch function and tune the piano accordingly. In fact, there are anecdotal accounts of pianists requesting stretch in excess of the natural stretch of the piano. In aural tuning, stretch is naturally, and accurately, taken into account. Therefore, although stretch is an important aspect of tuning, the tuner does not have to do anything special to include stretch, if all you want is the natural stretch of the piano.

(xii) Precision, Precision, Precision. The name of the game in tuning is precision. All tuning procedures are arranged in such a way that you tune the first note to the tuning fork, the second to the first, etc., in sequence. Therefore, any errors will quickly add up. In fact, an error at one point will often make some succeeding steps impossible. This happens because you are listening for the smallest hint of beats and if the beats were not totally eliminated in one note, you can't use it to tune another as those beats will be clearly heard. In fact, for beginners, this will happen frequently before you learn how precise you need to be. When this happens, you will hear beats that you can't eliminate. In that case, go back to your reference note and see if you hear the same beat; if you do, there is the source of your problem -- fix it.

The best way to assure precision is by checking the tuning. Errors occur because every string is different and you are never sure that the beat you hear is the one you are looking for, especially for the beginner. Another factor is that you need to count beats per second (bps), and your idea of, say 2bps, will be different on different days or at different times of the same day until you have those "beat speeds" well memorized. Because of the critical importance of precision, it pays to check each tuned note. This is especially true when "setting the bearings" which is explained below. Unfortunately, it is just as difficult to check as it is to tune correctly; that is, a person who cannot tune sufficiently accurately is usually unable to perform a meaningful check. In addition, if the tuning is sufficiently off, the checking doesn't work. Therefore, I have provided methods of tuning below that use a minimum of checks. The resulting tuning will not be very good initially, for Equal temperament. The Kirnberger temperament (see below) is easier to tune accurately. On the other hand, beginners can't produce good tunings anyway, no matter what methods or temperaments they use. At least, the procedures presented below will provide a tuning which should not be a disaster and which will improve as your skills improve. In fact, the procedure described here is probably the fastest way to learn. After you have improved sufficiently, you can then investigate the checking procedures, such as those given in Reblitz, or "Tuning" by Jorgensen.

(80) Kirnberger II, Equal Temperaments

Tuning consists of **"setting the bearings"** in an octave near middle C, and then "copying" this octave to all the other notes. You will need various harmonic tunings to set the bearings and only the middle string of each note in the "bearings octave" is initially tuned. Once one string of each note is tuned in this way, the "copying" is performed by tuning in unison and octaves.

In setting the bearings, we must choose which temperament to use. As explained in (77) Circle of Fifths, Temperaments, most pianos today are tuned to **Equal Temperament (ET)**, but the historical temperaments may be showing signs of gaining popularity, especially the **Well Temperaments (WT)**. Therefore, I have chosen ET and one WT, Kirnberger II (K-II), for this chapter. K-II is one of the easiest temperaments to

tune; therefore, we will visit that first. Most people who are unfamiliar with the different temperaments may not notice any difference at first between ET and K-II; they will both sound terrific compared to a piano out of tune. Most pianists, on the other hand, should hear a distinct difference and be able to form an opinion or preference if certain pieces of music are played and the differences are pointed out to them. The easiest way to listen to the differences for the uninitiated is to use an electronic piano that has all these temperaments built into it, and to play the same piece, using each temperament. For easy test pieces, try Bach's Inventions; for one of the best examples, try the 3rd movement of Beethoven's Waldstein Sonata. Chopin pieces may sound somewhat strange in WT.

Beginners should learn K-II first so that you can get started without too much difficulty, and then learn ET. One drawback of this scheme is that you may like K-II so much over ET that you may never decide to learn ET, especially because ET is more difficult. Once you get used to K-II, ET will sound a little lacking, or "muddy". However, you cannot really be considered a tuner unless you can tune ET. Also, there are many WTs that you may want to look into, that are superior to K-II in reducing wolves.

You can start tuning ET anywhere, but most tuners use the A440 fork to start, because orchestras generally tune to A440. The objective in K-II is to have C major and as many "nearby" scales as possible to be just (have perfect intervals), so the tuning is started from middle C. C4 = 261.6, but most tuners will use a C523.3 tuning fork to tune C4 partly because the higher harmonic gives twice the accuracy. Now, the A that results from K-II tuned from the correct C does not result in A440. Therefore, you will need two tuning forks: A for ET and C for K-II. Alternatively, you can just start with only a C fork and start tuning ET from C. Having two tuning forks is an advantage because whether you start from C or from A, you can check the tuning when you get to the other note.

Prepare for tuning by practicing the basic tuning skills of the previous section.

Tuning the Piano to the Tuning Fork. One of the most difficult steps in the tuning process is tuning the piano to the tuning fork. This difficulty arises because: (1) the tuning fork has a different (usually shorter) sustain than the piano so that the fork dies off before you can make an accurate comparison and (2) the fork puts out a pure sine wave, without the loud harmonics of the piano strings. Therefore, you cannot use beats with higher harmonics to increase the accuracy of the tuning as you can with two piano strings. One advantage of electronic tuners is that they can be programmed to generate square wave reference tones that contain large numbers of high harmonics. These high harmonics (which create those sharp corners of square waves – you will need to know polynomial math or Fourier transforms to understand this) are useful for increasing the tuning accuracy. We must therefore solve these two problems in order to tune the piano accurately to the tuning fork.

Both difficulties can be solved if we can use the piano as the tuning fork and make this transfer from fork to piano using some high piano harmonic. To accomplish such a transfer, find any note within the muted notes that makes loud beats with the fork. If you

can't find any, use the note a semi-tone down or up; for example, for tuning fork A4, use A4b or A4# on the piano. If these beat frequencies are a bit too high, try these same notes an octave lower and choose the better one, say A3#. Then memorize the beat frequency that the fork makes with A3#. Now tune the A4 on the piano so it makes the same frequency beats with A3#. To hear the fork, place the tip of the handle against the triangular cartilage (ear lobe) that sticks out towards the middle of the ear hole. Adjust the loudness of the fork by pressing the ear lobe in or out using the end of the fork. Another method is to press its stem perpendicular onto any hard, flat surface. Develop a habit of holding the fork at the narrow neck of the handle so that the fingers do not interfere with their vibrations.

WT: Kirnberger II. Mute all side strings from F3 to F4, using the felt strip, so that you are tuning only the center strings.

Tune C4 (middle C) to the C tuning fork. Then use

C4 to tune G3 (4th), E4 (3rd), F3 (5th), and F4 (4th). Use

G3 to tune D4 (5th) and B3 (3rd). Then use

B3 to tune F#3 (4th),

F#3 to tune Db4 (5th),

F3 to tune Bb3 (4th),

Bb3 to tune Eb4 (4th) and

Eb4 to tune Ab3 (5th). All tunings up to here are just. Now tune A3 such that the F3-A3 and A3-D4 beat frequencies are the same.

You are done with setting the bearings!

Now tune up in just octaves to the highest notes, and then down to the lowest notes, using the bearings octave as reference. In all these tunings, tune just one new octave string while muting the others, then tune the remaining one or two strings in unison to the newly tuned string.

Example: to tune C6 to the tuned center string of C5, mute strings 1 and 3 of C6 and use C5 to tune the center string of C6. Then un-mute 3 and tune it to 2, and then tune 1 to 2.

This is one time you might break the "tune one string against one" rule. If your reference note is a (tuned) 3-string note, use it as it is. This will test the quality of your tuning. If you have a hard time using it to tune a new single string, then your unison tuning of the reference note may not have been sufficiently accurate and you should go back and clean it up. Of course, if after considerable effort, you cannot tune 3 against 1, you will have no choice but to mute two of the three strings in the reference note in order to advance. When all the treble and bass notes are done, the only un-tuned strings left are the ones you muted for setting the bearings. Tune these in unison to their center strings, starting with the lowest note, by pulling the felt off one loop at a time.

WTs have the advantage that they provide the clearest harmonies. And K-II is

simple enough for amateur tuners to learn. Their disadvantage is that, if they go slightly out of tune, it becomes noticeable; therefore WTs require more frequent tunings. Since ET notes are intentionally detuned, a slight deterioration in tuning is not as noticeable as in WT. This difference is not as bad as it might sound because even in ET, all unison and octave tunings are just and are just as readily heard in ET and WT.

Equal Temperament (ET). I present here the simplest ET tuning scheme. More accurate algorithms can be found in the literature (Reblitz, Jorgensen). No self-respecting professional tuner would use this scheme; however, when you get good at it, you can produce a useable ET. For the beginner, the more complete and precise schemes will not give better results. With those complex methods, a beginner can quickly get confused without any idea of what he did wrong and get hopelessly stuck somewhere in the middle. With the method shown here, you can quickly develop the ability to find out what you did wrong, and figure out how to correct it.

Mute the side strings from G3 to C#5.

Tune A4 to the A440 fork.

Tune A3 to A4.

Then tune A3-E4 in a contracted 5^{th}, by tuning E4 slightly flat until you hear a beat of about 1 Hz. The contracted 5th should beat a little under 1 Hz at the bottom of the muted range (A3) and about 1.5 Hz near the top (C5). The beat frequencies of the 5ths should increase smoothly with increasing pitch. Keep tuning up in contracted 5ths until you cannot go up any more without leaving the muted range, then tune one octave down, and repeat this up-in-5ths and down-one-octave procedure until you get to A4. For example, you started with a contracted A3-E4. Then tune a contracted E4-B4. The next 5th will take you above the highest muted note, C#5, so tune one octave down, B4-B3. All octaves are, of course, just. To get the contracted 5th, start from just and tune flat in order to increase the beat frequency to the desired value and set the pin correctly at the same time. If you had done everything perfectly, the last D4-A4 should be a contracted 5th with a beat frequency of slightly over 1 Hz without any tuning. Then, you are done. You have just done a "circle of (contracted) fifths". The miracle of the circle of fifths is that it tunes every note once, without skipping any within the A3-A4 octave!

If the final D4-A4 is not correct, you made some errors somewhere. In that case, reverse the procedure, starting from A4, going down in contracted 5ths and up in octaves, until you reach A3, where the final A3-E4 should be a contracted 5th with a beat frequency slightly under 1 Hz. For going down in 5ths, you create a contracted 5th by tuning the lower note sharp from just. However, this tuning action will not set the pin. In order to set the pin correctly, you must first go too sharp, and then decrease the beat frequency to the desired value. Therefore, going down in 5ths is more difficult than going up in 5ths.

An alternative method is to start with A3 and tune up to C4 by going up in 5ths, and

checking this C with a tuning fork. If your C is too sharp, your 5ths were not sufficiently contracted, and vice versa. Complete the tuning by starting from A4 and tuning down to C4.

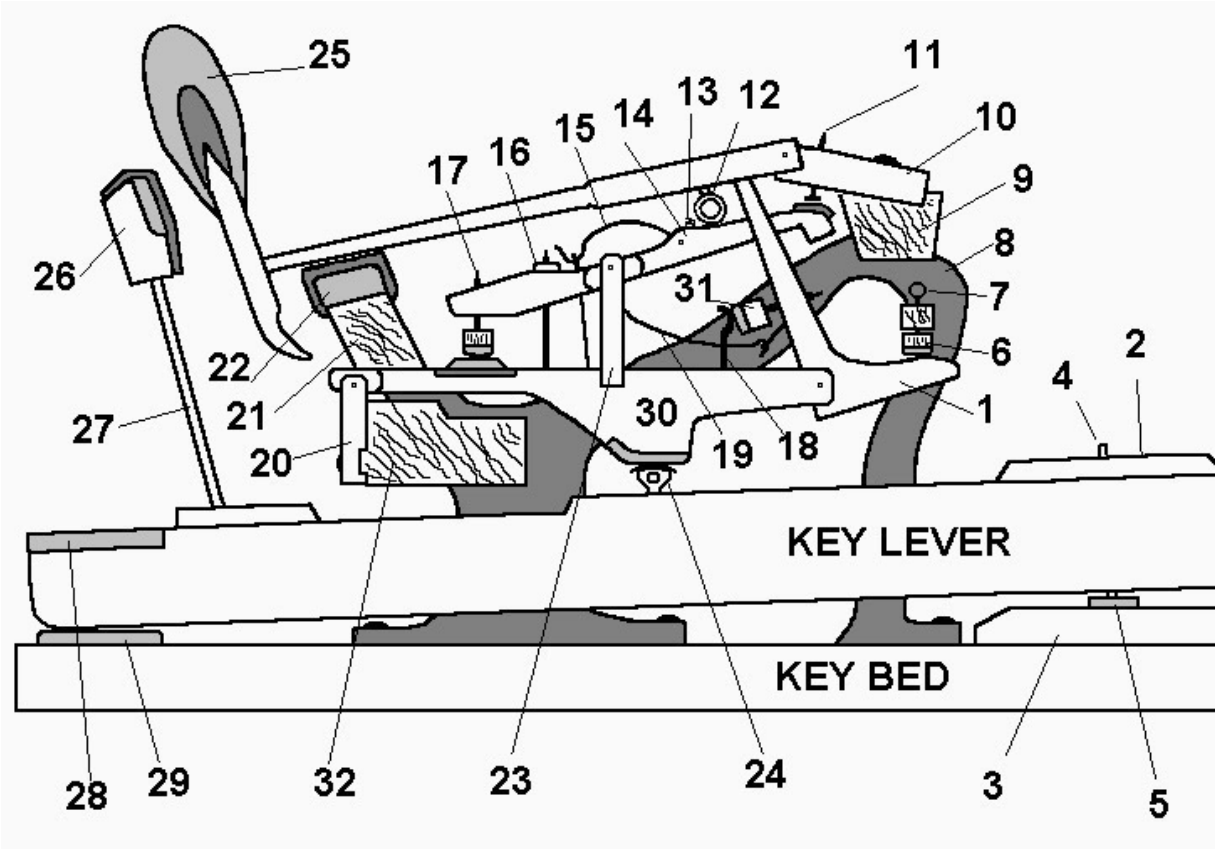
A similar variation is to tune up in 5ths from A3 about half way to G#, and then tune down from A4 to G#.

