

# General Principles of Piano Technique

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## Contents:

### **Introduction 2**

- A personal note 2
- Who should read this? 2
- Cautionary notes 2
- Assumptions 3
- Sound: touch and tone 3
- Pedaling 4
- Rhythm and tempo 5
- What makes a great pianist? 5

### **How to learn the music 5**

- The musical conception 5
- Learning the notes 6
- Chaining: putting the piece together 7
- Practicing 7

### **Technical principles 9**

- Characteristics of coordinated movement 9
- The fingers and the hand 9
- Positions and alignment 11
- Shifts and Leaps 14
- Fingering 15
- Impulse groups 16
- Body rhythm 18
- Refining rhythmic impulse playing 19
- Fine control: playing very slowly and softly 20
- Tension problems 20
- Virtuosity 20

### **Performing in public 21**

### **Sources 22**

**Note:** My Four Small Etudes (pdf and mp3: 1, 2, 3, 4) (Philippe Prud'homme, piano) which accompany this essay allow the reader to put these principles into practice. They can be downloaded at:

<http://alanbelkinmusic.com/Piano/PianoTechnique.html>

## Introduction

### A personal note

I started my musical life as a pianist and composer. After many years of piano study, I began to play the organ, and did not play the piano again for many years. Finally I had the means to purchase a beautiful Steinway, and now I have come back to my musical "home". At first I reviewed repertoire I had previously played, but I gradually moved towards more difficult works, which I had always wanted to play, but never mastered. This led to an in depth rethinking of my technique; many things evolved or changed completely. My work on these advanced pieces led me to fascinating discussions with pianist colleagues and friends, and also to lots of new reading. This essay is the result of these changes. I cannot claim to provide the "right way" to play the piano, but I can say that there is nothing in here I have not tried out myself: Everything I say here has at least worked for me. This is thus a personal document; as such it is subject to change. I am a good pianist, but not a great virtuoso; therefore my comments, especially in the section on virtuosity, should be taken with a grain of salt! This essay will be updated often, so please see the date on the first page.

### Who should read this?

My objective here is to present general principles of piano technique. Although these principles are fundamental, this essay is not meant for beginners. Piano playing is a very complex mental and motor skill; a beginner has so much to get accustomed to that he will not be able to appreciate or apply all these points at once. (His teacher, however, must maintain a global view, to prevent him from forming bad habits.) The pianist who will find this essay most useful is one who is already playing intermediate repertoire, but who wants to move further towards musical and technical virtuosity.

### Cautionary notes

- It is not easy to communicate physical movements and coordinations without visual and tactile feedback. Ideally, the student not only needs to see someone demonstrating what is described, but also to feel the sensations which go along with the discussion (good teachers often demonstrate sensations by "playing" on the hand or arm of the student), and also to hear the results. Eventually, I hope to provide video examples to accompany the text.
- It is important to distinguish descriptions of how piano playing feels to the pianist, from what a pianist is actually doing. Even great pianists' descriptions of what they are doing may be grossly inaccurate from a scientific point of view. For example, often one reads about aiming for "complete relaxation". As a scientific description, this is nonsense: Complete muscular relaxation only happens after death! Piano playing requires muscle tone, and even muscular effort. What is being described here is how a good pianist looks and feels: uninhibited, without excess tension. A talent for playing the piano is not the same as a talent for teaching, or even for accurate observation. Within anthologies of discussions and interviews with great pianists, the differences between what they say about technique are at times almost comical. One pianist swears by five hours of scales per day; another says scales are useless. One pianist says technique is all about relaxation, another says he stays fit and muscled like an acrobat. And even among good teachers, pedagogically useful images may not be scientifically accurate. Keeping this distinction (scientific description versus felt sensation) in mind helps to see past this confusion.
- Watching great pianists is always interesting, but a lot of what goes on in advanced pianism is almost invisible, involving coordinations which are extremely subtle and almost impossible to observe - especially from a distance and when the performer is playing at full speed.

- Knowing tried and true general principles can help you to improve. But reading is no substitute for a good teacher who can help to pinpoint problems in a given situation, and thus save much wasteful trial and error.
- Many of the sensations described here can only be experienced with a properly regulated piano. Uneven action, poor repetition, inconsistent escapement, etc., will only leave you wondering if the problem is you or the piano. If you are serious about becoming a good pianist, spend a few hundred dollars to get your piano regulated by a good technician; it is an essential investment.

### **Assumptions**

I make certain assumptions here about the physical side of piano playing. Although some may disagree, these assumptions are fairly widely accepted by many fine pianists.

- Any physically normal person can achieve a fairly high level of technical proficiency, given good teaching and enough practice. This does not mean that anybody can be a great pianist, but that the physical skills required to navigate the keyboard are not so difficult as to exclude most people.
- Piano playing should never cause physical pain, or do physical damage to the pianist. If it does (and provided there is no pre-existing medical problem) you are doing it wrong!
- The general principles given here are widely applicable, however the details of which positions and movements to employ in a given situation will vary according to the individual. People's bodies differ. Also, there are acceptable variations in many situations.
- The difficulties in piano playing mainly involve learning fine coordinations, not building strength. Pressing down piano keys is not a strenuous activity. (The "weakness" of the fourth finger is not really a muscular problem but rather a perfectly normal anatomical situation.)
- The two most important criteria remain:
  - Does it sound musically convincing?
  - Is it physically comfortable?

### **Sound: touch and tone**

*“Piano tone colour thus depends not on a single note, but on the combination and interrelation of tones”.* (Samuel Feinberg)

A word is needed here about the issue of tone, the way the piano actually sounds. Apart from the quality of the instrument itself (and of the technician!) the pianist directly controls very few aspects of any single note's sound:

- when the note starts and stops,
- how quickly it is hit (velocity),
- whether or not it is pedaled.

That is all! So why does every great pianist have a personal, recognizable sound? What makes for a "beautiful tone"? The answers depend on the relationships between the notes, successive and simultaneous. By far the most common weakness in pianists who are technically relatively proficient, but whose sound is unimpressive, is due to unimportant notes in a line receiving undue accents, and to insufficient distinction between planes of tone, e.g. melody and accompaniment.

- The timing, relative loudness, and the duration of the successive notes within a phrase, the ways of connecting tones - various degrees of separation or overlap, pedaled and/or fingered, corresponding to the shape and character of the line - create articulate, “singing” line. Playing where all notes are equal sound dead and mechanical.

- The timing, relative loudness, and duration of notes sounding simultaneously create multiple planes of tone, allowing the pianist to suggest varied musical textures. Some textures require consistent planes of tone over a whole phrase, e.g. bringing out a melodic line; others require adjusting certain notes/chords in relation to other individual notes/chords, e.g. voicing a chord to momentarily bring out a middle voice, playing the top notes of an arpeggio as "resonance" to the lower ones, etc. As anyone who has listened to a computer program playing a piano piece knows, chords which are unvoiced - all the notes are played equally - sound brittle and harsh.

