

## CHAPTER 6

## PHYSIOLOGY OF PIANO PLAYING

The writer once had a startling experience with piano-playing muscles. In the back yard was a shipping crate with good quality lumber (in which a new Bösendorfer piano had just been delivered from Vienna), and I decided to make a big garden gate out of it. After a great deal of prying, sawing, drilling, pounding and hoisting, the new gate was in place, and I was exhausted; forearm muscles were sore and hands, unaccustomed to it, that had been grasping tools tightly for hours were almost inoperative. Somehow, at that most inopportune time, I decided to cool off by trying to play the new piano, but expecting not to be able to do anything. As expected, the rapid or *forte* passages just would not come forth; but to my astonishment, I was playing slow *pianissimo* passages with better control over dynamics and phrasing than I had ever been able to manage before.

It required some study to understand this. The muscles which I had used habitually until then in piano playing (the forearm muscles which produce a grasping motion of the fingers and are most natural to us because that grasping is already an automatic reflex of every newborn infant) were fatigued to the point of refusing to function. But, unknown to me, Nature had given us a second set, which then came to the rescue and controlled finger motion far more precisely because they were not a foot away, connected to the fingers by long elastic tendons; they were right at the scene of action, in the hand and fingers.

**Muscles of the Hand**

These “new” muscles which I had discovered by accident, are called the Lumbrical and Interossei muscles. They are not naturally strong, being so little used by most of us; but like all muscles they are strengthened by exercise.<sup>†</sup> Fig. 6.1 is a stylized and simplified view of the hand and arm in piano-playing position, revealing the mechanical arrangement that is built into all of us by Nature; we therefore have no choice but to learn how to use this as best we can. The strong deep and superficial flexor muscles in the forearm are the ones that you feel thicken a great deal if you grasp your forearm while clenching your fist. They pull upon the finger bones (or *phalanges*, as the anatomists call them) in two different places.

The lumbricales are also depicted in Fig. 6.1, and both lumbrical and interossei muscles appear in Fig. 6.2, which shows the back of the hand. The arrangement is more or less the same for all fingers, although on closer inspection one finds that no two fingers are exactly alike.<sup>‡</sup>

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<sup>†</sup> However, in discussion with an anatomist, we learned that the lumbrical muscles are subject to great individual variations; and some people do not have them at all. So our conclusion is: “If you have them, use them! If you don’t have them, then consider taking up some other instrument than the piano.”

<sup>‡</sup> In particular, the fourth and fifth fingers are anatomically quite different from the second and third. Even their blood supply is arranged differently; as countless seamstresses have discovered, the fourth and fifth fingers bleed more profusely from a pin-prick than do the others.

Medical books have all this information in far more detail than we need here; for example, the book *Surgical Anatomy of the Hand* by Sterling Bunnell has the information needed by a surgeon doing reconstructive surgery on injured hands. Some may find all this a bit gory, as did Hector Berlioz, who started as a medical student. But in his memoirs written in his old age he is finally able to describe, with great humor, the horrors he experienced many years before, dissecting human corpses to acquire this kind of knowledge directly. The experience turned him to music, much against his father's wishes. Nevertheless, since anyone may have an injury or deformity of the hand, we are fortunate that at least a few people are willing to dedicate their lives to acquiring and applying this intricate anatomical knowledge.

The lumbricales are sometimes called the harp muscles, because as we see from the Figures, when a lumbrical muscle contracts it moves the finger in that combination of straightening and forward motions that is used in plucking a harp string. Using this fact, you can learn how to call upon the lumbricales consciously. We do not have naturally the ability to call consciously upon one particular muscle rather than another; we learn only to will a particular motion of the hand. By trial-and-error practice not unlike a musician's first year of practice on a violin, infants are busily learning how to bring about that controlled motion, without knowing consciously exactly how they are doing it.

But you can know easily when your fingers are being moved by the lumbricals; just will that harp-plucking motion of your finger. Generally, the lumbricals, flexors, and extensors will all be involved at once, in a way not under conscious control. But change the finger movement – that is, change the relative amount of straightening and forward motion – while pressing a piano key down and feeling your forearm with your other hand. If the flexor and/or extensor muscles are contracting, you feel that easily because they grow thicker and slide under the skin. When you are moving your finger forward in such a way that all muscular action in the forearm ceases, then the lumbrical muscle is doing all the work.

Then if you develop the habit of moving your fingers in that way while playing the piano, you have learned how to call consciously upon the lumbricals; with much practice this becomes automatic and you can switch back and forth at will between the two sets of muscles. Both control and endurance will be improved, because you can use the arm muscles for loud passages; then let them rest while you switch over to the lumbricals when fine control is needed; then let the lumbricals rest when fine control is no longer needed, *etc.* Of course, this ability is not acquired overnight; a year of conscious practice will be needed.

Reaching for octaves, ninths, and tenths requires the thumb and fifth finger to move out away from the hand, far beyond what a normal person needs in almost any other activity. Then the interossei muscles that move the fifth finger outward become large and strong in all experienced pianists – Sherlock Holmes could spot a pianist instantly by noting how thick the palm of the hand is at the outside edge just below the fifth finger. You can see it very clearly in videotapes of Alicia de la Rocha and Vladimir Horowitz performing (interestingly, her hand was more developed there than his, suggesting that he, with longer fingers, did not need to work the interossei so hard to achieve his span).

**Has Anyone Else Noticed This?** At this point in the reasoning it occurred to me that such a striking experience must surely have been reported by others, so I undertook

a literature search to find some mention of it. This turned out not to be easy; but three years later, browsing in Schirmer's music store in New York, I found what I was looking for. It had all been reported twenty years earlier, just as I had experienced it, in the book *The Riddle of the Pianist's Finger* (1936) by Arnold Schultz, a piano teacher in Chicago; and he tried to understand it in much the same way I had. Strangely, his account of the discovery does not appear in his book, but only in some supplementary notes that he wrote for its dust cover; so we quote them here:

“Throughout all of my musical life, I have been aware of variations in my technical relation to the keyboard which made enormous difference to my pleasure and skill in playing. One of the chief characteristics of a ‘good’ period was a sensation of tension and work in the palm of the hand, amounting in a long session of playing to actual muscular pain. But the sensation was on the knee of the gods. I was quite powerless to induce it voluntarily and I did not know what caused it. The whole problem of technique, so far as I was concerned, hinged on the explanation of that sensation.”

Then he recounts some long frustrating attempts to understand it, and finally concludes:

“I saw suddenly that a good technique must depend upon a dominant use of the small muscles in all the technical touch-forms. It required almost another year of experiment, however, to learn how they might be voluntarily controlled. I then began to write the book.”

Looking back at that work with 60 years of hindsight, we can say that it contains some very important truth that cannot, as far as we are aware, be found anywhere else.

But then the value of all this is nearly destroyed when Schultz – with no training in physics and so without giving any consideration to what is known about the mechanics of piano and finger – proceeds to invent an elaborate and fanciful mechanical theory of his own, concerning many imagined “touch-forms” by which a finger acts on a key, and inventing a new name for each – {*contra-fixation*, *contra-weight*, *trans-fixation*, *trans-pressure*, *trans-weight*, *trans-movement*} – each of which can be used with a {*fixed-base*, *moving-base*, *prepared stroke*, or *unprepared stroke*}.

Thus Schultz tries to define  $6 \times 4 = 24$  different ways of pressing a key down – all without asking whether the principles of mechanics recognize any such fine distinctions. As a result, the picture of piano technique that he presents to us is grotesquely confusing, and many times more complicated than the real facts.<sup>†</sup> We doubt whether any reader has ever been able to hold in his mind all these new, arbitrary definitions long enough to follow his exposition. So here our aim is to recover a valuable nugget of truth, cleansed of the mud in which it has been buried for 60 years.

**What are the Conclusions for Piano Technique?** Once aware of the availability of the small muscles in the hand, and the possibility of controlling them voluntarily, we can draw several conclusions important for present piano technique – and even for future piano design. The most effective piano technique involves perhaps 100 little details of hand motion, taking advantage of every little detail of the anatomy of hand and arm. We need not dwell on those that are so obvious that everybody discovers them at once without any help; but we want to explain in some depth the ones that are so subtle that without

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<sup>†</sup> This is not to say that every point Schultz makes is wrong, only that they are unreliable, and the average reader has no way of judging which are right and which are wrong. To his credit, he does recognize the essential role of the lumbrical muscles.

informed help one can practice diligently for years – as I did – without ever discovering them.