ET can be tuned using the **circle of fourths** instead of fifths as described above, by tuning in expanded fourths instead of contracted fifths. It has the advantage that it is two steps shorter and is therefore a bit more accurate.

Once the bearings are set, continue as described in the Kirnberger section.

ET is slightly out of tune. This is an advantage in the sense that if it goes slightly more out of tune, it is not noticeable, so you can get away with fewer tunings. Another advantage is that the above tuning algorithm is so simple that it is impossible to forget.

(81) Grand Piano Action Diagram



1. Jack
2. Key lever button
3. Balance Rail
4. Key lever center pin
5. Center pin felt bushing
6. Jack adjustment button
7. Jack adjustment screw
8. Action metal frame
9. Hammer butt rail
10. Hammer butt on sand paper
11. Hammer butt top screw
12. Roller or knuckle
13. Butt stop screw
14. Repetition lever
15. Repetition lever spring
16. Repetition stop hook
17. Repetition lever adjust. screw
18. Spoon - jack control
19. Jack spring
20. Wippen flange
21. Hammer rest rail
22. Hammer rest rail cushion
23. Repetition lever flange
24. Capstan
25. Hammer
26. Back check
27. Back check wire
28. Damper felt contact point
29. Back key rail cloth
30. Wippen
31. Jack button to adjust jack
32. Wippen Rail

There is a more detailed diagrams at: https://www.pianoparts.com/grand/
and many excellent models showing how it works on Youtube.

(82) References

Banowetz, Joseph, *The Pianist's Guide to Pedaling*, Indiana University Press; First Edition (April 1, 1985).

Beginner books, Humphries; Beyer , ; Faber Piano Adventures: http://pianoadventures.com/publications/mainLibraries/pa/level1.html.

Bernard, Jonathan W., *Space and Symmetry in Bartok*, Journal of Music Theory 30, no. 2 (Fall, 1986): P.185-200.

Bertrand, Ott, *Liszt et la Pedagogie du Piano, Collection Psychology et Pedagogie de la Musique*, (1978) E. A. P. France.

Lisztian Keyboard Energy: An Essay on the Pianism of Franz Liszt : Liszt Et LA Pedagogie Du Piano, Hardcover – September 1, 1992.

Beyer , http://imslp.org/wiki/Vorschule_im_Klavierspiel,_Op._101_(Beyer,_Ferdinand).

Boissier, August, and Goodchild, Neil J., (Boissier) *A Diary of Franz Liszt as Teacher 1831-32*, translated by Elyse Mach.

(Goodchild) *Liszt's Technical Studies: A Methodology for the Attainment of Pianistic Virtuosity*. Pianistic virtuosity via six principles illustrated by exercises; no useful information on how to practice.

Brandt, Anthony, *How Music Makes Sense*, http://cnx.org/contents/ae269fb8-8bf2-4884-8fc8-18c4ed1c66ff@22/How_Music_Makes_Sense .

Chapman, Brian, *Ludwig Van Beethoven, Moonlight Sonata,*
and in *Beethoven, Sonatas for the Piano*.
http://www.qedinteractive.com.au/html/jbc/bethvint.htm .

Csikszentmihalyi, Mihaly, *Flow: The Psychology of Optimal Experience*, 2008, Harper Perennial Classics.

Easy Bach, First Lessons in Bach - Book 1: Piano Solo: Walter Carroll, Bach -- Selections from Anna Magdalena's Notebook (Alfred Masterwork Editions).

Exercises: Hanon, etc., Look these up on the internet:
Cortot, Cramer-Bulow, Czerny, Dohnanyi, Hanon, Plaidy, or at:
IMSLP (mostly free): http://imslp.org/wiki/Main_Page .

Fay, Amy, *Music Study in Germany*, see chapter XXIV, near end.

Fine, Larry, *The Piano Book*, Brookside Press, 4th Ed., Nov. 2000.

Fischer, J. C., *Piano Tuning*, Dover, N.Y., 1975.

Gilmore, Don A., about *The Self-Tuning Piano* .

Grand Piano Diagrams, The Piano Deconstructed .

Gutmann, Peter, in *Classical Notes, Ludwig Van Beethoven Piano Sonata #23, Op. 57, "Appassionata"*.

Howell, W. D., *Professional Piano Tuning*, New Era Printing Co., Conn. 1966.

Jorgensen, Owen H., *Tuning*, Michigan St. Univ. Press, 1991.

Kang, etc., Brain Flush, Kang, Xie L., HXu QChen MJLiao YThiyagarajan MO'Donnell JChristensen DJNicholson CIliff JJTakano TDeane RNedergaard M (2013 Oct 18). *Sleep drives metabolite clearance from the adult brain*. Science. 342, 373-7.

Kotier, Steven, *The Rise of Superman: Decoding the Science of Ultimate Human Performance*, 2014, New Harvest.

Larips.com, http://www.larips.com .

Levin, Robert, *Improvisation and Musical Structure in Mozart's Piano Concertos*. L'interpretation de la Musique Classique de Haydn à Schubert. Colloque international, Évry, 13-15 Octobre 1977. Geneva 1980, Minkoff, 45-55. (English version of a paper delivered in French.)

Levin, Robert and Leeson, Daniel N.: *On the Authenticity of K. Anh. C 14.01 (297b), a Symphonia [recte: Symphonie] Concertante for Four Winds and Orchestra*. Mozart-Jahrbuch 1976/77, 70-96.

Listz's Teaching Bibliography,

below is a list containing information on Liszt's teachings; the contents are disappointing. Liszt's father, Adam, did a terrific job of teaching Liszt but, after soaring to fame, Liszt only gave "master classes" to students who were already concert pianists, while complaining about the conservatories that could not teach. The few teachers who knew how to teach were the parents of Mozart, Beethoven, Chopin, Liszt, etc. That tells us something valuable. The anointed teachers: the great Masters and their students were led astray by the grandeur of "talent", dogma, endless practice, etc., (instead of research, knowledge, documentation, empowerment, etc.) and piano pedagogy ended up in a dead end with no way out.

(1) *Life and Liszt*, Arthur Friedheim, Taplinger, NY, 1961.

(2) *The Piano Master Classes of Franz Liszt: 1884-1886, Diary Notes of August Gollerich*, Indiana Univ. Press, 1996.

(3) *Living with Liszt: From the Diary of Carl Lachmund, an American Pupil of Liszt 1882-1884*, Pendragon Press, Stuyvesant, NY, 1995.

(4) *Memories of a Musical Life*, William Mason, Century Co., NY, 1901.

(5) *My Musical Experiences*, Bettina Walker, R. Bently & Son, London, 1892.

(6) There are a diary by Lina Schmalhausen, the other articles already cited (by Fay, Amy, and Boissier, August, and Goodchild, Neil J.,), and the books by Ronald Taylor and Alan Walker.

Moscheles, Ignace, *Life of Beethoven*, 1841.

Olson, Steve, *COUNT DOWN: The Race for Beautiful Solutions at the International Mathematical Olympiad*, 2004. Olson explains the creative thinking process of these competitors and defies the assumption that genius is born, not made, as in music.

Patel, Aniruddh D., *Music, Language, and the Brain:* 9780199755301: Medicine & Health Science Books @ Amazon.com.

Pianoteq , https://www.pianoteq.com .

Piccolo, Stefano, *The Human Cells*, in Scientific American, October, 2014, P. 76.

Psychoacoustics, http://www.music.miami.edu/programs/mue/Research/mescobar/thesis/web/Psychoacoustics.htm .

Reblitz, Arthur, *Piano Servicing, Tuning, and Rebuilding*, 2nd Ed., 1993. The most comprehensive book on piano construction, repairs, and maintenance.

Rogers, Nancy; Ottman, Robert, *Music for Sight Singing* (9th Edition) Spiral-bound – January 12, 2013.

Rossato-Bennett, Michael, Alzheimer's/Music movie: *Alive Inside: A Story of Music & Memory,* http://the-alive-inside-project.myshopify.com or from Amazon.

Rubinstein, Anton; Carreño, Teresa, *The Art of Piano Pedaling: Two Classic Guides*, Dover Books on Music, Paperback – August 4, 2003.

Sethares, William A., *Adaptive Tunings for Musical Scales*, J. Acoust. Soc. Am. 96(1), July, 1994, P. 10.

Sheet Music, (at http://www.pianopractice.org/sheetmusic2.pdf)

Bach: Inventions #1, #4, #8, #13, Sinfonia #15,

Beethoven: Für Elise (short version), Sonata No. 14 (Moonlight, Op. 27),

Mozart: [from Sonata K300 (K331)] Rondo Alla Turca.

Chopin: Fantaisie Impromptu, Op. 66.

Solomon, Larry, *Bach's Chaconne in D minor for solo violin*, see Variation Techniques.

http://solomonsmusic.net/bachacon.htm .

Structural Energy Therapy, SET, http://structuralenergetictherapy.com/find-a-therapist/ .

Tomita, Yo, *J. S. Bach: Inventions and Sinfonia*, 1999.

Treffert, Donald A., *Accidental Genius*, Scientific American, Aug. 2014, P. 54, and *Islands of Genius: The Bountiful Mind of the Autistic, Acquired, and Sudden Savant*, Jessica Kingsley Publishers, 2010.

Trevor Rees-Jones, http://www.amazon.com/Bodyguards-Story-Diana-Crash-Survivor/dp/0446527750/ref=sr_1_1?ie=UTF8&qid=1415503669&sr=8-1&keywords=trevor+rees-jones .

Tuning Tools, Parts, Amazon.com: piano tuning tools: Musical Instruments ,

Schaff Piano Supply Co. - Products ,

Piano Tuning Tools - Hammers made in the USA .

Young, Robert W., *Inharmonicity of Plain Wire Piano Strings*, J. Acoust. Soc. Am., 24(3), 1952.

Zach's Piano Supplies , http://www.amazon.com/gp/node/index.html?ie=UTF8&me=A2ONYPD9NQF23S&merchant=A2ONYPD9NQF23S&qid=1412862674 .

(83) Book Reviews: General Comments

In the last 100 years, the piano literature evolved from finger exercises to using the entire body, relaxation, and musical performance and, finally, to practice methods. Therefore, the older publications contain concepts that are now discredited. This does not mean that Mozart, Beethoven, Chopin, and Liszt didn't have proper technique; just that the literature recorded mostly their great performances but not what *we* had to do to succeed. The piano literature and pedagogy had been inadequate, up to around year 2,000. This explains why "talent" had been such a precious asset, because students had to teach themselves.

There is universal agreement among the few teachers who teach the best practice methods that piano proficiency is not talent but a set of acquired skills. These teachers nucleated today's rapidly growing school of piano pedagogy based on efficient practice methods: knowledge is more important than talent for an overwhelming majority of pianists.

Almost every book deals with a subset of the same subjects. They treat the human mind and anatomy and their relationships to the piano: mental attitude and preparation, sitting posture, bench height, role of arms, hands and fingers - often with appropriate exercises, and injury. Then concepts of technique and musicality: touch, tone, thumb, legato, staccato, fingering, scales, arpeggios, octaves, chords, repeated notes, velocity, glissando, pedal, practice time, memorization, etc. There is surprisingly little literature on sight reading. There is a sprinkling of practice methods associated with each topic, and these tend to increase with the newer publications.

A few discourage the use of "thumb under" for playing fast scales; however, thumb under is a valuable movement for some legato applications. Chopin preferred thumb under for its legato, but taught thumb over [(30) Thumb Under, Thumb Over, Glissando Motion, Pivoting] where it was technically advantageous.