The pianist thus needs to develop a double sensitivity to sound: musical and physical. Again, this sensitivity is much more about relationships between tones than about individual notes.

"Singing tone" is an important goal for a pianist. How can this be accomplished? To understand this, we need to compare the piano and the voice. Singers control a note all through its evolution, not just at its attack; a piano cannot. Singers must stop regularly to breathe; pianists can go on much longer without stopping. These facts have important implications:

- Long notes on the piano must be played somewhat louder than shorter notes, to give them a chance of sustaining.
- Singers never accidentally accent short notes which follow a long note: The loss of breath makes this unnatural for them. For a pianist, such accents happen all too easily. The pianist must listen all the way through the long notes, so as to correctly gauge the next note's force. Unintended accents, on unimportant notes, will ruin the vocal character of a phrase.
- No two successive notes are ever alike when sung. Therefore, overly equal playing on the piano never sounds vocal. Each note's force must be proportional to its place in the phrase. Understanding the musical structure is essential (although this goes beyond the scope of this essay).
- The feeling of breathing at phrase points can be simulated on the piano by regularly starting new impulse groups.

### **Pedaling**

Chopin (in some sources, Liszt, or Anton Rubinstein) is reputed to have said that the (right) sustaining pedal is the soul of the piano. The key is to think of this pedal as a resonance control, not just a sustain switch. Pedaling greatly influences the overall sound of the piano, and will also vary with the room, the instrument, the musical conception, etc. The sustain pedal is not just an off/on switch, but, on a well regulated instrument, usable in many gradations, to obtain various degrees of legato and resonance. Subtleties of pedaling include:

- Gauging the loudness of successive notes/chords within one harmony, according to the remaining pedal resonance, sometimes called "playing on the overtones".
- Using short washes of pedal to suggest subtle background planes of tone, adding depth and richness to the sound at key moments in a phrase.
- Using the pedal progressively within a phrase, to create a resonant crescendo.
- Opening the dampers completely before playing, sometimes to pick up resonance from other instruments before starting to play, e.g. in chamber music.

For more detailed information on pedaling, in various styles, see the book by Joseph Banowetz, in the bibliography.

## Rhythm and tempo

Musical rhythm is intimately related to physical rhythm, which has its origin in repetitive movements (like walking) and breathing. A good musician must be able to maintain a stable tempo, but this does not mean playing mechanically. There is a good deal of misconception around this point, so it is worth clarifying. Many great musicians have insisted that tempo must be fluid – e.g. Beethoven’s “elastic beat”, or Chopin’s description of “tempo rubato”. This means that around a basic, stable, pulsation, there will be very slight anticipations and hesitations, according to the musical character and structure. For both technical and musical reasons, the pianist needs to breathe at cadences, and even at various smaller articulations within a phrase. This requires adding very small amounts of time. There are also places where even a pianist with a perfect technique will take a little extra time, for example when leaping between two different registers from one phrase to another, or when passing from a very loud passage to a much softer one. Listening to, say, a computer play such passages without micro-pauses, makes it clear that they sound worse when played absolutely evenly, not better.

**N.B.** The listener must never notice these micro-rhythmic changes as anything other than musical phrasing. If the listener feels that the tempo has changed, you are taking too much time.

## What makes a great pianist?

This essay is meant for people who love the piano and who want to improve their playing. However, it is worth reminding ourselves what makes a truly great pianist, above and beyond "normal" musicality and physical skill. When hearing artists like Michelangeli, Richter, Gilels, Horowitz, (to name only four I have heard in person) and other such masters at their best, what strikes one as surpassing about them is:

- ease: The technique, however transcendent, is not felt as something distinct from the music;
- personality: The pianist has an individual, beautiful, sound;
- simplicity and directness of line: Musical intelligence holds the work together, and communicates it as a single, unified statement;
- sensitivity: Every detail is given its rightful place; there is also meaningful variety of detail;
- richness of texture: Multiple musical planes of tone give a sense of depth;
- excitement, but always under control;
- emotional range: Great pianists can convincingly play music of many different styles and characters;
- and finally, the rarest quality of all: The ability to speak, intimately, to individual members of the audience, no matter how big the hall, no matter how many are present.

## Learning the music

### The musical conception

*“The ‘what’ determines the ‘how’”.* (The Art of the Piano, Heinrich Neuhaus, p. 12, French edition).

Technique is means to an end. Although there is sometimes an acrobatic aspect to piano playing, the piano repertoire is enormous, and filled with masterpieces, not all of which are showy. Also, even a light, acrobatic piece can be played with elegance and panache. The aim is always to play the music, and the music is more than just the notes. The pianist's movements and positions depend not just on the relationship between his body and the physical layout of the keys, but also on the character of the passage, the tempo, (including subtle flexibility where needed), decisions about which notes need

emphasis and which do not, the relation of various planes of tone (e.g. melody and accompaniment), and so forth. Decisions about movements which are made without reference to musical issues can only lead to crude, insensitive playing. Technique is best thought of as an efficient way of using the pianist's body, in the service of a clear musical conception.

Realizing a musical conception concretely has three stages:

1. Imagine the desired musical result.
2. Find a physically comfortable coordination to make it real.
3. Aurally check the result, and adjust as needed (feedback).

### **Learning the notes**

When learning a new piece, the pianist has to not only read the notes, but also to learn them physically. Obviously, the better your understanding of the musical patterns - form, harmony, etc. - the faster you will learn them in the music. In learning at the piano, meaningful musical patterns will determine technical choreography. As a basic principle, aim to learn the music by musical units: phrases, voices, and sections, rather than, say, a page or a line at a time. It is often useful to learn the notes at slow to moderate speed, playing rather firmly, always respecting the rhythm. Try to learn each section at a constant tempo, rather than slowing down and speeding up according to the difficulty of each bar: Control over tempo is vital to good musicianship. When you spot a difficult passage, do not repeat it until you are sure of how to best organise your movements; otherwise you risk imprinting wrong coordinations, which will just make your job harder. Rehearsing these passages first mentally, away from the piano, allows you to try out various solutions without developing "muscle memory" for the useless ones.

Learning the notes is an exercise in memory: You want to remember what is coming next, enough in advance, to be properly prepared for it, physically and mentally, so as not to rush there at the last minute. This involves a kind of conditioning: You create associations at key points, triggering the memory of what comes next. Since it involves muscle memory, it is useful to keep to hands poised, lightly in touch with the keys, while reading the music. Removing the hands completely, or completely relaxing them, requires you to re-orient yourself at the keyboard in mid-phrase. Relaxation points should therefore be placed in musically logical places from the start. It is also important to plan these "release" points from the start, so as to pace the performance, and, especially, to avoid buildup of tension. The more you are under stress, e.g. during a performance, the more necessary it is to have such a well learned scheme of muscular "breathing".