\*\*\*\*\* MUCH MORE HERE ! \*\*\*\*\*

So what does the future hold here? We think it is hopeless to try to change the thinking and teaching of any musician who has managed to reach the virtuoso level without conscious attention to these physical facts; his attitude would be, inevitably: “The methods I used have *worked*, with results so precious and fragile that it would be stupid to make any change in them in favor of something unknown.” We agree that *from his standpoint* this would indeed be stupid; but a mediocre player is free to try out anything because he has nothing to lose. Innovations in thinking and teaching must take place not at the summit, where too much is at stake; but at the most humble elementary level. Then a process of Darwinian Natural Selection must take place. If the ideas we suggest here are actually taken seriously and prove to be successful in practice, then within a generation there will appear many virtuoso musicians who understand and teach them. If they do not produce superior musicians, then our ideas will die out of their own accord, whether or not they are true.

### **The Schumann Slips.**

Another aspect of the anatomy of the hand played a famous role in the history of piano music, and gives us an instructive case history of how folklore grows to fill up the vacuum created by lack of hard facts. Referring to Fig. 6.3 showing the muscles and tendons in the back of the right hand, one sees that the tendon which lifts the fourth finger is tied by two small cartilage “slips” so-called, with the tendons on either side, which lift the third and fifth fingers. As a result of the angle they make, third and fifth fingers can be raised independently while keeping the fourth down; but the slips prevent one from raising the fourth finger unless the third and fifth are also raised at the same time.

Putting your fingers on a table in piano-playing position, you can experiment with finger raising and verify that you can easily raise the third or fifth finger while keeping all the others on the table; but – unless you are an extremely well-practised pianist – you are hardly able to raise the fourth finger off the table at all unless the third and fifth are raised at the same time. You can easily feel these slips directly; just press a fingertip lightly to the back of your hand between two finger tendons near the knuckle, and open and close your fist. You feel the slips moving under your finger and may verify that the one between the third and fourth finger tendons is wider and flatter. Pressing between the second and third finger tendons, you feel nothing sliding under your finger, verifying that there is no slip connecting them.

Nature has seemingly made a foolish and wasteful error here; while we are equipped with individual muscles and tendons for the individual fingers – and they are under our individual conscious control to move any one finger at a time – yet the ability to do

it is frustrated by these slips which, as far as we can see, perform no useful function for us, although they might for a duck or a tree-climbing monkey. Perhaps this is the unfinished business of evolution, from an animal without separate control of the phalanges to man, in which full independent control is not yet quite achieved. But if so, then it seems unlikely that the job will ever be finished if left to the devices of Nature.‡

This strange anatomical peculiarity causes no inconvenience to most people – the vast majority of us are not even aware of it. But it is a great inconvenience to a pianist, who learns quickly that the fourth finger is harder to control than any other. Awkward fingering is forced upon us by the refusal of the fourth finger to do the same things that the others do. By long practice and exercise specifically designed to stretch them, these slips can be loosened to the point where the fourth finger achieves a little more autonomy; but the amount of exercise needed is appalling.

Conceivably, if they cause too much trouble, these slips could mean the difference between becoming and not becoming an accomplished pianist. Robert Schumann (1810–1856), as a young man, was greatly troubled by this, and he tried to correct it himself. Exactly what he did to his hand is a matter of great mystery; there are many vague accounts of the story, but it seems that none of his biographers knew any authentic hard facts. Most have it that he invented some kind of mechanical contraption, which went wrong and permanently damaged his right fourth finger. But different sources disagree as to the purpose of the contraption and none gives any details about its construction or how it worked – which would be easy to understand if that contraption were a figment of the imagination, conjured up by someone who, unaware of the anatomical facts just noted, did not understand what the real problem was. There are many Schumann biographies; but we have found no writer on Schumann who showed any awareness of these slips as the cause of the pianist's fourth finger problems. Yet, as we shall see, medical people have been well aware of this all the time those biographies were being written.

For example, Schonberg (1970, p. 153) gives it only one sentence: “*Trying to achieve a short cut to finger independence, the impetuous Schumann invented a contraption that permanently ruined one of his fingers.*” We think, from the weight of other evidence, that he is correct in saying that finger *independence* was the goal; but we fail to see how any contraption could help to achieve that, much less how any contraption could *permanently*

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‡ Because anyone who happened to have a mutation making these slips smaller or absent, would get thereby no particular survival or reproductive advantage, so even if such mutations are happening today, there is no reason why the percentage of the population having them should be increasing; the Natural Selection mechanism of Darwinian evolution is absent. But as soon as sufficient intelligence is achieved, the Darwinian mechanism becomes inoperative anyway, to be replaced by a much more efficient one; conscious intervention of biologists of the distant future – with the knowledge and power to rebuild DNA molecules as a carpenter rebuilds a damaged house – might solve this problem and a thousand others.

ruin a finger. Sufficiently violent externally applied stresses and twists might cause a temporary finger sprain – but that would heal of its own accord in a week. Indeed, Nature can heal even a broken bone.

Brockway & Weinstock (1939, p. 295) tell a different story: “*He even invented a device for keeping the fourth finger of his right hand inactive while he practiced, evidently hoping that this curious procedure would overcome the laws of nature, and make the fourth finger as strong as the others. To his horror, the favored finger tended to retain this artificial position when free.*” Again, we can grant that the goal was stated almost correctly: to make that finger as ‘strong’ as the others (that is, as *functional* as the others). But again, that contraption is obvious nonsense; how could anyone believe that holding the finger inactive would help to make it stronger? The ones who perform any muscular activity best are the ones who have practised it most diligently; a runner does not train for the big race by spending a week lying in bed. Even more senseless; how could holding a finger inactive for the short period of a practice session cause permanent ruin to it? Surely, we have again the attempt of someone who does not understand the real problem, to visualize how things might have been. However, the statement that he lost the ability to raise his fourth finger at all would make excellent sense on the theory we suggest below; that is exactly one of the dangers that it would risk.

The Schumann biographer R. H. Schauffler (1945) devotes all of Chapter 5, entitled *The Crippled Hand* to this incident but again without giving a single hard fact about that contraption; only another conjecture of the same kind. He imagines Schumann’s right fourth finger in a kind of sling while practicing, which “*resulted in lamming for life the right ring finger, thereby shattering all his shining hopes of a virtuoso’s career.*” Again we find this fabulous, not only because putting the finger in a sling could only defeat his purpose, not help it; but also because, while a mechanical contraption might cause a temporary strain, we are unable to imagine how it could cause *permanent* damage, that would not heal of its own accord without any need for medical treatment. Permanent loss of a part of finger function would require some kind of *internal* damage, so severe that Nature could not heal it.

**The Chiroplast.** Then what accounts for the invention of the contraption theory, and the seemingly universal credence it received from later writers? This was explained, inadvertently, by Arthur Loesser (1954), pp. 297–300. There actually was such an infernal contraption, called the *Chiroplast*, which was sold by the thousands in the period just before this, 1814–1830, mostly in England and Germany. First the wrist of the player was clamped between horizontal bars, preventing any vertical motion; then the thumb and fingers were inserted into holes in brass plates called ‘finger guides’; finally wires were connected between the wrists and the finger guides to prevent the wrist from moving outward. This was supposed to force correct hand position in piano playing; but in fact it did exactly the opposite.<sup>†</sup>

The accursed inventor of this was one Johann Bernhard Logier, who also wrote a book on his weird, disastrously wrong theory of piano pedagogy.<sup>‡</sup> His contraption was

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<sup>†</sup> As was realized later, vertical motion of the wrist is essential in playing chords with best control, and outward motion of the wrist was the secret of Liszt’s perfectly smooth legato touch.

<sup>‡</sup> It is startling to learn that Friederich Wieck, Schumann’s piano teacher, owned a copy of Logier’s

manufactured in England by Muzio Clementi and it was promoted profitably by Logier, Clementi, and the pianist Friedrich Kalkbrenner. The latter proceeded to market in France another contraption called the *Dactylion*, in which the fingers were inserted into ten rings hanging from springs, supposed to train the fingers to lift off a key more quickly after playing a note (again it would, of course, do just the opposite by denying the lifting muscles the exercise they needed). We have no record of these horrors actually injuring anyone, but with the example in everybody's mind and the claims by well known musicians (with a financial interest) that such things could actually help one's piano technique, it is easy to see why, hearing of Schumann's injury but not being able to learn any details, a biographer might jump to the conclusion that he had also made use of some kind of contraption.