The lack of bibliographies (references) in many books is a reflection of inadequate research and documentation. Each author in effect had to re-invent the wheel each time, or else, earlier publications weren't worth referencing. This is also reflected in the actual teaching methods. Piano teaching methods were basically handed down by word of mouth from teacher to student, reminiscent of the way in which tribal humans handed down their folklore and medical practices through generations. This basic flaw almost completely arrested the development of teaching methods and they remained unchanged for hundreds of years since Bach's time. Even scholarly works like Fink's has only a list

of suggested reading material, and Sándor has no references whatsoever, an inexcusable omission that reflects the primitive nature of the literature on piano pedagogy. The numerous references and book reviews in Chang's FOPP book amply demonstrate how useful and *necessary*, references to previous works are. There is way too much useful information available for any one book, and certainly much more than any single super teacher could hope to learn.

Whiteside's book was widely acclaimed mostly because it was the first real attempt at a scientific approach to discovering the best practice methods. However, according to records of Chopin's teachings, most of her "discoveries" had been taught by Chopin, although Chopin's information was apparently not available to Whiteside. However, it may be more than a coincidence that Whiteside used Chopin's music most extensively in her teachings. Whiteside's book failed because, although she conducted experiments and documented the results, she did not use clear language, organize her results, and make any cause-and-effect analyses, etc., that are needed for scientific projects; she had not received sufficient scientific training or education. Nonetheless, her book was one of the best available at the time of its publication, a heroic effort.

A large number of teachers claim to teach the Franz Liszt method [(63) The Myth of Franz Listz's Teaching Methods], but there is only fragmentary and preciously little documentation of what that method is. There is abundant literature on where Liszt visited, whom he met, what he played, what magical feats of piano he performed, and whom he taught, but there is practically no record of what a student must do to acquire technique. Even Liszt was unable to analyze his technique; when asked to teach, he could only demonstrate on the piano. This is almost unbelievable because Liszt was the most famous teacher of his time, taught most of his life, and there are comments in the enormous literature on Liszt, that his teaching methods are some of the "most analyzed methods in the history of piano pedagogy". This demonstrates the lack of piano teaching knowledge in those days; the ability to play does not provide the knowledge to teach, even after a *lifetime* of teaching.

This book (FOPP) is the only one that provides the most complete set of practice methods for solving specific technique problems that should be taught at the beginner to intermediate stages. The other books deal mostly with "higher" levels of piano playing, but almost totally ignore the practice methods needed to get there. There are now books and internet sites that are starting to treat practice methods, a trend that should continue and finally enable practically every student to succeed.

MUST READ Books & Videos (alphabetically): Cannel, Eigeldinger, Fink or Sándor, Fraser, Humphries, Neuhaus, Prokop, Richman and Lister-Sink (video). The recommendations are based on whether there is useful information on acquiring technique.

Recommended books: Macmillan, Neeley, Onishi, Richard, Scoggin.

Book Review Format: Author, Title, Year of publication, number of Pages in book,

and whether references are cited (bibliographies).

The references indicate how scholarly the book is. These reviews are not comprehensive; they are concerned mainly with relevance to acquiring piano technique and "irrelevant" material have been mostly ignored.

Askenfelt, Anders, Ed., *Five Lectures on the Acoustics of the Piano*, Royal Institute of Technology Seminar, Stockholm, May 27, 1988. Five lecture on the Acoustics of the piano: Contents. A MUST READ if you really want to understand how the piano works.

Some of the most advanced series of lectures on how the piano produces its sound. The Introduction gives the history of the piano and presents the terminology and background information needed to understand the lectures.

The **first lecture** discusses piano design factors that influence tone and acoustical performance. Hammers, soundboards, case, plate, strings, tuning pins, and how they work together. Tuners tune the transverse vibrational modes of the string, but the longitudinal modes are fixed by the string and scale design and cannot be controlled by the tuner, yet have audible effects.

The **second lecture** focuses on the piano tone. The hammer shank has two bending modes, a **shank flex** mode and a faster vibrational mode. The first is caused by the rapid acceleration of the hammer, much like the flex of the golf club. The second is most pronounced when the hammer bounces back from the strings, but can also be excited on its way towards the strings. Clearly, the backcheck is an important tool the pianist can use to reduce or control these extraneous hammer motions, and thereby control the tone. The actual time dependent string motion is totally unlike the motion of vibrating strings shown in text books with fundamentals and harmonics that are integral fractional wavelengths that fit neatly between the fixed ends of the string. It is actually a set of traveling waves launched by the hammer towards the bridge and the agraffe. These travel so fast that the hammer is "stuck" on the strings for quite a few passes of these traveling waves back and forth, and it is the force of one of these waves hitting the hammer that eventually throws it back towards the backcheck. Then, how are the fundamentals and partials created? Simple - they are just the Fourier components of the traveling waves! In non-math terms, what this means is that the only traveling waves possible in this system are waves that have nodes at both ends because the strings are constrained by the fixed ends. The sustain and harmonic distribution are sensitive to the exact properties of the hammer, such as size, weight, shape, hardness, etc.

The strings transfer their vibrations to the soundboard (SB) via the bridge and the efficiency of this process can be determined by measuring the acoustical impedance match. This energy transfer is complicated by the resonances in the SB produced by its normal modes of vibration because the resonances produce peaks and valleys in the impedance/frequency curve. The efficiency of sound production is low at low frequency because the air can make an "end run" around the piano so that a compressive wave

above the SB can cancel the vacuum underneath it when the SB is vibrating up (and vice versa when moving down). At high frequency, the SB vibrations create numerous small areas moving in opposite directions. Because of their proximity, compressed air in one area can cancel an adjacent vacuum area, resulting in less sound. This explains why a small increase in piano size can greatly increase sound production, especially for the low frequencies. These complications make it clear that matching the acoustical impedances across all the notes of the piano is a monumental task, and explains why good pianos are so expensive.

The above is my attempt at a brief translation of highly technical material. My main purpose is to give the reader some idea of the contents of the lectures. Clearly, this web site contains very advanced educational material.

Bree, Malwine, *The Leschetizky Method*, 1997 (1913), 92P, no references.

Although this book appeared in 1997, it is a re-publication of 1913 material.

Teaching lineage: Beethoven-Czerny-Leschetizky-Bree.

Book of exercises for developing technique, photos of finger positions. Advocates thumb under method. Hand position, finger independence exercises, scales, chords, touch, glissando, pedal, performance, etc., a relatively complete treatment. Good book to read after reading Chang (FOPP), shows fingering conventions, hints of HS practice and flat finger positions, and beginnings of TO motion.

Bruser, Madeline, *The Art of Practicing*, 1997, 272P, references & suggested readings. http://artofpracticing.com/

Based on starting with preparing the mind (meditation) and body (stretching exercises), then goes into some useful specifics of piano skills. The amount of piano instruction is unfortunately reduced by the parallel instructions for other instruments (mostly string and wind). Though physical exercise (calisthenics) is good, exercises such as scales are not helpful. Contains a small amount of useful information.

Cannel, Ward, and Marx, Fred, *How to play the piano despite years of lessons, What music is, and how to make it at home*, 239P., 1976, no references. MUST READ.

Starts by bashing misconceptions concerning talent, repeated exercises, superiority of classical music, etc., that prevent us from becoming musicians. Great book for beginners, starting with the most basic information, playing single note melodies, etc.

You learn by playing melodies/songs from the very beginning. One hallmark of improvisations: no fingering instructions anywhere in entire book! Then basic chords (3 notes), then "skeletal arrangement", a universal scheme of RH melody and LH accompaniment that enables you to play almost anything. Then 4-note chords, rhythm (important!), arpeggios. Bolero (rhumba, beguine, calypso), tango, shuffle. Circle of 5ths and chord progressions: classical, romantic, impressionist, modern – very practical and useful. Play by ear, improvisation. How to end any piece. A well-designed sequence from very simple to more complex concepts, leading the reader along the simplest possible route. A supplement with 29 popular songs to practice with and learn from (guitar and

organist markings, changing arrangements on the fly, making things more interesting, etc.). Full of easy-to-understand explanations of basic concepts and useful tricks. This book is not for those looking to acquire technique and play difficult (classical) material.

Cook, Charles, *Playing the Piano for Pleasure, The Classic Guide to Improving Skills through Practice and Discipline*, Skyhorse Publishing, 2011, 187 P., no index, has list of "books consulted". Not Recommended

The skimpy Table of Contents and lack of an index makes it almost impossible to find any specific topic in this book; suggest that you write notes (with page numbers) the first time you read through it. Some good advice mixed with some now discredited concepts. Read Chang (FOPP) before reading this so that you can distinguish the useful from the questionable advice. This is an update of a 1960 edition and reads like some newer ideas grafted onto old, incorrect beliefs. Mainly for adults, including beginners.

Written from the point of view of amateurs, defined as non-professional pianists who do not routinely have to perform on demand. This reduces the demands on practice time and technical skills and makes it easier to make piano playing pleasurable - thus the title. However, in order to maintain the type of repertoire he suggests (which is critical to success), the amateur must practice an hour every day.

Written by a music reporter for The New Yorker, with a serious piano hobby and who had interviewed Horowitz, Hofman, Schnabel, Arrau, Rosenthal, Brailowsky, etc. Researched piano learning methods by consulting writings by famous pianists. An excellent example of how a serious, diligent pianist/reporter can be brain washed by interviewing famous personnel who feed him self-serving statements that make them sound like geniuses but provide no useful information or knowledge. Students and teachers of the "intuitive methods" fall for this and accept the intuitive methods religiously when they are not sufficiently informed. The famous artists who pour out these statements have little other choice because they do not know anything else.

Some nuggets of info: amateur pianists comprise the single largest population of musicians; once you become a "good" amateur pianist, you realize that the "pros" are not that good, after all. Practice softly; fast play can be bad and slow play is generally good for technique; scales and arpeggios are the foundation of technique; the more you memorize, the more you can memorize; use "memory aids" P. 83; some famous pianists have never really used exercises to become proficient. No need to practice Czerny. Many others.

Some misguided advice: P. 113 - technique = exercises = scales + arpeggios + Hanon! Stresses the importance of acquiring a sufficiently large repertoire and memorizing them, but gives no instructions on how to do that (such as practice methods). P. 55 - don't memorize from the beginning. Many other mistakes. As you can see, there are numerous contradictions in this book, a hallmark of uninformed/misinformed teaching methods.

Cortot, Alfred, *Rational principles of pianoforte technique*, Salabert Editions, 1930

(!), Paris, France, English translation; 102 P., Table of Contents (labeled "Index"), no bibliography or index. Not Recommended.

The translation from French is horrible; reads like a translation produced by a computer translation software with no knowledge of piano terminology.

Bad: The title is misleading because this book is just a book of exercises, reflecting on the lack of understanding concerning "exercises" almost a hundred years ago. It was written because, by the 1920s, there was effectively an infinity of exercises for piano students, presenting the dilemma "WHICH exercise to use?" Cortot decided to reduce this "infinity" to the smallest set possible, but still needed 102 pages. Obviously, it was written during the height of the exercise craze, before piano teachers began to realize (slowly - hasn't completely ended yet!) that exercises are mostly a waste of time, and have numerous disadvantages such as loss of musicality (Cortot was aware of this), development of brain laziness, loss of the understanding of efficient practice methods, etc.

This book is way out of date; it discusses Thumb Under (TU) as a newly discovered fingering compared to previous fingerings using only 4 fingers! There is no mention of Thumb Over (TO), which is unconscionable because Cortot's group of French pianists claimed to teach the "Franz Liszt Method" and a few pianists were already aware that Liszt used TO. Use of the thumb also leading to wider reaches (P. 60)!, even exceeding one octave!! Reads like the history of piano that is just emerging from the dark ages.

Filled with "conventional" advice that are now obsolete: unusual, difficult fingering exercises that are almost never encountered, "don't be discouraged by monotony of repetitions", "exercise is not music" (P. 53), considers only finger, hand, & wrist motions (nothing else!), (P. 72) "no teaching here (practically all teaching/learning left to teachers & students)", Czerny, etc., are necessary, etc.

Good: Describes method of sliding fingers from one note to next. Correct method of practice is soft play; one effective method is to touch the keys without depressing them. How to play 2 notes with the thumb. Good treatment of how to play glissando (wrist motion, black key gliss [P. 74-5]). There are 2 types of jumps, one skimming the keyboard surface, the other raising to shoulder height, because both are needed for hand crossing. Stresses the importance of repeat notes, and their relationships to tremolos and octaves. Good descriptions of wrist and finger motions.

Eigeldinger, Jean-Jacques, *Chopin, pianist and teacher as seen by his pupils*. 1986, 324P, bibliography. A MUST READ.

The most scholarly and complete compilation of relevant material on Chopin concerning teaching, technique, interpretation, and history. Because of a lack of direct documentation in Chopin's time, practically all the material is anecdotal. Yet the accuracy seems unquestionable because of the exhaustive documentation, lack of any detectable bias, and the obvious fact that such deep understanding of piano could only have come from Chopin himself - the results are in uncanny agreement with the best teaching

material available today. Eigeldinger has arranged the subjects into helpful groupings (technique, interpretation, quotes, annotated scores, fingerings, and Chopin's style). I certainly wish that there were more on practice methods but most of Chopin's teachings were lost because of lack of documentation.