Learning the notes is only a first step to learning the music. As discussed above, you are aiming to develop a musical conception of the piece. As the conception becomes clearer, you will gradually find the appropriate movements and sensations to express all the aspects of the music.

Once past the preliminary reading of the notes, your practicing will change over time. In general, there are two stages:

1. Work out the physical groupings (positions and alignment as well as shifts) required. If the shifts are not coordinated in simple, obvious ways with musical patterns, it can be useful to actually mark them into the music, to avoid confusion between visual and physical groupings. As mentioned above, for difficult passages this is best done mentally, away from the piano. Only when you are fairly sure of the way your movements must be organised should you begin intensive physical practice.
2. Work out whatever body rhythms are required. These must be first practiced slowly and then, if the music is fast, reduced in size, at full tempo. It may be useful in complex passage work to first simplify the music (see below).

These two stages are not rigid; there is often movement back and forth between them. But it is important to be aware of what one is aiming at, with each stage. Careful listening is always essential; it will often also lead to refining alignment and refining body rhythm.

### **Chaining: putting the piece together**

Once you have worked out and mastered the varied technical coordinations required in each (sub)section of a given piece, the next step is to chain them together. Such "chaining" means that you are always thinking of one movement as a preparation for the next one. The release, or follow-through, of each movement is transitive: It is directed towards the coming position/movement, physically reflecting the continuity of the music. One movement flows into another, without hard stops or square edges in between. A useful mental trick is to pretend that the last movement or note in one group "causes" the next one.

Although one normally should practice in musical units - phrases, motives, etc. - at this stage it may be useful to practice across them, since they eventually must all be chained together continuously. However, when working across groups in this way, it is important to keep physically and musically "breathing" in appropriate places, so as not to rush the joints between phrases.

### **Practicing**

Before discussing technical issues more concretely, a few words about how to practice. Practicing is learning, both musical and physical. Practicing is a musical activity, not just repetitive drill. All practice should aim for musically satisfying results; unmusical practice will not lead to musical playing. Practicing should also ultimately be directed at performance, otherwise essential steps may be omitted.

The basic tool of good practicing is directed attention. In general, moderate practice, with full concentration, leads much more quickly to good results than lengthy, mindless drill. The pianist, in effect, choreographs his mind and body to move in a certain way, at a certain time, mentally triggered by something specific in the music (e.g.: On the Bb at the end of the phrase, my arm starts to move left, preparing the shift required for the next chord). The principal goal of practicing is to find and "imprint" the movements/sensations which reliably and comfortably lead to the desired musical result.

This notion of directed attention is so important that it merits further discussion. Pianistic difficulties are usually limited to certain parts of a piece, or certain situations. Focused practicing means avoiding distraction, in particular:

- Work locally, only on problem areas. The more you focus your work on the real problem, the faster you will solve it.
- Stop and think: As William Newman points out, it is better to hesitate than to make a mistake. If, after playing a passage a few times, you make a certain mistake consistently, you need to find out what is wrong, and to determine exactly when in the music you need to mentally prepare for the correct movement. Practice stopping completely at that point, focus on whatever needs to be changed, and only go on when you are sure of getting it right. After a few times, you will have conditioned yourself to think correctly at the appropriate spot, and you can make the pauses smaller.
- Find out exactly what is wrong, and invent a simplification which will help correct the real problem. "What is wrong" has two aspects: the sound, and the movement/sensation.
- Sometimes it is enough to simply pay attention to the sound; sometimes you also need to choreograph a different coordination.
- Sometimes, it can be useful to do (and even exaggerate) the opposite of a problem to gain control of it. For example, I often tend to speed up in difficult passage work, especially if I am nervous.

Knowing this, I will first determine the exact places I speed up, and then deliberately practice slowing down at those spots. This has the double function of making me more aware of the problem, and giving me the feeling of being in control, being able to slow down as needed.

Note that slow practice and playing hands separately - the most common kinds of simplification - are not always the best ways to approach difficulties. A movement which is comfortable for a slow passage may be totally wrong for the same passage played fast. For example double thirds can be played legato when slow, but often must be dealt with as impulse groups when fast. The sensation is entirely different. Working the hands individually can be useful, but most of the time the hands need to be sensed in a coordinated way; sometimes one hand can actually help the other.

Here are a few useful ideas for focused practicing:

- Simplification, or outlining, helps in learning the notes, as well as in solving technical problems. The idea is to find the main musical and technical "turning points" in the figuration, and to begin practicing only with these. As explained below (impulse playing, body rhythm) many passages require a clear starting impulse to trigger figuration. These impulses can first be practiced alone; then the other notes can be added around them.
- Exaggeration: When first learning a complex movement sequence, it is easier to imprint the inner sensations if they are strong and clear. Economy comes later. Exaggeration of desired aspects, e.g. groupings, articulations, helps to focus on them..
- Reduction of movements for speed: As practicing gets faster, you will need to decrease the size of your movements, for efficiency.
- There are many things which will require more than one pass to really learn. As a rule, if you are trying to imprint something, say the physical groupings/shifts in a given passage, it is not advisable to repeat it more than three or four times in a row, since your mind will begin to wander, and mindless practice is not much use. Repeat difficult passages three or four times, move on to something else, and return a little later.
- Create exercises based on the music itself. The exercise should be worked until it can be done with a musical sound and with comfortable, flowing movements. Samuel Feinberg suggests some excellent guidelines for constructing such exercises:
  - The exercise should be as short as possible.
  - The exercise should focus on one difficulty at a time.
  - The exercise should be easier than the difficulty you are trying to resolve.
  - The exercise should allow for rapid progress. (If not, you have built the wrong exercise!)
  - Often, making a "loop" of a short difficult passage, which can be played first slowly and then faster, is very efficient.

A word about the use and misuse of the metronome. The metronome is an excellent diagnostic tool for finding out where tempo changes should and should not occur. However, it is neither a source of, nor a substitute for, a good sense of musical rhythm. As described above, phrasing must be organic, not mechanical. Playing for long stretches with the metronome actually stifles musical respiration. The best use of the metronome is for setting an initial tempo, and then for checking it occasionally. Eventually, a musician develops an internal sense of tempo, in place of the metronome. One way to do this is to search for a short passage in a given section, which you can play reliably at the appropriate tempo, and then use this as your "tempo tester".



## Technical principles

### Characteristics of coordinated movement

Playing the piano is a very refined physical skill, requiring extremely delicate coordination and control. Well coordinated movements of the body, in any context, have the following in common:

- They are efficient and economical: They do not use more energy than required. Movements are no larger than needed. The parts of the body not in use remain relatively quiet and free of excess tension.
- They **flow**; they do not feel abrupt or jerky. Shifts feel **prepared**, i.e. the pianist never feels rushed when getting into position for a given passage. (This can involve very refined micro-timing.)
- They are **comfortable**, not in the sense of being easy, but in the sense of not feeling strained.
- When they are repeated or periodic, they look and feel naturally **rhythmic**.
- They start from (and, if necessary, return to) a comfortable "basic" body position.