Furthermore, in the fifty years following the Schumann incident, various other contraptions of this sort were promoted, under names like *Chirogymnast*, *Manumoneon*, *Tech-nicon*, *Digitorium*, *...* etc. The idea was much in the air throughout the 19'th Century; for more details, see Loesser (1954, pp. 383–4, 541–3). So, of course, once one biographer had invented the contraption theory, it had an instant plausibility for anyone without detailed anatomical knowledge of the hand. Later biographers would tend to assume that he knew whereof he spoke, so they would repeat the story with embellishments; that is how folklore grows.\* But this ignores some far more cogent evidence pointing to a quite different theory.

**So What Actually Happened?** A theory which makes much better sense in view of the facts of physiology, some letters that Schumann wrote about it, and some more direct evidence to be noted, is that some time in early 1831 he tried to perform surgery on his own hand, to sever the slips; and bungled it. Firstly by not realizing the need for antiseptic conditions,† he incurred a horrible infection that required over two years to heal. He tried many treatments and reported that his rooms were like a chemist's shop. His doctor recommended constant application of raw meat and brandy! At least, the brandy would prevent further infection; but this treatment would also nearly prevent natural healing. In such conditions, it is remarkable that he recovered at all, but understandable that he then turned to full-time composition (in fact, the incident hardly affected his productivity; his first six Paganini caprices and the two books of Intermezzi for Piano were written while the injury was healing).

Secondly, under these unsanitary conditions (and before the days of anaesthetics), the knife probably slipped, severing something else like the main tendon of the fourth finger.

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book, but fortunately had too much good sense to believe it. To add still another coincidence we learn that Wieck's copy of that book was borrowed just at this time by a young man of 18 named Richard Wagner, who had enrolled as a music student in Leipzig University the year before – and Wagner too never became an accomplished pianist.

\* The *Larousse Encyclopedia of Music* (1974, p. 278) advances this process another step by repeating the contraption story, but moving the scene of action from the right fourth finger to the left third finger, undeterred by the fact that, of all ten fingers, this is the one in least need of any help.

† Recall that, at this time Louis Pasteur was eight years old and Joseph Lister was four years old; fifty years later, thanks to Pasteur and Lister, physicians were just beginning to comprehend the need for antiseptic conditions, and a large fraction of surgical patients still died of the inevitable infections.

This would, indeed, cause a lifelong disability, which Nature could not heal. Two years later, in 1833, Schumann was still writing letters indicating that the hand was not yet fully healed; a mere sprain from a finger sling could hardly do all that to him.

But the clinching evidence for this theory is supplied by a footnote in Schauffler's Chapter five, which we quote in full:

“The venerable Dr. Alfred Meyer of New York tells me that in 1878, while a post-graduate student of medicine in Leipzig University, he was told by a German doctor that Schumann had cut the tissue between his fingers with the object of increasing his span.”

Here Schauffler is recalling as best he can what the doctor told him; but unaware of the anatomical fact of the slips, he perceives the scene of operation to be between the fingers rather than between the tendons, and so imagines that if surgery was attempted, the problem must have been insufficient span. But again, as you can see at once on examining your own hand, cutting the tissues between the fingers would not help the span (and would cause other troubles far worse than a mere crippled finger); you can already extend your thumb and fifth finger out in opposite directions, achieving all the span which the length of the phalanges permits. The problem was not span; but the *independence* of the fourth finger.

But the truly important part of this quote – that Schumann *did* attempt self-surgery – was quite missed by Schauffler. We cannot understand why he gave this only enough credence to rate a passing remark in a footnote; it seems to us vastly more likely to be true than the fanciful story of a ‘sling’ with two physically impossible properties, which he puts into the main text. This is a good example of how a little attention to the facts of physics and physiology can change our appraisal of historical testimony.

If the bungled surgery theory is true, then since the incident occurred in Leipzig, it would of course be well known among medical people there for many years afterward; conceivably, some record of this may still be in the medical school archives. Indeed, Schauffler also quotes from some of Schumann's letters of the time referring to the injury, which provide further evidence for the bungled surgery theory and against the sling theory. But Schauffler does not seem to realize that Schumann is describing a serious broken-skin infection, not merely a soothing ointment.

In view of all this, we suggest that the truth is more like the following: in Leipzig with its medical school – many of whose faculty and students would have been then, as now, amateur musicians – Schumann would have no difficulty in meeting people who could explain to him the anatomical facts about the slips, which prevented independent control of the fourth finger.<sup>‡</sup> But the medical people, aware of the constant danger of serious infection, would naturally refuse to perform any operation if the patient's life were not in immediate danger; so the headstrong Schumann, perhaps while drunk, tried it himself. This theory violates no principles of physics or physiology, is not inherently implausible, and it explains very easily all the known facts.

The suggestion of drunkenness is not essential to this theory, but it has some plausibility in its own right. It is known that, at this age (21), Schumann had a strong predilection for alcohol which alarmed his mother and friends, who tried to urge moderation on him.

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<sup>‡</sup> Of course, Schumann also knew his way around Leipzig University and its library facilities independently, having been a law student there briefly three years before.



And we all know that when persons get very drunk, just at the point where they nearly lose all muscular coordination, they also acquire a bravado that makes them try all kinds of difficult and dangerous feats, which they would never attempt to do when sober.\*

Furthermore, the drunkenness theory helps to explain two other facts; it greatly increases the probability of the knife slipping and doing permanent damage; and it would account for Schumann's own reluctance to enter into details of the injury later, confining his remarks to the progress of the treatment. Surely, had the injury been inflicted in a less stupid way, he would have become a crusader, describing what he did in great detail in order to warn everybody else against it.

In any event, the main known fact is that Schumann never became a virtuoso pianist, because of some kind of self-inflicted crippling of his right fourth finger that occurred in early 1831. This shows in his piano music; he makes less demands on the right fourth finger than do other composers. Schauffler (*loc cit*, p. 494) quotes a letter from Morton Krouse, a good amateur pianist who broke his right fourth finger and never fully recovered its use:

“Long before I met you, I noticed that Schumann's piano works were much easier to play with my crippled finger than those of any other composer. For example, in most parts the Schumann Piano Concerto is easier for me than many passages in Bach's *Two-Part Inventions*, just because the fingering seems to suit my right hand much better. Whereas *Papillons*, written before his accident, is just as difficult for me as any other composer's works of approximately the same technical caliber. Any pianist who broke his ring-finger would notice how much more easily he could play Schumann than anybody else.”

By the end of the 19'th Century, surgical technique had advanced to the point where the Schumann operation could have been performed safely. Professor Wm. S. Forbes, writing in the Philadelphia Medical Journal for January 15, 1898, recommended that it was proper to try this if a pianist was having great difficulty from the slips. We do not know whether the operation was ever actually tried, but a search of old medical journals of this time might shed some further light on it.

Today, there are competent surgeons specializing in reconstructive surgery of the hand, for whom this operation would be trivial; if anyone believed that these slips were the main factor preventing him from becoming a first-rate pianist, the Schumann operation could be performed under proper antiseptic and anaesthetic conditions. The procedure would be very simple – even more so than the plastic surgery which many people undergo for merely cosmetic reasons – since the slips are very small and directly under the skin. With modern antibiotics to prevent infection the hand ought to heal in a matter of days. Although we do not advocate this operation for anyone, if it *were* done, it would be of great interest to follow the patient's subsequent fate and see whether it did indeed make a noticeable difference in his piano technique (but we suspect that failure to become a good pianist has other causes, far more important and not surgically correctible).

Robert Schumann was a medical phenomenon in more ways than one. He suffered from having been born 130 years too soon, when medical knowledge and technology were

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\* The writer knows this very well from his own personal experiences at the same age; it is in retrospect remarkable that I survived to the age of 25.

hopelessly short of what he needed. The cause of his mental breakdown, leading to his death in an insane asylum in 1856, could be neither diagnosed nor treated.<sup>†</sup> The symptoms appeared gradually in several different brain functions; auditory hallucinations, difficulty in speaking, inability to reason coherently and consequent preoccupation with trivia, at the end inability to recognize old friends. Only post-mortem examination was able to reveal a large osseous growth in his skull, which had been exerting increasing pressure on his brain. Today, NMR-imaging<sup>‡</sup> could reveal its exact location, size, and shape in a few minutes, and surgical correction would be a more-or-less routine procedure, although hardly a trivial one. From the available information it seems highly likely that, with modern medical facilities, Robert Schumann could have had another thirty years of normal, healthy, productive life, more than doubling his total musical output. Perhaps his musical horizons would have expanded over the years, as did Beethoven's.