The technical teachings are presented concisely on pages 23-64. These teachings are in almost complete agreement with those of all the best sources, from Liszt and Whiteside to Fink, Sándor, Suzuki, and this book (Chang, FOPP). The presentation is in stark contrast to Whiteside; here it is authoritative (Whiteside sometimes retracts her own findings), brief (only 41 pages compared to 350 pages for Whiteside!), organized, and clear, while covering a similar range of topics. The second part, pages 65-89, covers interpretation and therefore contains much less information on technique, but is just as informative as the first section. It touches (very!) briefly on how to interpret each of his major compositions. The remaining 200 pages are dedicated to documentation, illustrations, Chopin's annotations on his own compositions and fingerings, and a 10 page "sketch" of basic material to teach beginners.

Technique: Chopin was self-taught; there is little known about how he learned when young except that he was taught by his mother, an accomplished pianist. Chopin didn't believe in drills and exercises (he recommended no more than 3 hr practice/day). Chopin's methods are not as contrary to Liszt's as they might appear at first, although Liszt frequently practiced over 10 hours a day and recommended exercises "to exhaustion". Chopin, like Liszt, wrote etudes; these and Liszt's "exercises" were not mindless repetitions but specific methods of technique acquisition, based on music.

Learn to make music before learning technique. The whole body must be involved, and use of arm weight is a key element of technique. He taught thumb over (especially when the passed note is black) as well as thumb under, and allowed any finger to roll over any other whenever it was advantageous - the thumb was not unique and had to be "free". However, every finger was different. Thumb over (as well as other fingers) was especially useful in double chromatic scales (thirds, etc.). To Chopin, the piano had to speak and sing; to Liszt, it was an orchestra. Since C major scale is more difficult, he used B major to teach relaxation and legato. It is easier to start learning scales staccato, to avoid the difficult legato problems but he always came back to his specialty - legato. Wide arpeggios require a supple hand more than a wide reach. Rubato is one in which the rhythm is strictly held while time is borrowed and returned in the melody. [My opinion is that this definition is often misquoted and misunderstood; just because he said that a few times, it does not mean that he applied it to everything. This definition of rubato applied specifically to the situation in which the RH plays rubato while the LH keeps strict time. Chopin certainly also allowed that rubato was a freedom from strict tempo for the sake of expression.] Chopin preferred the Pleyel, a piano with very light action. His music is definitely harder to play on modern instruments, especially the pianissimo and legato.

Elson, Margaret, *Passionate Practice*, 2002, 108P., a few references.

Written from the point of view of a psychologist. Contains precious little advice on technical development and practice methods. Has a nice treatment of mental visualization (see Mental Play in Chang, FOPP). Useful for those who commit psychological mistakes (who doesn't?), and covers the correct/wrong mental approaches and environmental factors from practice to performance. Good for starting students not familiar with daily requirements of pianists or those with no performing experience. Art and psychology can be surprisingly close –"artist type" readers may enjoy this short book.

Fink, Seymour, *Mastering Piano Technique*, 1992, 187P., excellent list of suggested reading; can purchase companion video. MUST READ this or Sándor.

Most scholarly of all books listed here, as befits the work of a university professor. Scientific treatise using correct terminology (in contrast to Whiteside who invented her own language), easy to understand, starts with human anatomy and its relation to the piano, followed by a list of movements involved in playing, including the pedal. Scale must not be played thumb under, but thumb under is an important movement (P. 115). Illustrates each movement and the corresponding piano exercises. Good description of gravity drop. Strictly mechanical approach, but this book emphasizes production of richer tone and playing with emotion. The motions are difficult to decipher from diagrams, making it desirable to purchase the video. You must read either Fink or Sándor; preferably both since they approach similar subjects from different points of view. Some readers may love one and hate the other. Fink is based on exercises, Sándor is based more on examples from classical compositions.

The first half is a treatment of all the basic motions and exercises for these motions. These include: pronation, supination, abduction, adduction, hand positions (extended, palm, claw), finger strokes, motions of the forearm, upper arm, shoulder (push, pull, cycling), etc. The second section applies these motions to examples from famous classics, by Ravel, Debussy, Rachmaninoff, Chopin, Beethoven, Mozart, and others.

Fraser, Alan, *The Craft of Piano Playing*, 2003, 431P., bibliography. A MUST READ; more informative than Fink or Sándor.

Contains an incredible amount of information, some of which are the most advanced that you can find anywhere; however, the book lacks organization, leaving you to pick up the nuggets as he throws them out. The materials are extremely broad-based, taking teachings from Feldenkrais to awareness training and Tai Chi Chuan to Chi-Gung, but clearly from a well educated concert pianist/composer. The most useful are precise instructions on specific technical material: Chopin's glissando motion (finger "split"), the amount of note over-lap in legato, playing with sides of fingers, interpretation errors in otherwise useful concepts such as arm weight, correct use of thumb, chord attack type exercises, octaves, fortissimo, developing extensor muscles, uses of forearm rotation, musicality: rhythm-phrasing-orchestration, etc. The only weakness I found was that he comes so awfully close to the ultimate truth, but doesn't quite get there – there is still room for improvement, and the reader should research these advanced areas (in other

references) where even newer ideas may be hiding.

Gieseking, Walter, and Leimer, Karl, *Piano Technique*, 2 books in one, 1972, no references. Teaching lineage: Leimer-Gieseking.

First book: Gieseking, 77P. Importance of listening, "whole body" method (a la arm weight school), concentration, precise practice, attention to detail. Excellent treatment of how to analyze a composition for practicing and memorizing. This book is representative of most books written by these great performers. Typical advice on technique is, "Concentration, precise practice, and attention to detail will automatically lead to technique" or "Use your ear" or "All notes of a chord must sound together" without any advice on how to actually acquire such skills.

Takes you through how to practice Bach's Invention in C major (#1), Three Part Invention in C major (#1) and Beethoven's Sonata #1, but more from analysis and interpretation than technical skills points of view. He guides you through the first 3 movements of this Sonata, then dismisses the most technically demanding 4th movement as "presenting no new problems"! Note that this last movement requires a strong, difficult, and very fast 5,2,4 fingering followed by a thumb-over descending arpeggio in the LH and rapid and accurate large chord jumps in the RH. These are where we would have wanted some advice from Gieseking. Chang's book (FOPP) plugs up this hole by providing the missing guidance [(38) Outlining, Beethoven's Sonata #1, Op. 2-1]. Worth reading even just for the specific guidance on the above pieces.

Second book: Leimer, 56P., no references. Importance of rhythm, counting, accurate timing, phrasing. Excellent section on pedaling. Contains some specific information that is difficult to find elsewhere.

Green, Barry, and Gallwey, Timothy, *The Inner Game of Music*, 1986, 225P., no references.

Mental approach to music; relaxation, awareness, trust. Almost no technical piano playing instruction. Only for those who think that mental attitude is the key to playing piano. Those interested in specific instructions for practice will find little useful information.

Hinson, Maurice, *Guide to the Pianist's Repertoire*, 2000, 933P., huge bibliography.

Very complete compilation of piano compositions, with brief descriptions of important information/characteristics of each, degree of difficulty, availability of music scores, useful references for each composition, etc. Main part is "Composers: solo works in Various Editions", then many useful groupings: Anthologies and Collections (by nationality, contemporary, Bach family, etc), Recital programs by Rubinstein, Busoni, and Gabrilowitsch, and special indexes (Black Composers, Women Composers, by Nationality, etc.).

Hofman, Josef, *Piano Playing, With Piano Questions Answered*, 1909, 183P., no references. Teaching lineage: Moszkowki, Rubinstein.

The first half deals with very useful general rules and the second half is in question and answer form. Most of the book discusses general concepts; not much detailed technical instruction. Not an essential book for technique, but makes interesting reading.

Humphries, Carl, *The Piano Handbook*, Backbeat Books, San Francisco, CA, 2002, no references or index, 290 pages, and CD of lesson pieces; wire bound so that it can be placed flat on the music stand. MUST READ

The most comprehensive book on learning the piano, from beginner to intermediate levels, covering all the genres from classic to contemporary. For more details, go to the Amazon page and read the Table of Contents and Preface. The Table of Contents does not list the beginning chapter on "The Story of the Piano" (30 pages of history with beautiful photos) and the final "Reference" section (30 pages!) on buying/maintaining pianos, musical terms, repertoire guide, listening guide, and recommended reading. Each lesson is complete with sheet music and some instructions on how to practice and details of interpretation, musical nomenclature/structure, theory, and basics.

The biggest drawback of this book, like practically every book on piano, is the insufficient information on practice methods. Actually, there is a lot embedded in the lessons, such as forearm rotation, relaxation, etc., as needed, but if you are looking for a specific method to solve a specific problem, how are you going to find it? Also missing are essential concepts such as thumb over, parallel sets, mental play, memory methods, details of the jump, information on digital pianos, etc. Thus, in order to fully benefit from this book, you should read Chang (FOPP) first. Then you will have a deeper understanding of what he is trying to teach and be able to master the lessons more quickly.

The book treats every genre equally: Bach Invention on P. 214 and ragtime (Joplin's Entertainer) on the next page! – a very musically healthy approach appropriate for today's students. This is a great companion to Chang because: it covers beginner material, provides a complete piano education, explores most genres of music, and offers numerous suggestions for music to learn. Great value for the price, and a book that comes closest to getting a super teacher.

Lhevine, Josef, *Basic Principles in Piano Playing*, 1972, 48P., no references.

Excellent treatment of how to produce good tone. Brief discussions of: basic knowledge of keys, scales, etc., rhythm, ear training, soft & loud, accuracy, staccato, legato, memorizing, practice time, velocity, pedal. Mostly superficial -- book is too short. Good general summary, but lacks specific details and does not contain material you cannot find elsewhere.

Levitin, Daniel J., *This is Your Brain on Music*, Dutton, NY. NY., 2006, 314P., bibliography, index.

General: This book is characterized by the words: definitions, classifications, science, errors, and statistical/illustrative details, as explained below; overall, a good start in the neuroscience of music, but the difficulty of the subject matter (the human brain

which is mostly not understood) is painfully obvious.

Appropriately for a scientific treatment of the neuroscience of music, all basic terminologies are defined and various subjects classified so as to enable precise communications (first 3rd of book). This definition and classification process is in itself an enormous scientific endeavor because you need a lot of knowledge in order to define anything in a scientifically meaningful way. There are descriptions of musical, neuroscientific, psychological, etc., experiments that spawn explanations and theories -- just what we look for in this book. Unfortunately, there are errors and omissions that shouldn't be in a book published in 2006 that cast doubts on the quality of the rest of the book. This was written for a wide audience with very different levels/types of education; it provides a glimpse into the community of neuroscientist musicians working to unravel the mysteries of music using modern science.

Details: The Introduction asks some very relevant questions but the book gives no answers. The first chapter introduces and defines terms and concepts such as pitch and timbre (pronounced tamber). The surprise is how, in defining the terminologies to their ultimate depth, you develop a deeper understanding of music which he makes crystal clear with lots of examples. Sample: pitch is detected by the ear's basilar membrane in proportionate scale (mathematicians would say logarithmic scale) which is similarly mapped onto the brain; this determines the nature of musical scales and harmonies (followed by examples).

There are numerous "this is not known . . ." type of sentences throughout the book which is indicative of an expert in his field who knows the limits of our knowledge. Some statements are controversial: "Pitch is purely psychological . . .", while others are wrong: "the eye sees a continuum of colors (frequencies) . . ." (it actually sees combinations of discrete colors [determined by quantum mechanics], much like color TVs and printers and is therefore based on an absolute scale, unlike the ear). Or this innocuous sounding but totally uninformed statement ". . . most people cannot name the notes except for the one in 10,000 who have absolute pitch." Doesn't he know that absolute pitch is learned? The level of ignorance in some sections is inexcusable, P. 204: "I recently asked the dean of one of the top music schools . . . at what point is emotion and expressivity taught? Her answer was that they aren't taught. There is so much to cover, repertoire, ensemble, etc., etc., etc., ... there simply isn't time to teach expressivity . . . . . some of them come in already knowing how to move a listener. . . . .etc." Unbelievable! Yet, probably true of too many music schools. Sad. Moreover, there is no discussion of the correct/wrong practice methods and their effect on "talent", technique, and brain development.

Best treatment of rhythm that I have ever seen, P. 55; Whitesides repeatedly emphasized the importance of rhythm, but never explained it. Rhythm is "a game of expectation" and is highly complex -- we find here the precise explanations, definitions and examples that were missing in Whitesides that tell us what rhythm is, and how to create and execute it.