These are objectives, not starting points; achieving these goals requires careful, concentrated practice.

**N.B.** It is important to realize that, neurologically speaking, inhibition is just as important as excitation. Although nobody would argue that good technique should feel "inhibited", to achieve refinement with motor skills often involves learning to suppress superfluous or excess movements. Once mastered, this inhibition will of course not feel stiff.

### The fingers and the hand

It seems trivially obvious that the piano is played with the fingers. And indeed, the evolutionary structure of the human hand - four fingers for fine work, combined with an opposing thumb for grasping - defines many of the possibilities and the limits of piano technique. The possibility of very quick successions, where one finger follows another, and the refinement of sensation and of action of which the fingers are capable - these are among the enabling gifts evolution has provided the pianist. The beginning pianist needs much work to learn precise control of successive and simultaneous finger movements.

Because of the refinement of which they are capable, the fingers are most useful in piano playing for control of subtle details, especially in achieving the variety and richness of sound, as well as the consistent and subtle articulation which are heard in the best playing. Most pianists use a variety of finger strokes, often including:

- a vigorous attack (a finger "slap"), used for individual accented notes, or to set off impulse groups. Often ornaments (mordents, etc.) are played in this way,
- a light scratching or wiping movement, used for non legato playing,
- a more vertical stroke, useful for a sharper staccato,
- a very articulate non-legato: The notes are not connected, but also not quite staccato,
- legato overlapping.

Despite the considerable preliminary work required of a beginner to master finger independence and coordination, he must realise that the fingers do not exist in isolation: They are attached and anchored in the wrist and the arm, and, ultimately, in the trunk, sitting on the piano bench. Since the range and the strength of the fingers alone are very limited, the arm is needed to move them around the keyboard, and to reinforce them when power is required. Further, as we shall see below, the pianist's

body (not just the arms) has a very important role to play in music making in general. A good way of describing the appropriate relationship between the pianist's fingers and the arm/body is to imagine them as always feeling connected. Unconnected, ungrounded, the fingers are weak and not well adapted to the wide, straight line geography of the piano keyboard.

The fingers cannot feel connected without support in the hand, specifically in the knuckle and finger joints: these should be firm, although not tense. Some teachers call this “supported” position of the knuckles the “bridge” (or “arch”). Signs of lack of support include collapsed knuckles, and, frequently, a “pumping” action when playing single note passages (which should really be smooth); this makes for a bumpy sound. For the student who has trouble achieving this firm bridge position (which is essential for fine finger control), it may be useful to practice applying light pressure with the other hand, from above, on the knuckles. Apply just enough resistance to firm up the bridge; excess pressure will lead to stiffness. When practicing this way, it is especially important not to freeze the wrist, as muscular contraction has a natural tendency to spread. The simplest way to ensure this is to keep moving: Rigidity makes for ugly sound and uncomfortable playing.

When the fingers are thus connected and supported, and with the active participation of the larger units of the body, it is easy to add force, to position the fingers comfortably in relation to the keys, and to feel the music's rhythm in all its physical, expressive power.

The keyboard is organised geometrically in straight lines; the human body is not. This, as well as the fact that the music often creates patterns which follow neither the keyboard nor the hand, is the source of pianistic difficulties. Of the three - music, keyboard, body - only the body can be easily moved around!

Chopin seems to have been the first to point out that because of the bilateral symmetry of the human body, and also because of the differing lengths of the fingers, the simplest and most natural position for the hands on the piano is approximately that of a B major scale, in the middle of the keyboard, starting on E and going up in the right hand, and starting on B and going down in the left hand. The longer fingers rest on the black keys, and the hands mirror each other. (Note that although the hands are symmetrical with each other, they are not symmetrical internally: The thumb, designed by evolution to function in opposition to the other fingers, often needs to function at the piano, against its nature, similarly to the other fingers. This fact is at the root of many difficulties in piano playing. Because the hands are not internally symmetrical, many passages involving alternating up and down movement, e.g. Chopin's Etude op. 10 #1, require different movements when the hand is ascending than when it descends.)

Several things are significant about this "neutral", "natural", hand position, which is analogous to what might call the "core" position in physical training:

- the hands are symmetrical in relation to each other,
- the fingers are centered in front of the wrists and arm,
- the hands play neither completely over the white notes, not completely over the black notes,
- the fingers are neither very compressed nor very extended,
- the knuckle joints normally are lined up with a slight outward slant (i.e. not perfectly parallel to the keyboard).

Most preliminary exercises for beginners should be done symmetrically (i.e. in contrary motion), and in this centered, neutral position. Many difficulties at the piano arise from the need for independence between the hands in non-symmetrical passage work, as well as from prolonged extension or contraction. It is useful to think of the latter (both extension and contraction) as exceptional positions, which should always return to the normal, more comfortable, neutral position.

Finding the most comfortable relationship between the fingers and the rest of the body for a

particular musical situation is a central problem in piano technique. Often quite small changes in the angle between fingers and the arm/body can make things much more (or less) comfortable and efficient: A little sensitive experimentation is often required to find the best position(s) for a difficult passage.

### Positions and alignment

*“The finger which plays should be in a straight line with its flexor and extensor muscles.”*  
(Gyorgy Sandor, *On Piano Playing*, p. 61.)

*“Often pupils struggle with difficult passages and declare them impossible, when a mere change of hand position, such as raising or lowering the wrist or slanting the hand laterally, would solve the problem.”* (Josef Lhevinne, *Basic Principles in Piano Playing*, p. 34.)

Even when the fingers are supported and poised in Chopin's suggested basic position, one cannot comfortably play all five notes without a minimum of arm movement.

These arm movements will be guided by the principle of **alignment**. Whichever finger is playing should always be lined up with the arm behind it as centrally as possible. In fact, for purposes of alignment, one can almost think of the finger as an extension of the arm. As mentioned above, the finger joints should not be collapsed; otherwise, the fingers lose the connection with the rest of the body, the energy will not get to the keys efficiently, and it will be harder to achieve fine control, because of this (inconsistent) energy loss. The fingers should also not be splayed out above the keyboard, but rather will normally remain close to the notes, ready to play. If not, critical time will be wasted getting into position at the last minute. Also, the pianist's all important sense of where he is on the keyboard will be lost. An experienced pianist develops an inner, sensory, map of the keyboard. One way to encourage this is to play "blind", i.e. without looking at every note. You will quickly discover that this is much easier to do by keeping your muscles very mildly "alive". Complete release tends to "let go" of the inner, physical sense of where you are on the keyboard. The book (see the bibliography) by Seymour Fink provides some useful exercises for developing this kinaesthetic sense.

When playing double notes or chords, align the arm with the average center of the fingers' positions. If you want to bring out one note in a chord, angle more behind that note's finger.