If there were an abnormality within the brain, such as a tumor, this would be revealed by NMR equally well, in minute detail, although it might or might not be operable. But this would cause dysfunction of just one localized area of the brain, which does not check with Schumann's symptoms.

An example of such a localized dysfunction is given by the case of Maurice Ravel (1875–1937), who also died of an undiagnosed brain disorder, but a very localized, specific one. He lost the ability to speak and write, but retained his full intelligence and musical skills for at least a year longer. Other cases have been observed, in which a musician lost the ability to speak but could still play the piano as well as ever. Evidently, the verbal and musical functions are carried out in different areas of the brain.\*

The Schumann story is so interesting as an historical incident – and also possibly important for others today – that we have described it in some detail and taken pains to demystify it, even though it might seem a digression from the main purpose of this Chapter. Now let us return to the business at hand.

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<sup>†</sup> From time to time we still hear a dark rumor, that his mental deterioration was really the result of a venereal disease; and that Friedrich Wieck, aware of this, was quite right to raise strenuous opposition to Schumann's marriage to his daughter Clara. Anyone who wants us to believe that, must also explain to us how Clara then managed to bear him eight children without contracting the disease herself. In her late 60's – more than 40 years after their marriage – she was still healthy and engaged in active concertizing.

<sup>‡</sup> This stands for “Nuclear Magnetic Resonance”, in which a strong magnetic field causes the hydrogen nuclei in various tissues to emit radio waves revealing their location and chemical surroundings. The latter yields extremely detailed pictures of tissues, with no ill effects on the patient. The present writer, in the 1950's, participated in some of the early theoretical study of NMR as a physical phenomenon; but NMR imaging became possible only some twenty years later, with the development of the computers to process the enormous amounts of data and convert them into meaningful images.

\* But only in 1992 was the brain area involved in piano playing finally identified by NMR imaging. Justine Sergent, a neurologist at McGill University, Montreal and also a pianist herself, recorded NMR images of the brain as ten professional pianists sight-read and played, and found that the active area of the brain during this was a kind of network adjacent to, but distinct from, the areas used for verbal skills. This knowledge, reported in *Science* magazine, July 1992, will doubtless be valuable in the future, for treating musicians who may incur some kind of brain injury or dysfunction.

### But How did the Great Pianists Actually Play and Teach?

Having propounded a theory of correct piano playing based on the facts of physics and physiology, we need to confront it with the facts of actual experience at the keyboard. The great pianists learned their craft in many different ways. The first were of necessity self-taught; then a formal piano pedagogy (Czerny, Clementi, Leschetizky, Kullak) appeared, producing many of the best known concert artists, and advocating various ‘teaching methods’ which became fashionable in the late 19’t and early 20’t Centuries.

But the effectiveness of this pedagogy is unclear when we note that different teachers, although all apparently successful in the sense that a few of their pupils achieved worldly fame, used very different ‘methods’. And only a few of their pupils had that success; might they have been just the ones with exceptional drive who would have become just as great without the pedagogy? Indeed, some of the greatest masters of all, such as Leopold Godowsky, continued to be almost entirely self-taught.

In a sense, all the pupils of Liszt were self-taught, since he said nothing about technique. It seems that he could only demonstrate it, not explain it. The pupils of Chopin complained about the same thing; as one put it, his teaching method was “to play like an angel, then tell us to do likewise.” But that is equally true of every virtuoso, it is not confined to the piano, and once started it is self-perpetuating for reasons that we note next.

**Violin Pedagogy.** Leopold Auer (1845–1930) was one of the mainstream violin teachers (he was a pupil of Joachim, and among his pupils were Jascha Heifetz, Efrem Zimbalist, and Mischa Elman). He wrote a small book (Auer, 1921) on violin pedagogy, in which he reports on the teaching methods of Joachim:

“Anything which had to do with the technique of the two hands we were supposed to attend to at home. Joachim very rarely entered into technical details, and never made suggestions to his pupils as to what they were to do to gain technical facility . . . He rarely made his meaning clear in detail, and the only remark which he would utter at times, after having demonstrated a point would be: ‘*SO müssen Sie es spielen!*’ (That is how you must play it!), accompanied by an encouraging smile. Those among us who were able to understand him, who could follow his inarticulate indications, benefited enormously by them, and tried as far as possible to imitate him; the others, less fortunate, stood with wide-open mouth, uncomprehending, and fixed their attention on one of another of the great virtuoso’s purely exterior habits of playing – and there they remained.”

The similarity to what the pupils of Liszt and Chopin reported is remarkable. But then Auer in turn follows this same policy in the rest of the book; he goes in great detail into the gross matters that one can see directly, such as how many fingers should be used in holding the bow; but there is not a word on how the bowing point, bow velocity, and pressure of bow on string determine the tone produced. Yet the mechanical facts of how the string moves under the bow – and thus determines the necessary manner of handling the bow – had long been well known, thanks to the work of Helmholtz (1862).<sup>†</sup>

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<sup>†</sup> And to add to the mystery, Joachim was a friend of Helmholtz, who in addition to being the greatest German scientist of that time, was also a competent pianist. Joachim played Schumann’s *Abendlied* at the memorial service for Helmholtz in December 1894. Still, the fundamental knowledge that Helmholtz had given thirty years earlier to help violinists quickly master the rules of

Nowhere does Auer mention such essential facts as that to play louder, one must move the bow more rapidly rather than pressing harder on the string; or to produce a long sustained note, one must move the bowing point closer to the bridge, press a little harder on the string, and move the bow more slowly. For a beginning student, these completely counter-intuitive facts are the ones in most need of being pointed out and explained (and they can be not only understood at once, but *predicted*, from the physical principles given by Helmholtz). But each violin student had to discover them for himself as best he could; those who failed to do so simply abandoned the violin at an early stage. The more persistent ones learned them unconsciously, remained unaware of just what they were doing – and were therefore unable to pass it on to their pupils. The situation is self-perpetuating because those who manage to reach the virtuoso level in spite of their incomplete understanding of it can, like Liszt, Chopin, and Joachim, only demonstrate it, not explain it. Doubtless, the same thing can be said of the pedagogy of every other instrument.

**Back to the Piano.** Piano technique is more subtle than violin technique in at least one respect. In both, the crucial things happen too fast to see, but the laws of physics dominate violin playing so completely that unless one handles the bow in something like the correct way, it will be impossible to produce any musical sound at all. With the piano, any kitten can press a key and make a musical sound; but what is important about just how it is pressed is much less visible than is the motion of a violin bow. Not only does everything happen too fast to see; the crucial things happen out of sight. Needless to say, most pianists remained not consciously aware of these things; but all musicians readily noticed that there was no discernible connection between the ‘methods’ of piano teaching and the success of that teaching, and by the 1930’s the notion of piano ‘methods’ was in disrepute.

Looking back today, we can say that the ‘methods’ undoubtedly did have some important bits of truth in them; but without any attempt at objective, scientific validation they were all scrambled up with a great deal of superstitious nonsense which did more harm than good. Then the methods were greatly oversold by eager promoters. But can we now salvage the useful bits of truth and dispose of the superstitious nonsense and the promotional hype?

Put differently, in spite of the varied backgrounds of the great artists, is there any common factor in the final result? Regardless of how they learned to do it, does the actual performance of the great pianists provide evidence for or against our theorizing? There is plenty of evidence, if we will open our eyes to it; let us examine what is known about the early pianists (those who lived before the days of recording); and then turn to the much more detailed information available about recent and contemporary pianists.

Imagine what it would be like today to have videotape recordings of Mozart, Beethoven, Chopin, Liszt in their greatest performances. What we can only speculate on would become evident facts, and perhaps we might learn some important things from them. As it is, we would like to form the best judgments possible about how the great pianists who lived before the days of recording dealt with the keyboard; in particular, whether it was

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proper technique, was ignored by those who had the most to gain from understanding it. Perhaps, 100 years later, it may finally be appreciated.

importantly different from the way pianists perform today, as many believe (however, the controlling principles of physics and physiology were the same in 1790 as in 1990, so they could not have been very different; given the same problem and the same resources, one is forced inexorably to nearly the same solution, whether or not one understands the real reasons for it). However, we should be aware that many pitfalls face those who try to form judgments on this today.