Loudness is also complex; the ear compresses loudness to prevent ear damage and the brain compensates by expanding it back, so that loudness response is logarithmic, just as frequency is. The brain has the capacity to increase sensitivity in order to detect soft sounds -- something composers exploit to great effect — the PP section is what conditions the brain so that FF sounds explosively loud, because the amplification had been turned up for the PP. Most properties of music are not orthogonal; an important concept, but something you won't understand without a science background. It basically says that practically all musical parameters such as pitch, speed, loudness, melody, rhythm, etc., are inter-related; example: a rising arpeggio will produce totally different effects if at the same time, the volume is increased or decreased. This is why Beethoven's music is so effective.

Gestalt psychology, systems neuroscience, SSIR (shared syntactic integration resource), functionalism, cognitive psychology, cognitive neuroscience, etc., have been involved in brain/music analysis. Music uses practically every part of the brain - more than language and probably predates it - and much of music is concerned with producing (musical) illusions. Modern scientific methods, such as the use of MRI and fMRI, are identifying which part of the brain is involved in certain functions. "Constructionists" and "Relationists" argue about the nature of memory, but basically, the brain's memory function is still a complete mystery. Known methods of memorizing music are far more advanced than the discussions in this book, another evidence that our understanding of the brain lags behind our ability to use it.

The last section deals with effects of music from before birth, through childhood and adolescence, to sexual relationships.

Levitin studied music at a time when the "intuitive" methods [(1) Practice Routines, the Intuitive Method] were prevalent. This book is a strange hybrid of a scientist and a musician who had not completely grown out of the old, intuitive school of music. This demonstrates the unbelievable brain washing power of the intuitive teachings.

Lister-Sink, Barbara (Video), *"Freeing The Caged Bird"*, video, 150 min., 1996, Wingsound, Winston-Salem, NC. MUST VIEW

Readers of piano books often want to see videos of the actual playing; well, here it is, professionally produced. The teachings are based on the Alexander Method; discusses finger, hand, arm, body, motions and bench positions. Covers relaxation, gravity drop, basic piano stroke, flat finger vs. curled finger, scales, arpeggios, etc. Tension free (effortless) play, avoiding or recovering from injury, kinesthetic awareness and listening to your own music. Training program for relaxation and technique: methods/exercises/ tests for stress release, HS/segmental practice, sight reading, etc. List of bad habits: heavy arms, lifting elbows outward, raising shoulders, unnecessary body motions, curled fingers, collapsed wrist, etc. Piano is a set of skills, not talent. Complex tasks consist of simple steps; start from simplest steps, don't advance to next step until previous is completely mastered. Though not explicitly discussed, you can see TO ("thumb over") in

fast passages, students practicing TU, and parallel set type practice, flexible fingers, etc. If you just watch this video without preparation, you will miss a lot; however, if you read Chang (FOPP), etc., every clip will teach you many things.

Lloyd, Norman, *The Golden Encyclopedia of Music*, Golden Press, NY, 1968.

A handy music encyclopedia where you can find just about everything in one place.

Macmillan, Jenny, *Successful Practising: A Handbook for Pupils, Parents, and Music Teachers*, Jenny Macmillan, Cambridge, 2010, 103P., excellent index, list of additional reading material, and references - a professional quality teaching manual. Recommended

An organized and structured textbook for learning piano, based on Project Management principles (and therefore has applicability not only to other instruments but also any project in general). A fairly comprehensive treatment of practice methods, including segmental and hands separate practice, outlining, Mental Play, performance preparation, etc. Suggestions for practice methods/planning for students, parents, and teachers.

Mark, Thomas, *What Every Pianist Needs To Know About The Body*, 2003, 155P., can purchase companion video; no references or index but has 8 suggested reading material.

One of best treatments of human anatomy and its relation to piano playing (actually any keyboard), with section for organists and injury/recovery; scholarly and medically/scientifically/technically accurate. Book is not about technique but about preparing the body/arm/hand for technique and covers discussions on practically every bone/muscle from head to toe. Also has numerous discussions on correct/wrong ways to play, such as proper thumb motions that agree with promoters of "thumb over", dangers of curled fingers (debunks belief that flat fingers cause injury), need for acceleration during key drop, importance of the tactile awareness of the front finger pad, etc.

Mathieu, W. A., *Harmonic Experience*, 1997, 563P., bibliography, extensively indexed.

An advanced book on the experience of harmony; I don't have the music theory education to truly evaluate this book, but will review it from the point of view of an amateur pianist curious about harmony. It starts with the just intonations: unison, octave, fifths, etc., and their relationships to primes 1,2,3,5,& 7. The harmonies are actually experienced by singing over a drone, such as the Indian tamboura. Then reviews the concept of a lattice of notes for tracking harmony, and then the scales, from Lydian through Phrygian. An interesting observation is how the 7th partial used in blues music fits into this scheme.

Most of the book is devoted to the myriads of ways in which Equal temperament affects harmony which may be great for composers confined to this temperament, but a disappointment for someone seeking simple fundamental principles of pure harmony and harmonic progressions (which don't strictly exist in reality because of the Pythagorean

comma and its consequences). Thus musicians have no choice but to explore what is possible with the chromatic scale, and Mathieu does a terrific job of discussing the issues that harmony specialists struggle with. Thus cataloguing the harmonies in this imperfect system becomes an enormous task, even when confined to Equal temperament, where you can base the catalogue on the various commas – remember, he does all this with respect to how you feel about these harmonies, not by counting frequencies. To give you some idea of the contents:

"There are many books that this book is not: it is not a book about counterpoint, or figured bass, or melodic or rhythmic structure, or compositional development, although all of those subjects come into play. It is a harmony book that is meant to reconcile and go beyond, but not supplant, traditional texts. . . . . .

REVIEW OF THEORY: We recognize low-prime frequency ratios between tones as more than agreeable – they are affective in various ways. The primes 2, 3, 5, and 7 serve as norms both as given by nature and internalized by experience: inner/internalized norms. The overtone series is only one incarnation of this, not the source. . . . . .

Flaws and Limits of the Theory: . . . . Anyone can create a subjective tautology. The notion that affective commas are the driving force behind equal-tempered harmony can never be objectively proved. What is presented in this book is an elaborate, operative system based on what is presumed to be the clear sensibilities of the investigator. . . . . ."

I certainly agree with that; this is not a conventional textbook on harmony for the beginner; for that, see Cannel, Neely, Sabatella.

Neely, Blake, *How to Play from a Fake Book*, 87P., 1999; no references, but has a good list of fake books. Recommended.

Excellent starter book; fake books are easy because you don't need to learn chord progressions – they are indicated on the music, so you won't learn about the circle of fifths here. However, you must know scales and chords well; fake books are all about the accompaniments – the LH. Starts very easily, playing only one note with the LH (while RH plays single note melodies), then 5ths, and 3-note chords. Then progresses through all the useful chords, chord symbols, how to make things sound better, etc. From the beginning, each concept is illustrated by actually playing a song (60 in all). Inversions, common-tone voicing, arpeggios, major/minor chords, dominant 7th, augmented, diminished, larger chords, etc. Major faults are: no fingering instructions, almost no discussion of rhythm. Has complete list of: chord symbols and their notes, all scales & key signatures. It is a hallmark of improvisations that fingerings are not marked so that you develop your own as the need arises.

Neuhaus, Heinrich, *The Art of Piano Playing*, Kahn & Averill, London, 1993, 240P., index of pianists mentioned in the book, no references. A MUST READ.

One of the best ways to see what one type of the "Russian School of Piano" is like (the "Russian School" is quite diverse because, historically, nothing in piano was well organized). Full of detailed descriptions of how to deal with advanced technical situations

that can not be found in Chang (FOPP). However, in order to fully appreciate the benefits and pitfalls of Neuhaus, you should read Chang first, as Neuhaus rarely defines anything, there is no organizational structure in the book, and is written in the "artsy" style, an intuitive approach, but mostly in a good way: the established culture of the Russian School has built in some protections from the most obvious pitfalls.

He is aware of, and tries to answer, critics that the Russian method is all work and unfriendly to those without talent. Nonetheless, he follows the established self-serving pattern of ascribing success to talent instead of telling us how it can be done. That is, you practically have to know what it is before you can find it in the book, if at all (not because it isn't there, but because there is no way to find it). Although he disavows this self-serving tendency on P. 22, he keeps falling into it. Perhaps the best example of this is the claim on P. 22 that hands separate practice is only for emergencies -- what an (un-intended) endorsement of this method from one of the world's most respected piano teachers! Yet, the implication is that if you are talented (as he is, of course!), you shouldn't need it; wow!

He also makes fantabulous claims about what he can teach, but then follows with statements to the effect that they can't be written down in a book. But at least, this gives hope to the reader that he is aware of those dreams and that they have hopefully been achieved. This might be an improvement over sweeping everything under the talent rug, but still doesn't help the student. Because the book is not structured, and there is no useful index (only pianists' names), it is nearly impossible to find discussions on any specific topic, although it is probably somewhere in the book.

I will not go into the numerous gems in this book -- there are too many of them. It is far from a scientific approach (which some may prefer because these are the very topics artists struggle with, spoken in their own language), but is densely packed with anecdotes and pointers from a lifetime of experience at the highest level of pianism. P. 16: "As for the piano, I was left to my own devices practically from the age of twelve" in spite of the fact that both of his parents were piano teachers. Beginners reading his book may feel the same way; he was never completely freed from the intuitive approach, from his youth to his death in 1964 (and including this book); but Russian culture based on dedication gained him world respect.

Onishi, Aiko, *Pianism*, Anima Press, 1996, 124P., index, no references; originally published in Japanese as "Approach to Pianism", Zen-On Press. Recommended.

Tone (single note, etc.), technique, melody and harmony, interpretational expressions, exercises (stretching, finger lifting), learning new pieces, memory, imagery (of musical emotions), performing, teaching, pianistic analysis using Chopin, Debussy, Ravel. A compendium of correct methods by a well educated teacher.

Has clear discussions of Thumb Over (P. 27), use of Parallel Sets for practicing trills and double thirds (P. 33), repeated notes (P. 36), etc. Very concise, but profusely illustrated with diagrams and music examples. One of few books with instructions on

how to practice. She comes close to discussing Mental Play.

Prokop, Richard, *Piano Power, a Breakthrough Approach to Improving your Technique*, 1999, 108P., a few references. A MUST READ; you will see the same concepts in Chang (FOPP), but from a different person, providing independent confirmation.

This book is like a condensed form of Chang. This pianist, piano teacher, and composer has done an excellent job of researching piano technique. He briefly covers HS and segmental practice, specifics on relaxation, need for musical play, memorization, and mental play. Excellent photos of finger/hand positions, and examples of what/how to perform exercises. Importance of extensor muscles (lifting fingers); accurate lifting of fingers (and pedals), exercises for lifting each finger. Gives the best description of the bones, tendons, and muscles of the finger/hand/arm and how/what motions are controlled by each. Detailed analysis of the advantages/disadvantages of small, medium, and large hands. His use of "Theorems and Proofs" is somewhat silly because piano practice is not math. This compact book is incomplete, missing items such as Thumb Over versus Thumb Under (he treats only TU), chord attack, arpeggios, etc., and there is no space to treat each topic adequately.

Richard, Francois L., *Music in your head (Mental practice, how to memorize piano music)*, FLR Music Resources, Texas, 2009, 30P., no index or references. Recommended.

Mental Play, memorizing, ear training, chord progressions. Author is a pilot, aviation instructor, and pianist, living in the self-proclaimed Piano City, Fort Worth, TX, home of the Van Cliburn competitions. **This is the first book I have found on clear step-by-step instructions on using Mental Play to memorize.** Extremely brief, but concrete instructions with actual examples of music. Expensive: $23 for a 30 page paperback.

Richman, Howard, *Super Sight-Reading Secrets*, 1986, 48P., no references. A MUST READ.

This is the best book on sight reading. It contains all the fundamentals; they are described in complete detail, teaching us all the correct terminology and methodologies. It starts from how to read music, for the beginner, and advances logically all the way to advanced sight reading levels; it is especially helpful for the beginner. It is also concise, so you should read the whole book once before starting any actual drills/exercises. Starts with how to psychologically approach sight reading. Basic components of sight reading are Pitch, Rhythm, and Fingering. After an excellent introduction to music notations, appropriate drills are given. Then the sight reading process is broken down into its component steps of visual, neural, muscular, and aural processes that start with the music score and end up as music. This is followed by drills for learning "keyboard orientation" (finding the notes without looking at the keyboard) and "visual perception" (instantly recognizing what to play).

Depending on the person, it may take from 3 months to 4 years to learn true sight

reading; should practice every day. Finally, one page of ideas on advanced sight reading.

Sabatella, Marc, *A Whole Approach to Jazz Improvisation*, 85P., 1996, no references, but has a bibliography of fake books, jazz instructional books, and jazz history literature. This book can be browsed free at Jazz Primer: A Jazz Improvisation Primer | The Outside Shore .