The wrist needs to be flexible, to "breathe", without being flabby. Once again, the goal is not to break the line of energy between the arm and the fingers, but to remain constantly connected with the instrument: The wrist is loose but ready to move. This "breathing" - which allows a periodic release of tension - is critical to avoiding strain, and also to allowing the pianist to "reset", or "restart" regularly during the music: Tension thus never builds up for long.

In any kind of even moderately spread out passage work, the notion of the arm as "the motor aligned behind the fingers" means that your arm will be constantly moving. In a passage like the wide, quick arpeggios in the left hand of the last movement of Chopin's 3<sup>rd</sup> sonata, your arm will be constantly swinging back and forth in an arc; you should not feel like you are stretching. Here is a simpler example of this kind of figuration (the swinging movement will be smaller):



If you feel that you are stretching while doing a passage like this, you are not moving your arm enough. The wider the layout of the passage, the farther back towards your body you will have to go to get enough range of movement. For small range passage work, the wrist and forearm will suffice; for wider range, you often will be moving the upper arm. In extreme cases, you will be swinging your whole trunk.

Because of the fact that the thumb is shorter than the other fingers, the arc usually starts slightly low when moving away from the body. Conversely, it will move from a higher position towards a lower one when heading inward to the thumb. (Again, since the hands are not internally symmetrical, the movements to and from the body within each hand are not identical.) When leaving the centre of the keyboard, the elbow also changes position correspondingly: When the music moves substantially outward from the body, it remains more or less “tucked in”; when the music is coming inward it moves out, to put the thumb in a better position to play.

So, for the right hand (the graphics are exaggerated):



starting from thumb and moving out;



starting from outside, moving in towards the thumb.

When changing direction at the extremes of the keyboard, during continuous passagework, the change should be a smooth curve, not a sudden bump.

**N.B.** These movements are subtle; overdoing them will result in loss of balance. Also, they are more obvious as the hand leaves the centre of the keyboard.

The thumb affects alignment in important ways.

1. In passages where the thumb and the outer fingers both play on the white keys, the hand is positioned slightly back (i.e. closer to the player), out of the way of the black keys. Seymour Fink calls this the "white position". The thumb will be slightly farther back than the other fingers, allowing the wrist to be centred behind the middle finger.



2. In passages where the thumb and outer finger both play on the black keys, the hand must be positioned forward, in what Seymour Fink calls the "black position". The wrist will be higher than in "white" position, and slightly turned inward, to accommodate the forward position of the thumb on a black key.



3. If the outer finger plays on a black key, but the thumb plays a white note, the arm/wrist will be angled slightly outward, to maintain straight line alignment between arm and hand.



4. If the thumb plays on a black key but the outer finger plays a white note, the wrist/arm will be angled slightly inward, again to maintain straight line alignment between arm and hand.



In the latter two situations, it may also be useful to slightly tilt the arm, or even the body, to make the hand position feel less twisted.

There are also other “intermediate” positions, between these four, depending on which middle fingers play on black or white notes, but they are not worth detailing further.

As you leave the center of the keyboard, the arms, (especially when both hands are playing at one extreme), the whole trunk will need to move sideways.

You will often need to consciously map out these positions, until they become automatic.

In practice, movement between them will often be somewhat fluid, due to the constantly changing requirements of the passagework, but they are points of reference to be worked around, extremely important to feeling comfortable at the keyboard.

Here is an example, from the coda of Chopin’s Fourth Ballade:

The image shows two staves of musical notation. The upper staff is a simplified chordal representation of the music, with large numbers (2, 1, 4, 3, 1, 4, 2, 3, 2, 4, 2, 4, 1) above it indicating four positions. The lower staff is the original music, with suggested fingerings written below the notes. The key signature is three flats (B-flat, E-flat, A-flat) and the time signature is 3/4.

The lower staff contains the original music (notation slightly simplified; Chopin’s occasional polyphonic notation does not affect our discussion here), along with a suggested fingering. The upper staff groups the notes into positions, as chordal blocks; the large numbers above the staff refer to the four positions described above.

To maintain alignment when leaving the center of the keyboard, you have to be on the sitz-bones in your behind, rather than comfortably spread out back on the seat. Poised this way, seated forward on the bench, you remain grounded, but also easily mobile in any direction. Your body is actively ready to move, instead of passive and resting.

In intricate passagework, the difference between feeling comfortably aligned and feeling awkward can be quite subtle. Often tension or awkwardness can be relieved by very slight adjustments to the angle of the hand and arm. Experiment!

### Shifts and leaps

This brings us to the issue of shifts. There are two basic types of shifts are sideways (up and down the keyboard) and in-out (“drawer”, to accommodate black keys). Often they are combined. The goal of a shift is always to put you into a comfortable position for the coming notes. It is a good idea to practice shifts by “blocking”: Move into an entire position, rather than just to one single note. This also encourages or contributes to seeing the music in musically meaningful groups (motives and phrases), rather than as single notes.

It is useful to examine the position shifts in a given passage in detail, and to try alternate fingerings, involving different shifts. It is important to choreograph the shifts very specifically: You decide, consciously, that the best place to shift to the new position is between notes x and y - usually it will be a few notes before the awkward spot, i.e. the shift is prepared. You practice the passage, trying to imagine that the note where the shift starts triggers - I think of it as “causes” - the shift.

While in the passages discussed above the arm shifts gradually to “center” each note, there are

situations where more abrupt shifts are required. Here is an example:



These shifts again underline the need for preparation: Ideally the arm should be in position before the note in the new region is played. In fast passages however, sometimes the shifting movement itself turns into a dive into the note. The curve for a leap to a higher note (or chord)s is as follows; a downward leap will be the reverse.



The reason for this curve is that the descent into a note must be fairly vertical, so as not to arrive on the side of the key; the rise is already moving towards the new position.

In alternating passages, like the above, the arm will feel like it is making continuous, symmetrical arcs, with contact points at the keyboard, in the course of a continuous, rhythmic movement. As the speed gets greater, the height of the arcs and the amount of time in the air diminish.

Practice ideas for leaping shifts:

- Practice at slow tempo, but make the shifts at full speed.
- Look at the goal note in advance. If both hands are leaping at the same time, look at the hand moving farther.
- "Touch, then play": You lightly touch and prepare the distant note/chord before actually playing it. This requires the smallest of micro-pauses, which, however is usually musically quite logical, since this kind of texture actually implies two musical "planes".
- In a rapid shift from a phrase in one register to a new phrase in another register, the body should lean towards the new register during the last few notes of the first phrase. If both hands are leaping outward, the body movement is determined by the larger leap.

All of these techniques aim to make the pianist feel comfortable, not rushed, as he arrives at the new position. To achieve this comfort requires a well developed sensory map of the keyboard, and the utmost economy of movement.