**Difficulties of Historical Interpretation.** In 1963 the Music Critic of the New York Times, Harold C. Schonberg, published a book, *The Great Pianists*, in which he made some interesting attempts in this direction. But we think that his conclusions can be improved on greatly – in some cases reversed. This is not a problem of *logical deduction* because the necessary information is lacking. It is a problem of *inference* (*i.e.*, how to reason consistently and honestly from incomplete information, so that we take fully into account what is known, but avoid assuming what is not known) in which it is important to take into account all the evidence available, of whatever kind. The principles of inference, being needed constantly in science, are rather well understood (Jaynes, 1994); and a person familiar with them can see that Schonberg did not avail himself of some cogent evidence that would have changed his conclusions. Let us point out the nature of some of this.

The testimony of eyewitnesses is obviously very important, but it can also be distorted and biased due to faulty memory and ulterior motives. For example, when Carl Czerny (a Beethoven piano pupil) and Anton Schindler (a violinist who acted as Beethoven's private secretary) give conflicting testimony about him, whom are we to believe? This is a relatively easy decision, because Schindler is drawing upon recollections forty years after the fact, with some obvious personal animosity toward Czerny<sup>‡</sup> in a work full of provable factual errors on almost everything; we believe Czerny.

In addition, the further back we go, the more inclined are witnesses to believe in the supernatural and the miraculous, and the less likely to comprehend the simple facts about mechanics, acoustics, and physiology that are familiar to educated persons today. Even today, the notion that a cause–effect relationship requires a physical mechanism to bring it about, is quite foreign to the thinking of many persons without scientific training.\* Therefore, the further back we go, the more essential it is to have and use the relevant scientific knowledge of today. If a witness, writing in 1830, claims to have seen something that we know to be physically impossible because of scientific knowledge that was not discovered until later, that needs to be taken into account. We have seen this in the fabulous Schumann stories.

Likewise, if today an historian (out of ignorance of scientific facts or failure to perceive their relevance) takes for granted things that scientists now know to be impossible, or disbelieves what is known to be true, his interpretations of old testimony can be thrown far off the truth. We think that Schonberg's conclusions suffer greatly from this, and particularly so in the case of Beethoven.

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<sup>‡</sup> Waiting just until Czerny was dead, Schindler proceeds to disparage both his playing and his teaching, with criticisms that we can find from no other source. He even tries to blame the theatrical mannerisms of Liszt on Czerny's faulty teaching!

\* And this ignorance is also self–perpetuating; because of course, those who never look for the real causes of things never find them.

Beethoven was famous for breaking hammers and strings on the fragile pianos of his day. Modern commentators such as Loesser and Schonberg draw what we think are two erroneous conclusions from this. Firstly, they suppose that he demanded far greater dynamic range than other composers; but let us observe that those pianos were not capable of very much sound volume before the strings snapped, and he was also going deaf. Most of us have observed that people who are only slightly hard of hearing habitually talk much louder than the rest of us.

Secondly, Schonberg (1963) states several times that all early pianists except Beethoven kept their hands close to the keys, but Beethoven raised them high. He even entitles his Chapter on Beethoven: “*String-Snapper, Hands on High*”. But this contradicts the testimony of many independent eyewitnesses, all of whom stated the opposite; how could Schonberg have got such an idea? On closer examination, we find that whenever Schonberg states this in the text, the *fact* that he is trying to interpret for us is simply that Beethoven played *loudly*. Not understanding the physics of it, he merely *imagines* that this requires highly raised hands; but as Robert and Gaby Casadesus demonstrated so nicely, the opposite is true.

Schonberg displays his lack of comprehension of this point in several other places; for example, in discussing Clara Schumann’s performance, he notes that her father had drilled into her that the finger must never strike a key percussively. Then he states (p. 229), “*Apparently, even with this hands-close-to-the-keys technique, she was able to draw a full, colorful tone. All her hearers are united in this.*” He need not have been so surprised; it was, of course, just her correct hands-close-to-the-keys touch that *enabled* her to draw a full, colorful tone with minimum effort – as it did also for Gaby Casadesus 100 years later. Friedrich Wieck was indeed a very good piano teacher for technique.<sup>†</sup>

It was Liszt who raised his hands high at the beginning of a loud passage, as attested by many eyewitnesses; but he knew perfectly well that this was showmanship that had no effect on the sound. The ladies, not comprehending the physics of a piano action any better than Schonberg (that the effective mass of a piano key is many times greater than that of a finger) expected it of him; and he obliged.

You can snap a string (or with the steel strings of today, more likely break a hammer) most easily by holding the second and third fingers vertical and rigid on the key and suddenly bearing down with the full muscular strength of your arm, without raising your hand at all. This is the point about mechanical efficiency that Tobias Matthay did not understand either, when he warned his readers that the “forward dig” produces a harsh tone.<sup>‡</sup>

Keeping in mind these examples of how easily wrong conclusions can be drawn, we find scattered through an immense literature the reports of many eyewitnesses concerning the keyboard performances of all the aforementioned greats, and much auxiliary evidence

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<sup>†</sup> Yet he failed to teach Clara even the rudiments of harmony, as Robert Schumann discovered after their marriage, leading him to give her some much needed remedial instruction in music theory.

<sup>‡</sup> It does so only because it is so much more efficient mechanically that it produces a much *louder* tone for the same muscular effort. Had he relaxed that effort sufficiently, the forward dig would have given him just the tone he wanted, with far less muscular effort than flat-handing was costing him.

concerning the credibility of the witnesses. We have their compositions indicating their style and technical level. This is enough to draw some reasonably sure conclusions about the keyboard methods and powers of the first great pianists.

**The First Pianists.** In the first place, what do we know, from credible sources, about the keyboard techniques of Mozart and Beethoven? We have the most valuable testimony about this from Carl Czerny (1791–1857), the Beethoven pupil who went on to become perhaps the first professional piano pedagogue, and surely knew whereof he spoke concerning both the musical and technical sides of Beethoven’s keyboard performances. His pupils included Liszt and many of the next generation of piano teachers such as Theodor Kullak (1818–1882) who founded the Berlin *Neue Akademie der Tonkunst*, and Theodor Leschetizky (1830–1915) who taught in St. Petersburg and Vienna, and probably had more famous pupils than any other teacher. Czerny was already a highly accomplished prodigy when he came to Beethoven in 1800 at the age of nine; he played the just published *Pathétique* sonata Op. 13 in a way that impressed even Beethoven, and for the next few years Beethoven was his teacher. Beethoven appreciated his talent so much that he then entrusted Czerny with the proofreading of his new works from 1805 on (that is, starting at about Op. 47).

With such credentials, we trust Czerny’s testimony. In his reminiscences of Beethoven’s teaching, Czerny reports that Beethoven first made him read C.P.E. Bach’s *On the true manner of performing upon the clavier*, and for the first few weeks put him back to practicing scales, showing him the right positions of the hands. Then in Czerny’s words,

“After this, he - - - drew my attention to the *legato*, which he himself mastered in so incomparable a manner and which at that time all other pianists considered impracticable, as it was still the fashion (dating from Mozart’s time) to play in a clipped, abrupt manner.”

We would need no more evidence than this to infer that Beethoven did play in the manner we have recommended, hands on the keys; and that he was the first, or one of the first, to do so (it may be that Clementi – the master of smooth, lightning-fast, parallel thirds – had also discovered this technique).

We infer also that Mozart did not play in that way; but as we noted in Chapter 3, the *legato* was in any event mechanically impossible on the early Späth claviers on which he learned to play. Then on discovering and praising the more advanced Stein piano, he failed to make use of its *legato* capabilities in his later piano sonatas. Apparently, as soon as he settled in Vienna and acquired a Stein action piano of his own, he reverted to his previous mindset and did not think in terms of finger legato. So Mozart’s performance was always limited by the mechanics of the old Späth instrument rather than by the capability of his fingers; in Beethoven we see finally the limit of capability of human fingers. There is much additional evidence of this kind, but it all supports the same conclusions.