This not a beginner's book. No actual music to play; discusses the language of jazz, understanding how jazz players play, and improvisation. Detailed definitions/discussions of chords, scales, and chord/scale relationships (swing, bebop, fusion, free improvisation, etc.) – these are the heart of jazz theory, performance, and history; they are also where students must spend the majority of their time. Suggests many names of jazz players that you should listen to ("selected discography"), and a list of 92 "jazz standards" (no music score) including blues, swing, rock, latin, ballad, and standard/modal jazz. Not a book for beginners.

Sacks, Oliver, *Musicophilia, Tales of Music and the Brain*, Vintage Books, Random House, NY, 2007, 425P., index, references (bibliography).

A most comprehensive and detailed compendium of accounts of the relationship between brain (human behavior) and music, written by one of the foremost experts in this field. Although the book is not organized in a structured arrangement, the extensive index and detailed Table of Contents make it possible to locate most of what you want in this enormous assemblage of accounts, observations, and analyses. Because the subject matter is so complex and inadequately researched and understood, there are almost no theories that explain the observations or solutions to the problems. However, all the hypotheses, popular theories, and possible explanations are discussed, as well as flat statements to the effect that the phenomenon is not understood – something only the experts can tell us.

This is a "What's out there" book from a phenomenological, medical point of view, not a "How to" book for music students or pianists. For example, in Part III, there is nothing about how to memorize music or how the brain accomplishes that task. There is precious little, if any, useful instructions on how to practice at the piano, although the headings in each Part sound so tantalizing. However, it is truly an eye opening experience to read, in vivid detail, about the enormous range of effects that music has on the brain. In almost every case, Oliver Sacks does not try to explain them, simply because the explanations aren't there, but he does tell us how far (or little) we understand them.

The entire book consists of case studies and detailed accounts of actual events and people involved with each of the topics listed in the Table of Contents:

Part I: Haunted by Music

1. A Bolt from the Blue: Sudden Musicophilia
2. A Strangely Familiar Feeling: Musical Seizures
3. Fear of Music: Musicogenic Epilepsy
4. Music on the Brain: Imagery and Imagination
5. Brain Worms, Sticky Music, and Catchy Tunes

6. Musical Hallucinations
Part II: A Range of Musicality, Sections 7-14
Part III: Memory, Movement and Music, Sections 15-22
Part IV: Emotion, Identity, and Music, Sections 23-29
End.

Sándor, György, *On Piano Playing*, 1995, 240P, no references!

Teaching lineage: Bartok-Kodaly-Sándor. A MUST READ, but Fink will give you similar information at lower cost.

A complete and scholarly, but the most expensive, book. Contains most of the material in Fink, stresses arm weight methods. Discusses: free fall, scale (thumb-over method; has most detailed description of scale and arpeggio playing, P. 52-78), rotation, staccato, thrust, pedals, tone, practicing, memorization, performance. Takes you through learning the entire Waldstein Sonata (Beethoven).

Numerous examples on how to apply the principles of the book to compositions from Chopin, Bach, Liszt, Beethoven, Haydn, Brahms, Schumann, many others. This book is very complete; it covers subjects from the effect of music on emotions to discussions of the piano, human anatomy, and basic playing motions, to performing and recording; however, many topics are not treated in sufficient detail. A major defect of this book is the absence of any references, casting doubt on whether there was sufficient research to support the contents of the book. Because of this defect, some ideas are incorrect.

Scoggin, Nancy, *Baron's AP Music Theory* with Audio Compact Discs, Barron's Education Series, NY, 2010, 648P., index, no references. Recommended

An excellent, comprehensive starter book on music theory, composition.

Sherman, Russell, *Piano Pieces*, 1997, 244P., no references.

Consists of five sections dealing with playing, teaching, cultural issues, musical scores, and "everything else". The contents are arranged in no particular order, with no real solutions or conclusions. Discusses the politics of art (music), opinions, judgments, and observations that pianists can relate with; whether non-pianists can understand these musings is questionable but will provide insight. Seating position, thumb serves as momentum balance. Fingers = troops, but body = supply line, support, carrier ship, and manufacturing. Fingers vs body = sales vs CEO; thus controlling fingers does not result in music. Easy pieces are valuable for learning to make music. What is the value of learning piano? It is not even a good career, financially. Should you slide the finger? What is involved in beauty or character of piano sound? How important are quality pianos and good tuners? Pros and cons of competitions (mostly cons): preparing for competitions is not making music and often becomes more like an athletic competition; is the stress and effort worth it?; judging is never perfect.

Deals with issues faced by pianists, teachers and parents; describes many of the major problems but presents few solutions. This book touches on numerous issues, but is

as aimless as its title. Read it only if you have time to burn.

Slenczynska, Ruth, *Music at Your Fingertips*, Cornerstone Library, NY, 1976 (reprint of 1968 edition), 162P., no index or references.

By today's standards this book is outdated although it contains a lot of useful information. Statements like "The point I'm trying to make is that the pianistic problem doesn't exist that cannot be solved by determined imagination. No individual, no book, has all the answers. Many of the most important solutions are in your heart, your hands." do not help the student, is typical of the "intuitive method", and reveals a sorry lack of pedagogical education. It is not a well organized textbook for learning piano, but a set of opinions and experiences of a world renowned concert pianist. Click on the title above and look up the Table of Contents. Even this Table of Contents is not a good guide to what is inside because she picks and chooses what she thinks are important according to older traditions that do not address the topics that most students need today. Although you may not be able to find what you want, reading the entire book and discarding what is obsolete will yield gems that confirm many accepted teachings, such as always playing with the lid open for a grand (P. 18) and "silent play" (P. 119), one way of practicing Mental Play. There are 9 pages of suggested repertoires of compositions, with each composition labeled from E (easy) to T(technical), discussions of suggested performance programs, and explanations of ornaments.

Stannard, Neil, *Piano Technique Demystified, Insights into Problem Solving*, NoSuchThing Press, 2013, 120 P., no references or index, but has list of suggested reading books.

The author tries to make this reading lighthearted; consequently, about a quarter of the book consists of remarks not directly relevant to the subject matter; P. 32-33 are good examples of this, but will not be reproduced here as it will take too much space. The Introduction basically says: "You need practice methods!" Also, "You can't learn to play the piano just from a book and you can't teach someone to play the piano without one".

As befits a pianist/teacher familiar with the Taubman Method, he starts with explaining forearm rotation, but then proceeds to define movements such as shaping, grouping, in, out, over, under, etc., that have specific definitions that are initially difficult to grasp (impossible for beginners to reproduce, and not as all-important/effective as implied in this book – there are many other factors) which makes slogging through the pages mentally tiring and time consuming. Although most subjects of interest for solving problems (jumps, "Thumb Over" type play [P. 9], memorizing [P. 40], performance anxiety, relaxation, etc.,) are discussed, they are too brief and many essential practice methods are missing, such as the continuity rule, parallel sets, mental play, post practice improvement, etc.

Most of these post-2010 publications are finally trying to emerge from the intuitive methods towards knowledge/methods based learning (but are not yet completely successful); examples: P. 38, Performance memory depends on hand memory, although

other memories are also helpful (but these other methods are not fully explained); P. 26, the note just before the jump determines jump accuracy (but incomplete explanation of jumps); P. 38, memorize as much as possible (not quite there yet!), P. 43, Horowitz did not teach because he couldn't figure out how he learned [validates section on (64) Why the Greatest Pianists Could Not Teach], P. 45, performance anxiety – "take with you the idea of the music" (i.e., mental play); P. 70-73, Hanon and Czerny are basically useless; P. 105, 50 pointers on how to practice mostly Bach (and a few Mozart) pieces; etc. Clearly, he knows what the solutions are, but can't spell them out in sufficient detail (which may be too difficult with such a relatively small book that covers as much material as he does).

There are extensive examples of difficult fingerings that are fairly standard, mainly from Chopin, Beethoven, Mozart; he presents numerous examples from Bach, but does not mention the fact that most of the Bach examples he cites are for technique development of specific fingers and, therefore, fingerings should not be changed (from standard fingerings) to make them "easier" to play.

For more details, go to Amazon and see the Table of Contents.

Suzuki, Shinichi (et al), two books (there are more):

(1) *The Suzuki Concept: An Introduction to a Successful Method for Early Music Education*, 1973, 216P., no references, has large, excellent bibliography.

Mostly for violin education starting at an early age. One small chapter (7 pages) on piano teaching methods.

(2) *How to Teach Suzuki Piano*, 1993, 21P., no references.

A brief, general outline of the Suzuki Piano methods. The methods described by Chang (FOPP) are in general agreement with the Suzuki methods. Let baby listen; no Beyer, Czerny, Hanon or etudes (even Chopin!); must perform; teachers must have uniform teaching methods and open discussions (research groups); balance memory and reading, but memorizing is more important. Teachers are given a small set of graded music on which to base their lessons. Suzuki is a centrally controlled teaching school; as such, it has many of the advantages of the faculties of music conservatories and colleges, but the academic level is, in general, lower. Suzuki teachers are one notch above the average private teacher because they must meet certain minimum standards. Describes many general approaches to teaching, but few specifics on how to practice piano for technique. Classic example of how an authoritarian system can eliminate bad teachers by imposing minimum standards, but good "Suzuki piano teachers" must find their own materials beyond the minimal standards that Suzuki provides.

Taylor, Harold , *The Pianist's Talent*, Kahn & Averill, London, reprint 2009, 112P., no index, bibliography (20 books).

This book represents the "Alexander School of Piano" and makes fascinating reading for comparing it with other schools of piano pedagogy. I will highlight this comparison by comparing this book designated by (T) - for Taylor - with my book,

designated (F) - for Fundamentals of Piano Practice. Before you read (T), you should read this review and (F); otherwise, you will miss a lot of information contained in (T) because unlike (F), (T) does not always define terms because (in my opinion) they are not totally understood or even definable -- that is the nature of the "artistic approach". The name of the term (such as mind/muscle co-ordination) or its use in context is supposed to serve as the definition, or, as in the case of "talent", it is discussed in an entire section without pinning it down to anything specific. Without reading (F), (T) can seem quite impressive because of its (unsubstantiated) promises and claims; however, armed with sufficient knowledge, (T) is at times a comedy of errors that can be easily exposed. Nonetheless, (T) is a time-tested, highly developed discipline and, where it is correct, it should agree with (F) if (F) is also correct, as we shall see.

(F) tries to be knowledge based [i.e., nothing can be absolutely knowledge based because we never know everything, which ultimately limits (F)]; (T) has no such limitation because it depends on the ability of the human brain to accidentally discover whatever is needed at the moment, and (T) is all about how to do this, see below, so that we need both (T) and (F). However, the limitation of (T) is that unless you have the right parents, teachers, circumstances, etc., such discoveries might never happen. Thus we might summarize this comparison by postulating that in the absence of knowledge, (T) is superior, but with sufficient knowledge, (F) should be better.

(T) starts by trying to define "Talent": "Talent may be briefly defined as the ability to perform without training . . ." P. 14, an opinion that is now discredited by those who have studied this phenomenon under controlled conditions. This is confirmed by (T)'s own later assertion "The super-talent of today may well become the accepted norm of tomorrow" - which is exactly the thesis of (F) because knowledge can only increase under scientific processes. Another confirmation: "A student once asked me, 'What has Horowitz got that I haven't?' The short answer is 'Nothing!'" (T) finally comes close to a working definition of talent: "the highly talented pianist is neither a biological 'sport' nor the possessor of extra-human capacities, but merely an optimum example of the way in which these capacities operate when applied to piano playing." In (F), this is succinctly stated as "Talent can be taught", whereas (T) uses 6 pages without reaching a definitive definition.

The first half of (T) is mainly an exposition of the theory of piano learning or technique acquisition based on the concepts of "expansion" (good) vs "contraction" (bad) co-ordination, etc. I could not understand the physical bases of these theories even after trying his examples of standing at a wall (P. 27) or trying to lift a match box (P. 31). I found practically no useful information up to P. 63; in fact there are many incorrect/ outdated statements throughout the book. However, reading between the lines, I concluded that the entire methodology is based on relaxation. Such a basis can confer significant validity to the method.

The second half consists of reviews of the teachings of Raymond Thiberge; these

methods eventually blossomed into the Alexander and related techniques and share many basic principles, especially relaxation. Another basic tenet is that you either make music or you don't play at all. Those who memorize and practice bar-by-bar are derisively called "end-gainers" who end up with "black-smith music" P. 17. There are too many excellent suggestions to list here, so this book is worth reading, although the correct explanations and details of execution are too often lacking.