## Fingering

*"[...] a given fingering pattern defines the possibilities for arm movement."* (Mastering Piano Technique, Seymour Fink, p. 60.)

By this point, it should be obvious that fingering can never be separated from what the arm is doing. Fingering will naturally break the music into groups - positions - which, as much as possible, should make musical sense. These groups will be connected by flowing arm movements. Hands vary in size and flexibility; a fingering which is good for a large hand will often feel strained for a small hand. If your hand feels stretched, or stiff, you need to change the fingering, the arm movements, or both. Occasionally fingerings are chosen to force specific musical effects, e.g. a break before a specific note. As long as the appropriate arm movement backs up the unusual fingering, this is fine.

An important note: What is traditionally called "passing the thumb under" is a misnomer. Contorting the hand in such a drastic way usually puts you badly out of alignment for the coming notes. What really happens here, if the scale or arpeggio is at moderate or greater speed, is that once the thumb has played its first note, it begins to move towards the next group position, and, by the time it arrives under the rest of the hand, the arm is also well on the way to its next position.

The standard fingerings for scales and arpeggios should be familiar, and are worth trying out as a first step, but they should not be considered as absolute rules. In particular, the rule about not using the thumb on black keys is often misleading. Placing the thumb on a black key does require shifting the arm forward (a "drawer shift") and raising the wrist slightly, but it makes some passage work far easier.

Here is an example of where to use a standard fingering (the first bar), and where a less conventional one is better (the second bar). The accents require no particular effort if the passage is fingered as written. Reversing the fingerings given here would make for unmusical, awkward playing.



Note that when playing arpeggios, the arm shift should not feel like it is happening one note at a time, but rather as though the center of the hand is gradually moving. Sometimes it is helpful to imagine that the arm is "driving" the fingers.

Although the following advice is not always possible to follow, all other things being equal:

- Try to organize fingering/shifts into rhythmically regular groups.
- Given a choice between fingerings which require many shifts or few, aim for fewer shifts.
- The same musical pattern should usually be played with the same fingering, regardless of the presence or absence of black notes.
- Try to make shifts in both hands at the same time, when possible.

### Impulse groups

Now, an essential notion: playing in groups. Impulse groups allow you to play faster than you could with distinct, separate movements. Note by note playing sounds heavy and unmusical, and it is downright impossible during rapid passagework. In all but the slowest tempi, you will normally be playing groups of notes, set off by a somewhat stronger impulse than those which will follow. This first impulse will come from above the playing unit: A finger group is set off by a wrist impulse; a wrist group (e.g. a series of quiet double notes or octaves) is set off by an arm impulse, and so on.

You use a lively, uninhibited, "falling" (or, for very vigorous passages, a "throwing") movement, to set off the group. The attack is not limp, but spring-like. This sensation of an uninhibited, "free" movement into the keyboard is mentioned by many pianists; it seems to help the body to gauge distances and intensity more accurately than a tense, over-controlled movement. The notes following the initial impulse are not felt as separate movements, but as filling out the group. These secondary notes feel like rebounds, or continuations of the initial impulse, and their movements are smaller. They show the combination of vigour and ease seen in well-trained athletes.

The vigorous, clean fall, or throw, sets off an impulse group. Most typically seen when playing a few quick octaves in a row, this is also the best way to play double notes - especially wide intervals - at medium to high speed. Again, the first impulse (the falling, or throwing movement) comes from a part of your body above the one doing the actual playing. So if you want a rapid finger staccato, you



need to use at least the wrist to generate the impulse. If you want octaves, you need to trigger the group with (at least) the forearm, and then "shake" the remaining notes out of your sleeve. If you need more power, or are playing full chords, you will generate the starting impulse from the upper arm, or even the torso. If you want to get the feeling of producing an impulse all the way from your core, do it while abruptly exhaling and saying "FFFT". Throw into the keyboard as you pronounce this, playing one single octave, rather loud, feeling the energy going forward and down into the keys. It should feel like you are playing the octave with your whole upper body. This is appropriate for loud, very energetic attacks.

Note that there is an approach phase (the fall or throw), and a release phase, after the group. Without the release phase you will freeze up with tension: The movement must breathe. This short relaxation, between successive main (i.e. group starting) attacks, is critical, both to physical comfort and to musical playing.

The best way to develop a feel for this rebounding sensation is to practice quick groups of repeated chords or octaves. Start with one solid attack, then add one, then two, and finally three shaking rebounds. In between, make sure the wrist breathes.



Once you can do this, move up or down in scales rather than repeating the same chord.



Sometimes it is musically necessary to place the accent at the end of the group; in this case the first notes bounce towards a main arrival point, the earlier notes acting as grace notes. The initial impulse is the same, but the final note or chord gets an additional, forward moving accent. To work on this, practice the above two exercises, but place the accent on the last note.

Here is an example of double thirds, to be played very fast. Use the same shaking coordination, and make no attempt to play legato. Fall on the first chord, then rebound for the others.



All the examples of impulse groups given so far have involved repeated, rebounding movements, coming from the wrist or higher. However there is another essential type of group impulse playing: fingered groups. Here, a succession of fingers is still felt as one unit. The first note in such a finger group comes from a miniature "fall", which feels like slapping the finger, or it may come from a wrist, or even an arm impulse, depending on what precedes the group, and how loud it is. Fingered impulse groups require special attention, to make sure you don't miss notes when going fast.

Here are some typical examples:



In the first two bars the finger groups are set off by the first note; the latter two are aimed at the last note. This is the way ornaments should be played.

Fingered groups may also be sub-groupings, set off by larger, rhythmic wrist and arm impulses (see body rhythm, below). In the middle of a continuous passage, such a subgroup can be triggered by the finger slap described above, where one finger is lifted a bit higher than normal, or by a larger arm movement. In either case, the trigger vigorously sets off the new group. This kind of "hierarchical" grouping leads us to our next subject: body rhythm.