On the piano techniques of Liszt and Chopin we have already made several comments in our Preface and in Chapter 3. There is a vast amount of eyewitness testimony, of which we note particularly the recollections of Charles Hallé (1896), those quoted in the Liszt biography by Sacheverell Sitwell (1955); and most importantly in the testimony of Amy Fay, described below. It seems that Chopin had a delicacy unsurpassed before or since, while Liszt started as a mere technical powerhouse, capable of breaking strings on much stronger pianos than Beethoven’s. But Liszt learned precise control from the

example of Paganini and delicacy through his association with Chopin. Outliving Chopin by many years, in his old age Liszt's string breaking days were over, but he was still the master of all other pianists in the matter of smooth, expressive *legato* execution at any speed. His superior control showed itself even on the simplest compositions, well within the technical grasp of any beginner. One witness to both Anton Rubinstein and Liszt, in quick succession, playing the famous first movement of Beethoven's "Moonlight" Sonata Op. 27–2, reported that Liszt's performance made Rubinstein's seem clumsy and amateurish. Our own ideal of pianism is some kind of blend of middle Beethoven (before deafness) and late Liszt (after string-breaking).

**The More Recent Pianists.** The level of technical proficiency and musical perceptiveness of the great pianists of the past 100 years is not in doubt. Since about 1910 we have had the advantage of audio recordings, so that we can know exactly what sounds Camille Saint-Saëns, Ferruccio Busoni, Leopold Godowsky, Moritz Rosenthal, Josef Hofmann, Sergei Rachmaninoff, Josef Lhevinne, Ignaz Paderewski, Artur Schnabel, Wilhelm Backhaus, Rudolph Serkin, Artur Rubinstein, Vladimir Horowitz, and so many others, actually produced (although some of the earliest ones were already past their prime when recorded), what degree of precision they achieved, and what liberties in phrasing and dynamics they allowed themselves.\*

The results are surprisingly uniform; hearing these pianists, we are at first shocked to realize that their standards were not as high as we expected. Their reputations were considerably better than their actual performances (at least, their performances in recording studios; they might well have been nervous and apprehensive of the experience). Their technical apparatus was doubtless impressive to untrained audiences of their time; but it was inferior to that of most young pianists today. However, great technique is not really necessary for a successful concertizing career, as we see next.

**Artur Rubinstein** was far from a great technician – and perhaps not even a great interpreter – but he was always popular with the concert-going public because of his basically healthy attitude in an age when so many of his contemporaries had serious problems. He never took his music or himself too seriously, and his music was the better for it. If he did not have the technique of Godowsky<sup>†</sup> he was also free of the annoying, distracting mannerisms and psychiatric hangups of most of his contemporaries. He would raise his hands high in the air occasionally for dramatic effect or perhaps out of sheer exuberance; but unlike some of the others he understood that this contributed nothing to the actual music, and when a difficult passage was called for, his hands went right back close to the keyboard and he accomplished it without any unnecessary hand or finger motions.

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\* The making of recordings can also defeat a musician's purpose. Artur Schnabel (1935) published a highly edited version of the Beethoven sonatas, full of detailed instructions on their execution; then it was startling to hear Schnabel's actual recorded performance of those works, showing little regard for his own instructions. The reaction of many (including the present writer) was to ignore both his practice and his precept, go back to the *Urtext* edition of Beethoven; and rely on our own judgment.

<sup>†</sup> One pianist remarked of Leopold Godowsky (1870–1938) that his ten digits were "ten independent voices." But Rubinstein remarked instead: "Look at Godowsky! It would take me 500 years to acquire his mechanism, but what does it get him? He is uptight and miserable, while I am happy!"



In the early 1950's Rubinstein was a regular performer at concerts in San Francisco and the present writer, then at Stanford University, knew his piano tuner. Gustav Gulmert was an old friend of Rubinstein's who had settled in the San Francisco Bay area, and whenever Artur Rubinstein came to town, Gulmert was called in to tune the pianos he would use. He reported back to me some of their conversations; on one of his visits, Rubinstein said to him, wearily, "*Gustav, you don't know how lucky you are to be in your line of work instead of mine. You have only to be as good as you were last time; every time I come here I have to be better than I was last time, or the critics will know it.*" Rubinstein was then in his middle 60's; and in fact, he *was* better each time.

His playing actually improved markedly as he grew older; he was playing better at 75 than at 60. In his early performances the sound had a muffled quality, due to the combination of wrong or half-missed notes (*i.e.* accidentally striking two keys instead of one) and too much pedal and bass; but probably from listening to his own recordings and comparing with what others were doing, he learned to overcome it. He himself was very much aware of this, and in his old age he would give horrible examples of how he used to play when young, bringing back all the old muffled quality; then show how he could do it now, with crisp articulation when the music called for it. We suspect that many young pianists profited from this lesson in piano technique, which he gave on public television.<sup>‡</sup>

**Videotape Recordings.** Today, for studying piano technique mere audio recordings are obsolete; we have the great advantage of movie and now videotape recordings of piano performances, which we can slow down and replay as many times as we please and thus see exactly, in minute detail, what hand movements a pianist was using to produce those sounds. From studying these, we can learn things about a pianist's technique that the pianist is not consciously aware of. We can see Alicia de la Rocha, Aldo Ciccolini and André Previn obeying the rules of efficient sound production indicated by our theory, with the good results to be expected; and Glenn Gould violating them, also with the results to be expected (in addition, his annoying and distracting personal mannerisms intruded upon the music more than did those of any other contemporary pianist).

We can see Vladimir Horowitz (at least, in his old age) flat-handing the keyboard like Tobias Matthay; and thus using more muscular exertion than would be needed and achieving less control and endurance than would be possible. Of course, with enough musical perceptiveness and enough physical strength to spare, one may produce good results in spite of this; but might they have been even better? His last recordings, unlike those of Artur Rubinstein, lacked the clear, crisp quality of the ones\* that he made in his prime.

Becoming clinically diagnostic, we can see Robert Taub's right fifth finger sticking up in the air where it has no business being (but somehow managing to get back down to the keyboard when it is needed); a mannerism that could be corrected quickly, were he to be persuaded that it is costing him some control over what is being played.

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<sup>‡</sup> A few years before his death in 1982 at the age of 95, Rubinstein made a request that two works be played at his funeral: the slow movements of the Beethoven 'Archduke' trio, and of the Schubert C major cello quintet. It was interesting to hear him say this in a TV documentary, because those were just the movements that I had already decided, twenty years earlier, were the two most beautiful pieces of music ever written.

\* We have in mind particularly his Moussorgsky *Pictures at an Exhibition* (RCA LM-1014).

\*\*\*\*\* MORE HERE! \*\*\*\*\*

### Amy Fay Gives Away the Secret

A remarkable American girl, Amy Fay (1844–1928) became the source of much of what we know about the state of music in general, and piano pedagogy in particular, just at its most formative time. She studied piano in Germany in the years 1869–1875, an ideal time to be there. The piano had just reached its present state of mechanical development, and its possibilities were being exploited furiously. This was the time of the great piano teachers of the next generation after Czerny – Liszt, Kullak, Deppe, and Tausig – all of whom she studied with. It was also the time when Clara Schumann, Joachim, Wagner, Hans von Bülow, Anton Rubinstein were in their prime, and she listened to, and met all of them. She had long private conversations with Liszt and Joachim, and spent an evening in the home of old Friedrich Wieck, Clara’s father. About the only notable German musician of the time whom she, apparently, failed to meet was Brahms. On top of all this, she also met Bismarck and made friends with some of the German nobility.

How could a lone American girl manage all this, at a time when the European intelligentsia regarded America as a land of illiterate savages? Amy Fay was perhaps the only one who had the talent and connections to bring it off. Her family had German connections (her great-grandfather had been a prosperous Hamburg merchant), and her father was a Harvard-trained linguist who taught her Latin, Greek, German, and French. She received her first piano instruction from her mother (the daughter of an Episcopal Bishop and an accomplished pianist) and by the age of five Amy was performing with notable proficiency.

The American conductor Theodore Thomas (manager of New York’s Steinway Hall) was her brother-in-law, and with him she had performed the first complete piano concerto heard in America. But she felt that she still lacked the polished style of a true artist, which could at the time be obtained only from the European masters. She knew exactly what she wanted to do, and had the means to do it.