Chapter 7 is an excellent description of how you typically start to learn this type of (Alexander, etc.) method (the first lessons): how to play octaves, the "finger splits" discussed in (F) which is described as a hand rotation in (T), uses of the thumb [TO type motion in (F) described as an arm rotation in (T)], how to avoid playing between black keys by using the thumb, importance of imaginative fingerings, etc. Technique practice is P or even pianissimo, in agreement with (F). Chopin was the most progressive teacher. Chopin's Pleyel had a very light touch and there are some doubts as to whether his teachings could be applied to today's concert grands. My reaction to this was the question of whether today's digital pianos, with their lighter touch, might have resembled the Pleyel more than today's concert grands in touch weight. (T) recommends "sight reading" which is a process similar to Mental Play in (F).

So when it comes to valid specifics, (T) and (F) come to the same conclusions; that is, (T) is also knowledge based when it comes to specific practice/technique methods. The one glaring difference between (T) and (F) is that in (T), you should never practice anything beyond your skill level. I don't know if this is correct. I certainly hope not because (F) is essentially a compendium of methods for breaking the technical barriers that previous methods could not overcome. (F) is faster because you quickly acquire technique so you can play relaxed, but risk losing music, erecting speed walls, or injury if you do not carefully observe the precautions. (T) plays it safe by learning relaxation first because it does not have enough knowledge to overcome all technical difficulties or avoid injuries and is therefore much slower. Clearly, the chapters/comments on relaxation in (F) are critically important, and (T) and (F) are gradually merging into one school, although (T) still contains many misconceptions.

Taylor, Ronald, *Franz Liszt, the Man and the Musician*, Universe Books, NY, 1986, 285P., bibliography, index.

Liszt's biography – another endless accounts of Liszt's numerous liaisons, none of whom he married (that produced at least 3 offspring). The list of famous musicians he met is astounding: Wagner, both Schumanns, Paganini, Chopin, Beethoven, Schubert (Walker claims Liszt never met him), Berlioz, Brahms, Salieri, etc., not to mention the equally famous writers, artists, etc., as also covered by Walker (no need to read both books – read Walker or this one). Distressingly little information on how Liszt learned to play. He disliked the curled finger position as producing dry sounds (P. 32) and used a flexible system in which the fingers changed to meet each requirement. Other teaching methods mentioned are the well known litany of pedagogical tools such as

encouragement versus criticism, too much body or arm motion, etc., that do not address the specifics of technical play.

Walker, Alan, *Franz Liszt, The Virtuoso Years, 1811-1847*, 1983, 481P., references.

This is the first of 3 books; it covers the period from Liszt's birth until the time he decided to stop performing at age 36. The second book covers the years 1848-1861, when he mainly devoted himself to composing. The third book covers the years 1861-1886, his final years. I review only the first book here because that is where we should find the details of how he learned to play the piano.

Liszt is known as the greatest pianist of all time. Therefore, we would expect to learn the most about how to acquire technique from him, as practically everybody did. Unfortunately, every book or article written about Liszt is an utter disappointment. Perhaps technique was like a "trade secret" in Liszt's time and his lessons were never documented. Paganini practiced in complete secrecy, and even covertly tuned his violin differently in order attain results no one else could. (An obvious guess would be that he tempered his open strings to reduce the number of fingered notes.) Chopin, on the other hand, was a composer and professional teacher - those were his sources of income, and there are more accounts of his lessons. Liszt's claim to fame was his performances. His success in this regard is reflected in the fact that practically every book on Liszt is an endless and repetitive chronicle of his incredible performances. This secrecy might explain why so many pianists of the time claim to have been students of Liszt yet they seldom describe Liszt's teaching methods in any useful detail. However, when these details are probed among today's teachers of the "Liszt school", they are found to use similar methods (hands separate, shorten difficult passages, chord attack, etc.).

Another possibility is that Liszt's concepts of technique were too deep and complex to be reduced into simple analytical explanations, an idea that conveniently played into the adulation of "prodigies" and "talent" that was the basis of their commercial success. In reality, Chang (FOPP) shows that the fundamental elements are almost trivially simple (once someone explains them to you), almost common sense to someone like Liszt, and too obvious to be bothered with. My guess is that he was simply unable to translate what was in his fingers to a teachable system. Whatever the real reasons, Liszt's teaching methods were never adequately documented. One legacy that Liszt left us is the well-chronicled fact that the kinds of feats he performed are humanly possible. This is important, because it means that we can all do similar things if we can rediscover how he did it.

Walker's book is typical of other books on Liszt that I have read, and is basically a chronicle of Liszt's life, not a textbook on how to learn piano. As such, this is one of the best Liszt biographies and contains numerous discussions on particular compositions with specific pianistic demands and difficulties. Unfortunately, a description of an impossible passage "that was executed with the greatest of ease" does not teach us how to do it. This lack of technical teaching information is surprising in view of the fact that publications

about Liszt number well over ten thousand! In fact, any useful technical information we might glean from this book must be deduced from the contents using our own knowledge of the piano (see the "relaxation" example below). The section entitled "Liszt and the Keyboard" (P. 285-318) contains a few pointers on how to play. As in all three books, Liszt is revered as a demi-god who can do no wrong, even endowed with super hands somehow configured ideally for the piano -- he could reach a tenth easily. This bias reduces credibility and the incessant, repetitive accounts of superhuman performances create a boredom that detracts from the vast amount of revealing and fascinating historical details in these books.

From the point of view of "incredible performances" resulting in broken strings, perhaps an interesting observation is that Liszt was a thin, sickly man in early youth. At age three, he was given up for dead after an illness and they even ordered a coffin. He started piano sometime before age six and didn't even have a decent practice piano until seven, because his family was so poor. He was taught by his father, a talented musician, passable pianist and close acquaintance of Haydn, and was steeped in music since birth. Nonetheless, by seven, he was "amazing his parents with piano playing and was already composing". Such reports do not do justice to his father who was probably most influential in Liszt's rapid development. Czerny was his first "real" teacher, at age 11 (when Czerny notes that Franz didn't even know proper fingerings), and Czerny claims to have taught Franz all of his fundamental skills. However, he acknowledges that Franz was already an obvious prodigy when they were first introduced (he could sight read practically anything) -- which seems suspiciously inconsistent. Liszt actually rebelled at Czerny's drills, but nevertheless used exercises extensively for his technical developments and expressed the greatest respect for his teacher as well as Beethoven. The things he practiced were the fundamentals: runs, jumps, repeat notes. My interpretation is that these were not mindless repetitions for building muscle but skill exercises with specific objectives in mind, and once the objectives were achieved, he would move on to new ones.

But how does a frail person perform "impossible" exercises to exhaustion? By relaxing! Liszt may have been the world's greatest expert on relaxing, out of necessity. Concerning relaxation, it may not be a coincidence that Paganini was also a sickly man. By the time he became famous, in his thirties, Paganini had syphilis, and his health further deteriorated because of an addiction to gambling and contraction of tuberculosis. Yet, these two men of poor health were the two greatest masters over their instruments (as an adult, Liszt was comparatively healthy for his time). The fact that both were not physically robust indicates that the energy for superhuman performances does not come from athletic muscle power but, rather, from complete mastery over relaxation. Chopin was also on the frail side, and contracted tuberculosis. A sad historical note, in addition to Paganini's poor health and the grotesque consequences of the primitive oral surgical attempts of that time, are the circumstances of his ghastly death, as there was a delay in

his burial and he was left to rot in a concrete cistern.

Another notable teacher of Liszt was Saliery who taught him composition and theory. Saliery also taught Schubert, but Liszt never met him. By then Saliery was over 70 years old and, for years, had been suffering under the suspicion of having poisoned Mozart out of jealousy. Liszt was still improving at age 19. His feats are credited with popularizing the piano. He is credited with inventing the piano recital (by bring it out of the salon and into the concert hall). One of his devices was the use of many pianos, as well as many pianists. He even played multi-piano concerts with Chopin and other luminaries of his time. This climaxed in extravaganzas with up to 6 pianos, advertised as a "concert of 60 fingers". In one stretch of 10 weeks, he played 21 concerts and 80 works, 50 from memory. That he could so enthrall his audiences was the more surprising because adequate pianos (Steinway, Bechstein) were not available until the 1860s, almost 20 years after he stopped concertizing.

The lack of piano technique methods in this review is typical of everything written about Liszt, even articles about technique. This illustrates how piano teaching was led astray by wrong concepts, such as "students must be taught to practice", that sound so intuitively correct, but is useless for students. How piano pedagogy taught everything except what students needed (practice methods) for 200 years is the greatest mystery in the history of piano.

Weinreich, G., *The Coupled Motions of Piano Strings*, Scientific American, Jan., 1979, P. 118- 127.

This is a good article on motions of piano strings if you need to learn the basics (that can be found in textbooks). However, the article is poorly written and the experiments were not well conducted; but we should be cognizant of the limited resources that the author had. Even more advanced research had surely been conducted long before 1979 by piano manufacturers and acoustics scientists. I will discuss below some of the deficiencies in this article in the hope that the awareness of these deficiencies will enable the reader to glean more helpful information from this publication and avoid being misled.

There is no information on the frequencies of the notes that were investigated. Since the behavior of piano strings is so frequency dependent, this is a vital piece of missing information. Keep this in mind as you read the article, as many of the results will be difficult to interpret without knowing the frequency at which the experiments were conducted. For example, different experiments might have been performed at different frequencies, in which case we would not know how to compare them.

The center graph in the lower row of figures on P. 121 (there are no figure numbers anywhere in this article!) has no explanation. The article, later on, proposes that the vertical modes produce the prompt sound. The figure therefore might be showing the sustain of a single string. I know of no note on a grand piano having a single string sustain of less than 5 seconds as suggested by the figure. The left hand figure of the upper

row of graphs from a single string shows a sustain of over 15 seconds, in agreement with my cursory measurements on an actual grand. Thus the two plots from single strings appear to be contradictory. The upper plot measured sound pressure whereas the lower one measured string displacement, so that they may not be strictly comparable, but we would have liked the author to at least provide some explanation of this apparent discrepancy. Strings with very different frequencies may have been used for the two plots.

In reference to these figures, there is this sentence: "I used a sensitive electronic probe to separately measure the vertical and horizontal motions of a single string," with no further information. Now any investigator in this field would be very interested in how the author did it. In proper scientific reporting, it is normal practice (generally required) to identify the equipment (including the manufacturer and model numbers) and even how it was operated. The resultant data are some of the few new information presented in this paper and are therefore important. Future investigators will probably have to follow up along this line of study by measuring string displacements and will need this information.

The four figures on page 122 are not referenced anywhere in the article. Thus it is left to us to guess about which parts of the article pertain to them. Also, my guess is that the lower two plots showing oscillations are just schematics and are not actual data. Otherwise, the prompt sound would be over in about 1/40th of a second, according to these plots. The curves plotted in these two lower figures are purely imaginary in addition to being schematic. There are no data to back them up. In fact the article presents no other new data and the discussions on the ensuing 5 pages (out of an 8 page article) are basically a review of known acoustical principles. As such, the descriptions of the springy, massive, and resistive terminations, as well as the sympathetic vibrations, are all known and should be qualitatively valid.

The major thesis of this article is that the piano is unique because it has an after-sound and that the proper tuning of the after-sound is the essence of good tuning and creates the unique piano music. My difficulty with this thesis is that the prompt sound typically lasts over 5 seconds according to this article. Very few piano notes are played for that long. Therefore, essentially all of piano music is played using only the prompt sound. In fact, piano tuners use mainly the prompt sound (as defined here) to tune. In addition, the after-sound is at least 30 db less in power; that is only a few percent of the initial sound. It will be completely drowned out by all the other (prompt sound) notes in any piece of music. What is happening in reality is that whatever is controlling the quality of the piano sound controls both the prompt and after-sounds, and what we need is a treatise that sheds light on this mechanism.

Finally, all publications require references so that we can know what has or has not been previously investigated. In defense of the author, Scientific American does not allow any references except references to previously published articles in Scientific American. This makes it necessary to write articles that are "self-contained", which this article is

not. According to Reblitz [P. 14], there is a 1965 Scientific American article on "The Physics of the Piano", which is not referenced in this report.

Over-all, a poor piece of work.

Werner, Kenney, *Effortless Mastery*, 191P., 1996, with meditation CD, references as footnotes and lots of suggested listening material.

Mental/spiritual approach to making music; almost no descriptions of the mechanics of playing or how to practice. Detailed instructions on meditation. In the same category as Green and Gallwey, but a different approach. Written for jazz players, but applies to all pianists and other instrumentalists. The first half of book consists of discussions of dysfunctional practice, teaching, performances, etc.; the second half provides solutions, but they are the classic exhortations of "practice until you can play without thinking", and controlling playing through mental attitudes – if you want to see a caricature of the "intuitive method", this is it! This book is for those who believe meditation can solve problems without technical knowledge. However, there is little question that controlling the mind/body system is an important factor in successful musicianship.

Whiteside, Abby, *On Piano Playing*, two books in one, 1997, no references.

This is a re-publication of Indispensables of Piano Playing (1955), and Mastering Chopin Etudes and Other Essays (1969).

Teaching lineage: Ganz-Whiteside.

First book: *Indispensables of Piano Playing*, 155P.