### Body rhythm

*Rhythm in this sense, the integration of sound and movement, can play a great role in coordinating and invigorating basic locomotor movement.* (Oliver Sachs, Musicophilia, p.241)

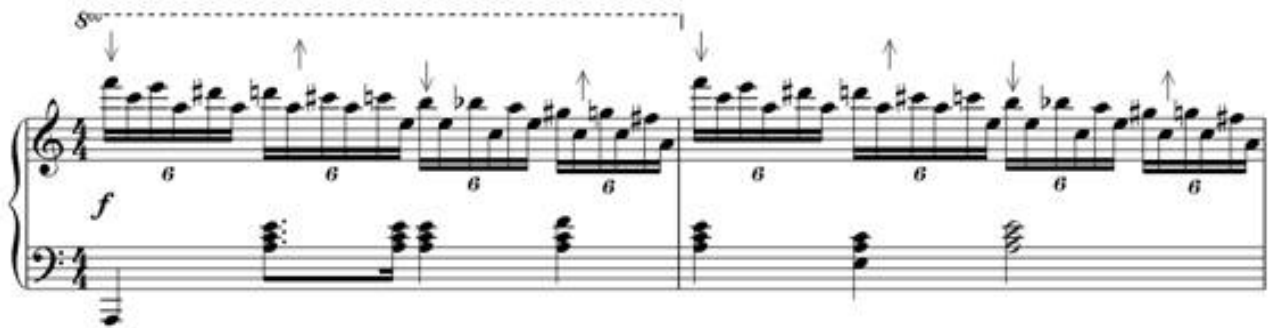
Apart from the swaying movements common to virtually all musicians during playing, reflecting the ebb and flow of the music, there is one situation where body rhythm becomes absolutely critical in piano technique. There is a limit to how many successive notes you can subsume under one single impulse, and this is where body rhythm comes in. In playing something like the beginning of Ondine, from Ravel's Gaspard de la Nuit, or Variation #1 from Brahms' Paganini Variations, you need to rhythmically generate new impulses at regular musical intervals. Depending on the speed required, these groups could be as short as two notes, or as long as eight or nine. A swinging body rhythm regularly throws out renewed impulses to trigger new groups. It feels like you are doing little dance with your body core, in time with the music. The rhythm will energize you and allow you to produce many groups in succession, without freezing up. In very fast passages, the release and the new attack will link into one, smaller, continuous movement.

Body rhythm should not be visually distracting to the audience: While it may help to practice it with large movements, eventually it needs to be reduced to subtler proportions.

Combining of impulse groups into larger units, through body rhythm, acts as a "reset button". In continuous passagework, the inner groups will often be triggered by smaller initiating movements - sometimes just a finger slap. Without these new triggers, tension will take over and you will lose control. **The key to using impulse groups in continuous passagework is these regular, rhythmic restarts.**

If we take the Chopin Etude op 25 # 11, in A minor ("Winter Wind"), we can illustrate several of these points. This etude is non-stop, very fast, and the right hand wanders all over the top half of the keyboard. To keep it under control, you need a deeply felt rhythmic impulse, from your torso/stomach, which will subsume and coordinate the local figuration. In cases like this, the rhythmic impulse is

easier to feel in the left hand, which plays fewer notes, mainly on the beat. You would first practice the left hand alone, so as to easily feel the physical "swing". The left hand chords should first be practiced with the kind of downward or forward approach described above. Then play the left hand at full speed, at first adding only the notes in the right hand which arrive on the beat, then two notes of each group, and then gradually the remaining notes. You should feel the right hand notes as being "triggered" by the body rhythm, set up by the left hand, coming from your torso/core.



At full speed and with all the notes in place, the arm/wrist will “fall” into the first note of every group (as indicated by the down arrows), and begin to rise a few notes before the next group (more or less as indicated by the up arrows). Some pianists prefer to use as an in-out movement; personally I find it less comfortable.

Once again: Rhythm consists of alternations; to and fro, in and out, up and down. It is very closely linked to the natural sense of breathing. Indeed, good playing feels natural in the way that healthy breathing does: There is an effortless sense of tension and release, of taking in and letting go, of balancing the body from one moment to the next.

Trills are an excellent exercise in higher technique. Playing an even, controlled trill requires using impulse groups. The best way to practice this is first with strong, regular accents during the trill, coming from the arm. It may help to think of these arm movements as “pushing off” the subsequent group. When you can play the trill at a fair speed, reduce these movements (and the accents) until they are barely perceptible.

Feeling a strong physical pulse in this way is also useful even in passages where it is not absolutely necessary; it helps keep control of the tempo, and often helps details fall into place. It also helps counteract nervousness during public performance. As mentioned in the quotation from Oliver Sachs which starts this section, using the body's natural rhythmic responses seems to aid fine coordination in general.

One special situation: fast repeated notes. Play these in groups, set off by upper arm/body rhythmic impulses, and with your hand slightly sideways over the repeated note: This puts all the fingers in position over the repeated note all the time. Fast repeated notes require clean finger articulation combined with strong arm impulses. Avoid any sticking of the fingers on the notes; do not waste any time glued to the key.

### **Refining rhythmic impulse playing**

Sometimes, even if your basic rhythmic impulses are solid, you will find that some details still do not fall into place. In such cases there are invariably small areas which have little, micro-rhythmic faults, subtle unevenness across two or three notes. These defects tend to happen consistently in the same places; you can find them through careful listening. Very often they are in places where it makes musical sense to take the smallest of "breath-pauses" between presentations of a motive, between changes of register, etc. Practice deliberately slowing down at these moments: You take the rhythmic

"smudge", and clarify it, using an opposite rubato. Often this will be enough to solve the problem. You have been playing the group impulse a trifle out of control, and you are learning to inhibit the miniature muscular spurt/spasm which causes the problem.

### **Fine control: playing very slowly and softly**

Slow, very soft passages present a special problem: the pianist may be tempted to stop moving. Such stops break up the physical sense of musical continuity, and usually lead to audible bumps in the sound. Unless there is a sustained period of rest in the music, always keep the arm in mild, rhythmic motion; in this way, such slow, very soft notes will feel like part of the physical "phrase", and will be much easier to control. Here again, a smooth, uninhibited movement into the key is crucial.

### **Tension problems**

Probably the most common problem in piano technique is excess tension. While normal muscle tone is necessary for any physical activity, the fact that such refined coordinations are involved in piano playing, and the fact that one normally plays continuously for long periods, combine to make even minor excess tension potentially very serious. As a resumé of much of what has been said above, I present the following list of common sources of tension, and how to relieve them:

- misalignment of hands, arms, body - try other positions,
- unrelieved extension - plan places for momentary contraction of position,
- not "breathing" regularly - plan reset points,
- rushing within a group - practice slowing down.

### **Virtuosity**

By virtuosity I mean the ability to play extremely fast, in a musically controlled way. Virtuosity is obviously acrobatic, but it also hides a musical challenge: Playing fast alone will not make the result musically convincing.

Great speed requires the most economical movements possible, so as to waste no time. This physical "laziness" must be combined with mental and musical alertness. Choreography must be memorized, and repeated numerous times, until the movements connect completely automatically. At this speed, things happen far too fast to consciously control every note; even a moment of uncertainty will disturb the flow. Hand and arm movements need to be especially fluid. Since there is no time for on-course corrections, stopping the flow of the movement is a cardinal sin: It immediately ruins the group impulse.

The easiest passage to play at top speed is a simple five finger scale: The consecutive use of all five fingers, in a comfortable position, allows for great speed, without complication. As already discussed, this is done as an impulse group.