To be sure, her success in Germany was not entirely due to her own talents. In Berlin, the American Ambassador Bancroft and his wife were enthusiastic music lovers, who took a parental interest in Amy and saw to it that she attended all the right concerts and social occasions and met all the right people. She had already acquired enough social graces and proficiency in piano playing to take full advantage of this (the fact that she had only to play once for Liszt, Tausig, Kullak, and Deppe in order to be accepted immediately as a pupil is ample testimony for that). After her return to America she embarked on a very successful career of concertizing and teaching.

What distinguishes Amy Fay from all other music students is that when in Germany, almost every week she wrote a long letter to her sister back home, telling in detail of all her adventures, and these were preserved. Somehow the letters came to the attention of Henry Wadsworth Longfellow, who saw their value as a social history of the times and urged that they be published – indeed, it was Longfellow who personally carried the manuscript to the publisher. The first edition appeared in 1880 under the title: *Music-Study in Germany*, and it has since been republished over thirty times in the United States and Europe. It was published by MacMillan in London at the request of Sir George Groves, who wrote a

preface for it. A French translation was introduced by Vincent d'Indy, who had heard her play and was impressed; and a German translation was sponsored by Franz Liszt himself.

Amy Fay's letters provide the most interesting and detailed account we have of the teaching methods, performing skills, and personalities of the great musicians of the time. Indeed, they provide almost the only information we have about Carl Tausig, who might have surpassed Liszt as a pianist, but also had serious psychiatric problems (how familiar that sounds to us today, when half the great pianists of our Century were afflicted likewise!). Tausig died suddenly and unexpectedly at the age of 31, when Amy Fay was his pupil.

Of immediate importance for us is that Amy Fay discovered, quite by accident through Ludwig Deppe, a major secret of Liszt's technique, of which Liszt himself was not consciously aware. Deppe understood the hand movements required for automatic legato playing, but had never seen Liszt play; Amy had, many times, standing close beside him in his Weimar studio and observing his hands closely without realizing the significance of what she saw until she met Deppe. This understanding revolutionized her own playing, and she explained it clearly, for the first – and to the best of our knowledge, the only – time in print. At least, she explained enough of it so that anyone with the wit to recognize it and carry on the line of reasoning, can reconstruct it all, and extend it further.

In the writer's opinion, two pages of Amy Fay's Chapter 24 – the letter of December 11, 1873, where she explains how to play the E major scale – are of greater value for piano technique than all the dozens of books written by teachers who did not really understand the physical facts.<sup>‡</sup> Many, with ulterior commercial motives, proceeded to embroider their 'methods' with grand, arbitrary claims – unjustified and dangerously misleading. Amy, with no such motives, was trying to explain it privately, and as clearly as possible, for the benefit of her own sister, and she had the expository sense that almost all of the others lacked: state things not in aesthetic or subjective terms that mean different things to different people, but in *objective* terms that all of us understand in the same way. And her words were always written within a few days of observing the event.

In other words, in Amy Fay's writings, everything is at last going right to give us a document full of detailed, explicit, and reliable information. One such good document is worth a hundred bad ones.

The principle she explains here is that, in playing the ascending E major scale, when the time comes for a shift of hand position (third finger on G $\sharp$ ) one does not turn the thumb under, reaching hard for the A; but instead rotates the hand a little on the third finger as a pivot, until the thumb is brought automatically over the A. One prepares the way for the thumb, which is kept free from the hand and slightly curved. Then to continue with the second octave, she reports:

“... when I got my third finger on D sharp, I kept my hand slanting from left to right, but I prepared for the turning under of the thumb, and for getting my first finger on F sharp, by turning my wrist sharply out. That brought my thumb down on the note and prepared me instantly for the next step. In fact, my wrist carried my finger right on onto the sharp

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<sup>‡</sup> One hundred twenty years later, reading those two pages accomplished for me in a day what 30 years of practice had failed to accomplish – the smooth legato touch that I had been striving for (or at least, the knowledge of how to practice so as to acquire that touch in any particular passage).

without any change in position of the hand, thus giving the most perfect legato in the world, and I continued the whole scale in the same manner. . . . The direction of the hand in running passages is always a little oblique.”

Then she recalls having watched Liszt play, as she had recounted some time earlier to her sister:

“Don’t you remember my telling you that Liszt has an inconceivable lightness, swiftness and smoothness of execution? . . . I suddenly remembered that when he was playing scales or passages, his fingers seemed to lie across the keys in a slanting sort of way, and to execute these rapid passages almost without any perceptible motion. Well, dear, *there* it was again! As Liszt is a great experimentalist, he probably does all these things by instinct, and without reasoning it out; but that is why nobody else’s playing sounds like his. Some of his students had most dazzling techniques, and I used to rack my brains to find out how it was, that no matter how perfectly anybody else played, the minute Liszt sat down and played the same thing, the previous playing seemed rough in comparison.”

Of course, it would be ridiculous to suppose that mastering this one little detail of hand motion is enough to make one a great pianist. It is only one of a hundred equally important little details; yet for nearly everybody it seems to be the least obvious, therefore the most difficult to discover. It feels wrong and unnatural at first, because one is bending the wrist joint in the “wrong” direction; not the one that Nature intended. But, having overcome every difficulty except this, it would indeed then become the remaining bottleneck, of overriding importance to a pianist, as it seems to have been for Amy Fay and her fellow pupils of Liszt. In a few months of conscious practice it becomes automatic; then one can go back to concentrating entirely on the music.\*

But in order to appreciate this at first hearing, one needs to have a little knowledge of physics and physiology, and some experience at piano playing. Therefore, it seems a pity that Amy Fay did not also meet Hermann von Helmholtz, who just two years before had moved from the University of Heidelberg to become the Director of the new Physical – Technical Institute in Berlin. This man, the greatest scientist in Germany and as we have noted also a competent pianist and a personal friend of Joachim, would have understood instantly her discovery that this was the long missing fact behind Liszt’s seemingly supernatural technique, seen its full implications, and extended it beyond what Amy Fay had seen. He could have used the facilities of his Institute to produce photographic proof of it (an early movie), by persuading Liszt to allow his hands to be thus photographed while playing; Liszt was vain enough to jump at the chance to leave this evidence for posterity. Helmholtz could have sponsored a public demonstration of it at his Institute; now that it was understood, talented young pianists who had just learned this could then exhibit the old wrong, and the new right way of playing in much the same way Artur Schnabel had, showing that they too could now play like Liszt. Had this happened, this new understanding would have been a central part of the pianistic tradition from that time on.

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\* But we think that one can waste much time on endless practising of scales for this purpose only, as Amy Fay seems to have done. We were gratified to see the great pianist Josef Hofmann (1909) later expressing exactly our view: “*I do no technical work outside of the composition, for the reason that I find plenty of technic to work on in the piece itself.*” This has the further advantage that by concentrating on the actual music, no bad unmusical habits are formed.

As it is, this little detail has been so far from obvious to others that those whose minds were unprepared for it were unable to see the point even after Amy Fay had explained it; even today, it is not generally comprehended. For example, the statement is made, in the unfortunate Introduction to the 1965 Dover Edition of her book, that this method of achieving legato was the “weight–relaxation method” taken up by Tobias Matthay and others (that is, a method in which the arm muscles are relaxed, so that the keyboard supports the weight of hand and arm, and one plays successive notes by transferring that weight from one key to the next).<sup>†</sup> It seems to us that this is a calumny on Amy Fay; anyone who makes that claim has simply not taken the trouble to read and understand her words. She is not discussing weight–relaxation at all; she is concerned with lateral hand movements, which can be done with or without weight–relaxation. A glance at Matthay (1947), with his foggy confusion, facts all wrong, inconsistencies, fiercely argumentative over matters far above his head – is enough to dispel that idea; Amy Fay committed none of that foolishness. In any event, for mechanical and anatomical reasons, weight–relaxation is not possible except in slow *pianissimo* to *mezzo-forte* passages; and then it is done automatically by anyone who follows the general advice to avoid unnecessary motions and exertions.

Misreading of Amy Fay’s clearly written remarks is surprisingly common, because her message was so unexpected. As another example, Schonberg (1963, p. 169) tells us that:

“Liszt himself was no theorist of technique and must have played without thinking twice about how he accomplished his effects. It seems clear, though, that he employed a weight technique, playing with loose shoulders and a fairly high position of hands and fingers, with hands slightly out–turned so that they naturally covered the E major scale (Amy Fay is quite specific about this).”