Uses non-standard English, convoluted logic, biblical phraseology, long winded and repetitive.

Contents are excellent, but the terrible write-up makes learning unproductive. Many of the ideas she describes appear in other books but she claims to have originated (or rediscovered) many of them. Although I had difficulty reading this book, others have claimed that it is easier to understand if you can read it rapidly. This is because she often takes a paragraph or even a page to describe something that can be written in one sentence.

Almost the entire book is like this (P54): "Q: Can Weight - an inert pressure - help develop facility? A: It is exactly the inert pressure of weight which cannot be used for speed. Words are important in teaching. Words of action are needed to suggest the coordination for speed. Weight does not suggest the muscular activity which moves the weight of the arm. It does suggest an inert pressure." I did not pick this section because it was particularly convoluted -- it was picked at random by opening the book with my eyes closed, because the entire book is like this.

Contents: Must follow her methods religiously; why rhythm is important, the body-arms-hand-finger combination has infinite possibilities of which we are mostly unaware; thumb under scale is reviled; functions of each part of anatomy for playing piano (horizontal, in-out, vertical motions); discussions on creating emotion, memorizing, pedaling, phrasing, trills, scales, octaves, teaching methods. Points out importance of

rhythm to music and how to attain this using outlining (P. 141). Czerny and Hanon are useless or worse.

The following is her attack on passing thumb-under for playing scales, excerpted from over two pages; the ( ) are my clarifications:

"Passing. Here we are faced with a welter of stress in traditional teaching concerning the exact movements that should take place with finger and thumbs. . . . .If I could blast these concepts right out of existence I would not hesitate to do so. That is how faulty and pernicious I think they are. They can literally cripple a pianist . . . . . If it (playing perfect scales) seems quite hopelessly impossible and you have no glimmer of an idea as to how it can be accomplished, then you are trying with a coordination which actually makes a scale an impossible feat. It means thumb snapping under the palm and reaching for position; and fingers trying to reach over the thumb and seeking a legato key connection. It doesn't matter if the performer achieving the swift and beautiful scales and arpeggios tells you he does just that (thumb under) -- it isn't true. No suggestion is meant that he is lying, but simply that he was successful in discarding the coordination that he was taught when the occasion arose which made it inadequate . . . . They (thumb under players) have to be re-educated physically to a new pattern of coordination; and that re-education can mean a period of wretched misery to them. . . . . Action (for thumb over passing) can be taken through the shoulder joint in any direction. The top arm can move so that the elbow end of the humerus can describe a segment of a circle, up or down, in and out, back and forth, or around and about . . (etc., an entire page of this type of instruction on how to play thumb over, then). . . . .With control from center the entire coordination operates to make it easy to have a finger available at the moment it is needed . . . . The best proof of this statement is a beautiful scale or arpeggio played with complete disregard for any conventional fingering. This often happens with a gifted, untaught pianist . . . . For passing (thumb over), the top arm acts as fulcrum for all the "other techniques" involving the forearm and hand; flexion and extension at elbow, rotary action, and lateral hand action at wrist, and last and least, lateral action of fingers and thumb. . . . . Between rotary action and alternating action, passing is made as easy as it looks when the expert does it."

Second book: *Mastering the Chopin Etudes and Other Essays*, 206P., no references. Compendium of edited Whiteside manuscripts; much more readable because they were edited by her students, and contains most of the ideas of the first book, based on playing the Chopin etudes which were chosen for their unequaled musical content as much as for their technical challenge. This is like a catechism to the above bible; may be a good idea to read this book before reading the first book. Describes outlining in some detail: P. 54-61 basic description, and P. 191-193 basic definition, with more examples on P. 105-107 and P. 193-196. Although outlining can be used to overcome technical difficulties, it is more valuable for learning, or learning to play, the musical concept of the composition.

These two books are a diamond mine of practical ideas; but like a diamond mine, you must dig deep and you never know where it's buried. The use of the Chopin Etudes here turns out not to be a random pick; most of Whiteside's basic tenets were already taught by Chopin (see Eigeldinger); however, Eigeldinger's book was written long after Whiteside's book and she was probably unaware of many of Chopin's methods. It's not a mystery that two teachers found the same methods — if they are correct, they should be the same.

There is no middle ground -- you will either love Whiteside for the treasure trove of information or hate it because it is unreadable, repetitive, and unorganized.

(84) About the Author

I was born in Tainan, Taiwan (1938), grew up in Japan (1945-1958), was granted a BS degree in Physics from RPI, Troy, NY, USA (1962) and PhD in Physics from Cornell Univ., Ithaca, NY (1967). Worked in materials science (using electron spectroscopy), mostly at Bell Laboratories at Murray Hill, NJ (1967-1998). I lived in the suburbs of Tokyo when the carpet bombing started near the end of WWII and watched the search lights seeking B29s and gunners trying to shoot them down. The suburbs were bombed with incendiaries, not the blockbusters that leveled Tokyo from horizon to horizon.

My involvement with piano started before birth because my parents, both Taiwanese, briefly majored in piano at a college in Japan and my father was constantly listening to classical music and taught my aunts to play the piano. One aunt eventually became a respected piano teacher in Tainan, Taiwan. The piano was always a major influence in our family, and I took lessons (1949-1957) and practiced almost every day, up to eight hours on weekends. I was fascinated with the piano and became the accompanist for our school choir and organist at local churches (three consecutive masses on Christmas eve!). I loved the piano, but it was my second priority; education came first because "my talent was obviously insufficient" to earn a living as a musician.

As a young child, I was a dishonest crybaby and earned the nickname "monkey" from a mean aunt. At age 10, I realized that dishonesty made life difficult, miserable and scary; therefore, I tried honesty. Suddenly, a huge weight was lifted from my shoulders, life became simpler, and I have been happy with the successes that followed. An honest person asks questions and learns, instead of cooking up stories to cover up ignorance and staying ignorant. I attribute my life's successes to honesty, curiosity, and a insatiable desire to learn, because I have no special talents to rely upon. I learned that education is the basis for honesty.

My lack of progress with piano was a mystery because I was successful in practically every endeavor that I attempted. I always persevered and *developed an intense interest* in any project that I tackled. I had completed the twelve years of primary

education in ten years, was first in class and elected class president most of those years. The sense of fairness in that Catholic primary school (St. Joseph's College in Yokohama) was amazing, as I was only one of several non-Catholics in my class but never experienced discrimination. For example, I graduated first in class, class president, valedictorian, and was elected School Man of the Year because I garnered six of the twelve prizes awarded to the graduates.

I studied Physics at RPI in Troy, NY, on a full scholarship, and I graduated with only 51 classmates from a freshman class of 200 science majors. I kept up my piano practice in college because, in those days, the practice rooms and pianos in the music department were not locked. I even befriended a classmate whose hobby was keys, and he made me a key to unlock the Steinway concert grand in the auditorium. I was amazed that practically all of my science classmates and faculty played some type of musical instrument and we would assemble at our department head's house to play chamber music. So I never stopped practicing piano, yet I was not making the progress that I expected.

The piano was instrumental in our marriage. My wife's brothers and sister played either the piano or violin and, while I was at RPI, she was living with her brother nearby. He had bought an inexpensive, but playable, upright. So I visited their apartment to practice, which presented opportunities to meet her and start dating.

I won a research assistantship at Cornell University towards a PhD in Physics. My professor was Germer, the discoverer of the wave nature of electrons. Initially, I thought things were easy because I came in #10 out of 200 taking the screening exams for entering graduate degree students. I quickly realized that I should have applied for the Applied Physics Department, not the Physics Department, and barely graduated at the bottom of most of the classes I took. I had to study so hard just to avoid flunking out that I ended up in the infirmary a few months before graduation, from exhaustion. The doctor wasn't worried, smiled at me, and said "hold on for three months, and you will be fine".

I bought a $400 used upright, towed it home in a U-Haul, and taught myself to tune the piano by reading books because, as a married student living on a research stipend and my wife's baby-sitting income, I did not have the money to pay a piano tuner. Since neither my wife, I, nor anyone in our families had absolute pitch, I must attribute our two daughters' accurate absolute pitch to the fact that I had kept our piano in tune since before their birth. One identified up to ten notes played simultaneously, in a few seconds. Although my wife had taught rudiments of piano to our girls before they could read the alphabet, we knew nothing about absolute pitch and never even thought of teaching it to them. We had been taught that absolute pitch was a rare inborn talent, and were flabbergasted when their piano teacher, Mlle. Yvonne Combe, discovered their absolute pitch (at ages 4 and 8) during their initial lessons. They had acquired absolute pitch without being taught, without even trying, and didn't even know they had it, because the piano was always in tune!

Combe had confided in me that her desire was to tape record her teaching methods

(cassette tapes in those days) because she knew that few teachers taught them. I absorbed and started using some of Combe's methods because our girls were using them every day and upon Combe's death, realized that if I didn't document them, they would be lost. The first draft of this book was written in 1994 when I had six months of free time between jobs. In writing the book I naturally confronted questions such as "why is this method valid and why is that one not?" etc., because that is what scientists do. I also had to look for obvious missing parts, etc., so that everything in the book was there because it was needed and demonstrably valid. In science, you can't just write down something because someone taught that way, as has traditionally been done in piano; it has to have some validity; also, anyone must be able to reproduce the results. Even Combe had some incorrect ideas. One day, she squeezed my hand and said, "See, my hands are strong because I am a pianist." I have a handshake well over twice her grip strength but she plays the piano much better.

After finishing that first edition, I could finally try out the methods of the book for the first time. Their effectiveness amazed me and naturally led to the question, "why didn't anyone write such a book when there were thousands of accomplished pianists since Bach and hundreds of piano books, some of them written by the most famous pianists?" If I had this book when I started piano, I would have been way ahead in just a few years, like our daughters. After 50 years of dedication to piano, I finally found out why I never succeeded — I was never taught!

It took me over ten years after writing the first edition to understand that, in order to undertake such a ginormous task of writing a piano learning manual, you needed a pianist, researcher, teacher, analyst and writer, who could devote a significant chunk of a lifetime to the effort, and who was lucky enough to learn from one of the best piano teachers the world has ever known — a forbidding seven requirements! The probability of such an event is statistically almost zero and explains why it never happened. Most pianists do not have the training to research or teach, see the section (64) Why the Greatest Pianists Could Not Teach.

My career was in analytical research for 31 years. I worked in fundamental research (surface science on the atomic scale), materials science (physics, chemistry, biology, mechanical engineering, electronics, optics, acoustics, metals, semiconductors, insulators), and industrial problem solving (failure mechanisms, reliability, manufacturing), using mainly electron spectroscopy.

All scientists must learn practically every day just to stay current. So, who teaches them? Other scientists! That is, scientists must teach each other all the time and, by necessity, become good teachers by publishing reports, attending conferences, and interacting daily with other scientists in the company, in frequent meetings and during lunch in the company cafeteria — opportunities piano teachers seldom experience, even at conservatories. I have published over 100 peer-reviewed articles in most of the major scientific journals and written about 1,000 internal company reports. This qualifies me for

four of the seven requirements above; in addition, I never stopped practicing piano all my life, was fortunate enough to meet Combe, and I retired in 1998 partly to work on this book, so it is not surprising that nobody else had written such a book. I must thank all the volunteer translators who have translated it into over ten languages. I estimate from the book sales and internet activity, that over 100,000 pianists had used this book by 2013.

Back Cover

All the efficient piano practice methods I could find have been assembled in this one book, starting with the teachings of Mlle. Yvonne Combe.

Combe's grandmother was a famous soprano in France and Combe's mother was a voice teacher and they gave Yvonne a good start in piano. Yvonne won the first prize for piano at the Paris Conservatory in 1910 and graduated at age 13. Franz Liszt had attracted high level pianists to Paris and the "French School of Piano/Music" developed some of the most advanced teaching methods. Combe's mentors in Paris were Cortot, Debussy, and Saint Saëns, and her interpretations of the latter two composers were without peer. She was one of Debussy's students who helped him transcribe his new compositions for publication as he played them out on the piano, and Debussy added some of her suggestions into his compositions. She was one of the most promising pianists of her time, concertizing and performing under famous conductors such as Saint Saëns, until she injured her hand in a bicycle accident (she was quite an athlete, a good skier), ending her performing career at age 15. She subsequently dedicated herself to teaching, organizing schools with about 30 teachers at one time, in England, Switzerland, and Plainfield, NJ, USA, where she briefly coached Van Cliburn because her teaching methods were similar to his mother's.

Piano pedagogy had wrongly attributed success in piano to "talent" for two hundred years and this assumption stagnated teaching until about year 2000, when information became freely available over the internet. Today, talent is being replaced by knowledge, empowering students to quickly learn piano skills that were previously considered the exclusive "talents" of geniuses. Piano pedagogy can finally catch up to other fields of study that have proper textbooks that provide teachers with all necessary material that should be taught, enabling every student to learn at the fastest pace possible.