Taking the basic five finger scale as the most comfortable technical manoeuvre, any of the following will add difficulty:

- longer groups - Subdivision and (preferably regular) reset points are necessities;
- extension (beyond a five finger position) - Extensions must be relaxed as soon as possible, even if only for very short periods of time, to prevent tension buildup;
- changes in hand angle and sideways shifts - These shifts take time, and therefore they should happen in advance of the note where the new position is required;
- repetition - Repeated movements (rebounding chords, octaves, etc.) are always slower than sequential ones. If continuous, they will require reset points, to avoid muscular "jamming". Fast repeated notes require special attention to releasing the note as fast as possible, to make way for the new finger;

- change of direction - When fast passagework changes direction, the change must be made smoothly and economically; curves are always better than straight lines;
- interference - If the other hand is doing different figuration, the combined coordination will require careful overall choreography.

In general, when preparing virtuoso passages, look for the following:

- Where can I reduce size of the movements?
- Can I finger this to allow for more gradual shifting, or less shifting overall?
- Where can I relax for a split second?
- Can I simplify the relationship between the hands?
- Where can I start a new impulse, and set a reset point?

One last suggestion: If the music is very fast but not loud, it is not necessary to reach the bottom of the keys: A more superficial, but swift attack will suffice to sound the notes. Normally, the pianist avoids this kind of “surface” touch: In legato playing a sense of moving along the bottom of the keyboard is very helpful to maintain smoothness; in staccato passages, there is a risk of the note not sounding. But at great speed every economy is critical. The lightening of the touch allows for faster group (impulse) playing.

## **Performing in public**

While some pianists play only for themselves, most advanced pianists aspire to perform. Performing brings several additional challenges to playing the instrument, the main one being dealing with the effects of stress and excitement (adrenalin, etc.). Under performance conditions, it is normal to feel tense and/or shaky, to perspire, and to be distracted by the source of the stress: the audience! Here are a few suggestions for preparing for performance:

- Practice exaggerating the duration and movements of the “reset” points mentioned above; treat them as clear respirations. Since performance tends to make people rush, deliberately use these places as planned relaxation spots. Practicing this way will give you the feeling of staying in control.
- Practice deliberately slowing down during hard passages. This is not because you want to play them slower, but to get used to the feeling of being able to control the pacing of your movements at will.
- Run through your program in front of various people, even a bit before it is perfect. The important thing is to learn what happens to you under stress, and, especially, where in the music it happens. This allows you to then do concentrated work on those spots.
- Record yourself during rehearsals. Perception is affected by stress; often things you think are problems end up sounding fine, and other things become unpleasant surprises.
- To really get a concert program up to comfort level, it must be played in public more than once. After each performance, examine what went well and what went wrong; work on these things before the next time.

## Sources

The ideas expressed here come mainly from various books, as well as from discussion with various pianists and teachers I know personally. All of these people have played and /or taught the piano at a high level. A few of the ideas are my own.

Thanks to Montano Cabezas for explaining and demonstrating to me Marc Durand's approach to piano technique. Thanks to Jimmy Briere and Myriam Gendron for reading a draft of this essay, and for valuable feedback. Thanks to Tan Trao Phi for some very perceptive comments. Thanks to Lauretta Altman for explaining her approach to piano teaching. Special thanks to my colleague and friend Paul Stewart for ongoing discussions about piano technique and piano pedagogy. Thanks to Jean Saulnier for an interesting discussion about the same subjects. Not all these people agree entirely on their approach to the piano, and what I present here does not necessarily represent their respective points of view. However, I have learned from them all. Needless to say, they are not responsible for any mistakes or misunderstandings.

Here is a short, selective, annotated bibliography of books of interest. Note, once again, that some things in these books contradict each other. Partly this is due to the confusion, mentioned in the introduction, between descriptions of the pianist's internal sensations and descriptions of physical facts; partly it stems from differences in approach.

- Barnes, Christopher: *The Russian Piano School*, London, Kahn and Averill, 2007. Essays by various well known Russian piano teachers; the overall usefulness is somewhat uneven, but the first essay, by Samuel Feinberg, is especially good.
- Berman, Boris: *Notes from the Pianist's Bench*, Yale UP, 2000. Practical but subtle discussion of many technical and musical issues, especially tempo and pedaling.
- Banowetz, Joseph: *The Pianist's Guide to Pedaling*, Indiana UP, 1992. Indispensable guide to the subtleties of pedaling.
- Deschaussées, Monique: *Frédéric Chopin, 24 Études - Vers une interprétation*, Éditions van de Velde, Paris. A student of Cortot's gives valuable advice and tips for mastering the Chopin Études.
- Eigeldinger, Jean-Jacques: *Chopin, pianist and teacher, as seen by his pupils*, Cambridge University Press, 1986. A fascinating look at Chopin's (very original) teaching methods.
- Fink, Seymour: *Mastering Piano Technique* (book and accompanying DVD video), Amadeus Press, 1992. An excellent, multi-media resource, useful for pianists of all levels. Prof. Fink describes many "coordinations", demonstrates and explains them clearly, and shows their musical applications. He supplies many exercises based on bilateral symmetry, excellent for beginners/ An excellent example of the modern approach to piano teaching, focusing more on arm movements rather than on the older style standard fingerings.
- Kochevitsky, George: *The Art of Piano Playing*, Summy-Birchard Inc., 1967. Based on the older Russian school, Kochevitsky's book includes a concise and lucid history of approaches to piano technique, and an insightful (if a bit dated) discussion of piano playing in terms of the nervous system.
- Lhevinne, Josef: *Basic Principles of Piano Playing*, Dover Publications, 1972. Very simple advice but with useful details.
- Neuhaus, Heinrich: *L'Art du Piano*, Éditions Ven de Velde, 1971. By the teacher of Richter and Gilels, as well as of many other fine Russian pianists, this book provides many valuable musical and technical ideas.
- Newman, William: *The Pianist's Problems*, Harper & Brothers, 1956. Many useful, down to earth, practical suggestions.

- Ortmann, Otto: *The Physiological Mechanics of Piano Technique*, Dutton, 1962. This is the most detailed, genuinely scientific research into how experienced pianists actually play. The result of years of experimentation in a laboratory specially designed for the purpose, it is informed by a thorough understanding of physiology and mechanics. While knowing which muscles do exactly what will not necessarily make you able to produce a given movement, the facts presented in this book will prevent teachers and students from making impossible demands. It also calls attention to some aspects of piano technique which are little emphasized elsewhere.
- Sandor, Georgy: *On Piano Playing*, Schirmer Books, 1995. A clear and methodical presentation of five "Basic Technical Patterns", by a famous pianist and teacher, who studied with Bartok.
- Taylor, Kendall: *Principles of Piano Technique and Interpretation*, Novello, 1981. Many useful insights, gleaned from a long life as a teacher and performer. Especially good when discussing technical decisions as flowing from musical requirements.
- Whiteside, Abby: *On Piano Playing*, Amadeus Press, 1997. Abby Whiteside seems to have been the first (in the 1930's and 1940's!) to explore, in depth, the notion of using deep body rhythm in piano playing. Original and stimulating.

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