Somehow, he has got her message completely fouled up; there is no one position of the hand which “naturally covers” the E major scale (as he might have discovered for himself in ten seconds at a keyboard); and Amy Fay said no such thing. She is discussing what happens at the turning points in an ascending passage with the right hand or a descending one with the left hand. There the hands must be turned *inward* (that is, wrists outward as Amy says) in order for the finger to be brought into the correct position for the next note after the turning point.<sup>‡</sup> Again, we are unable to understand how he can see in her words any reference to a ‘weight technique’; that is just not the topic. But psychologists

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<sup>†</sup> As is evident from the considerations of the previous Chapter, by transferring the weight of hand and arm at different rates one can achieve a certain dynamic range. But even a ton of weight simply transferred instantaneously to a different key would not be enough to achieve the loudest sound, because a weight dropped does not start moving at high speed, as Galileo showed 400 years ago. Any weight released and falling freely requires 44 milliseconds to fall the first 3/8 inch, corresponding to the key travel; and this (representing the acceleration of the earth’s gravity) determines the maximum key velocity that can be attained by pure weight transference. Dynamics from *pp* to *ff* corresponds, as we saw in Chapter 5, to about 120 to 12 milliseconds key depression time; 44 milliseconds stands somewhat below the middle of this range, and corresponds to a rather mild *mezzoforte*. If the loudness called for by the music is greater than this, then weight transference alone will not suffice; it must be supplemented by muscular exertion to increase the downward force on the key. Put differently, anyone who plays louder than a weak *mezzoforte* cannot be using pure weight transference, even though he may think that he is.

<sup>‡</sup> Thus to an onlooker, the right hand seems to drag behind the wrist as it moves up the keyboard;

are well aware that people tend to see what they expect to see, whether it is there or not; the more unexpected the message, the more the mind refuses to see it.\*

We are concerned here not only with wrist motion but also with finger motion. For absolutely smooth, seamless execution of a passage, it is necessary that while one note is sounding, the finger for the next note must be brought not only into the right position over the next key, but it must be actually in contact with that key. When one finally accomplishes this, the sound suddenly becomes not only just what one wanted; at the same time, there is a wonderful sensation, that you have finally achieved complete control over the exact phrasing and dynamics, and are therefore able to explore fine differences in phrasings that were not possible before. Once you have experienced this you will never again use any other hand motions on a really expressive passage, and it is easy to understand why Liszt's playing sounded like nobody else's.

Why did Amy Fay mention only what the hand must do in playing an upward scale? Because the downward (in the right hand) motions always seemed to come relatively easily; everybody learns quickly how to do it. Indeed, in playing scales, arpeggios, and even parallel thirds, the right hand finds downward passages much easier to execute smoothly than upward ones. Nevertheless, one might think that the motions required for downward scales must be the same as for upward ones, only in the reverse direction; so why do not the same considerations apply?

To answer this, merely play any scale, very slowly, and watch what your right hand is doing. On the upward passage, the break occurs when the thumb must be moved – not so much under, but past – the third or fourth finger; the new thing Amy Fay learned is that the hand should be pivoted about the third or fourth finger, which requires an unusual and unaccustomed large sideways bending and forward lateral motion of the wrist. But on the downward scale, the third or fourth finger must be passed over the thumb; and now things are very different, in two respects. In the first place, smooth execution requires the hand to pivot instead about the thumb. It is *not* the same motion in reverse direction; the pivot point is now much closer to the wrist, and less sideways motion of the wrist is needed.

But secondly, a new factor comes into play here; if the downward passage calls for the fourth finger immediately after the thumb, then everything we said above applies unchanged. But if it calls for the third finger, another motion – counter-clockwise rotation of the hand about the arm as an axis – is now available, which will accomplish the same smooth transition.† This rotary motion is easier for a pianist to discover by trial – and –

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this is what Amy Fay saw while watching Liszt, and what we would be able to see today, had that movie been made.

\* The writer has observed this phenomenon many times when he tried to expound some unconventional ideas about physics; no matter how hard I labored to achieve absolute clarity – every sentence rewritten a dozen times over many months to avert every possible misunderstanding – several readers would miss the point completely, and dash into print, accusing me of saying all kinds of different things, entirely unrelated to what I *did* say. At its best, the human brain is an imperfect reasoning device; the surprised brain, having no prepared response, may become totally irrational.

† It is impossible to see the reason for this from a verbal description; one must try it at the keyboard, and then it will become clear why it works so well.

error practice, and this is why we find downward passages easier to execute. In any event, some conscious thinking and practising with both of these hand movements in mind can improve the smoothness of downward passages also, by increasing the usual amount of wrist bending and adding a little hand rotation, so that the legato is achieved more easily.

The ease of discovering the rotary motion is shown by another historical incident. Some forty years after Amy Fay's German study, Karl Leimer (Founder of the Municipal Conservatory in Hannover) was a successful piano teacher there. His most notable pupil was Walter Giesecking, whose sole piano instruction was from Leimer, in 1912 – 1917. This collaboration resulted in a very small book (Leimer–Giesecking, 1932) on piano teaching methods. They start with some excellent advice about using your brain first, fingers second. Then they discuss, very succinctly, some of the points we make above in a way that we consider, from the standpoint of physics, almost entirely correct and important, only incomplete.

In particular, they stress the inadequacy of pure weight transfer and the necessity of avoiding all unnecessary finger movements and of keeping the fingers on the keys in order to achieve the smooth, sonorous tone for which Giesecking was famous in his interpretations of Debussy (just what Schonberg did not understand in the case of Clara Schumann). They recommend this hand rotation movement for the same purpose we did. However, there is no mention of Amy Fay or the lateral wrist bending movement, which we consider far more important and more generally needed. This work communicates to the reader almost as well as does Amy Fay's, because it is presented in objective terms.

**Liszt's Dummy Keyboard:** These considerations also suggest an explanation of something that has been puzzling to pianists for a Century. We know that Liszt, on his concert tours, carried with him a little silent keyboard on which he practiced when alone in his room. A photograph of it may be seen in the Larousse Encyclopedia of Music (1974, p. 319); it has standard size keys but only four octaves,  $C_2$  to  $C_6$ . The puzzle has been: it seems that such a toy could be of interest only to a child in the first week of piano practice; of what use could it possibly have been to Liszt? With only four octaves, he could not have rehearsed what he would be playing at the concert; and with no sound it could not possibly lead him to correct dynamics and phrasing of anything.<sup>‡</sup>

We have now a plausible conjecture for what Liszt did with this strange device, because we have discovered that practicing the Amy Fay movements can be done as well on an electronic keyboard with the sound turned completely off. What is essential is only that the size and spacing of the keys and extent of key motion be correct. If one's execution of a running passage is not perfectly smooth, the fastest way to correct it is to play it very slowly, while watching the hand. This makes it evident at once how much lateral wrist motion is required at each turn-over point so that the next finger is brought into exactly the proper position for the smoothest execution of the next note. Then one increases the velocity while keeping the same wrist and finger movements.

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<sup>‡</sup> Lawrence Schauffler (1937, p. 119) expressed the same view more strongly: "The vogue of the clavier or 'dummy' keyboard is so far past that we need hardly mention the often disastrous musical results of such practice. It might possibly be used in the one case of practicing exercises, provided the key resistance were made no greater than that of the piano, but even then it would serve no real purpose."

This is purely a matter of geometry, for which both the production of sound and the key resistance are quite irrelevant. We suggest, then, that Liszt may have used this keyboard for touching up – before anyone else detected them – passages which he had noticed, in his previous concert, did not go with perfect smoothness. For getting the exact lateral wrist movements needed, a dummy keyboard is just as good as a real piano. We are unable to conceive of any other way in which such a keyboard could have helped him.

### **Summary: The Three Commandments**

Although we have been through a large mass of details, it can all be summarized very quickly. There are three basic rules for achieving accurate control and endurance in any coordinated muscular activity, from piano playing to pole vaulting:

- (1) Do not make unnecessary movements or muscle contractions.**
- (2) Do necessary movements as smoothly as possible.**
- (3) Use the strongest muscles that will do the job.**

On meditation, it will be seen that all the detailed recommendations we have made, can be reasoned out as simple consequences of these rules. We suggest that all the grains of truth in the various ‘piano methods’ of the past, are contained in these three Commandments. In the third, “do the job” means, of course, “do what needs to be done, at sufficient velocity and *under full control*.”