CHAPTER 1

DEFINING OUR GOALS

Our basic goal here is to help a musician to get technical facility in playing a musical instrument, more quickly and to a higher level, than would the traditional trial–and–error practice. There are some secondary goals which will become evident as we proceed.

Many persons who might have become important performing artists, give up and leave the field because a few years' practice failed to give them the technical facility needed before one can concentrate on the music; and it was evident that further practice was not producing any improvement and their teachers were unable to help them. We need first to explain why the information we have to offer is important to such persons, why it is difficult to communicate, and how – for that reason – the reader needs to cooperate with the writer. The reader's responsibility is not to learn some science first; but rather to understand why we do things in a particular way and bear with us as we do them.

Communication Difficulties

In the writer's experience, a person without any musical education has heard the names: *Bach, Mozart, Beethoven*, but has no conception of exactly who they were, when they lived, what they did. Furthermore, in the mind of the musically untrained person such terms as *symphony, sonata, concerto, string quartet, cadenza, melody, harmony* are all lumped together, indistinguishably, all having vaguely the same meaning to him as the word *music*.

Then imagine a musician trying to discuss music with such an untrained person. The musician will use those words, which have to him clear and distinct meanings; but the listener will not grasp those meanings, and will not understand what the musician is saying. And this works both ways; the musically untrained person, trying to say something about music, will use indiscriminately whichever of those words happens to pop into his mind. The musician will naturally try to interpret the words as having meanings that they do not have to the speaker and will not be able to make sense out of them; and so again, the message will not get across. The trained and untrained persons, having no common vocabulary of musical terms, are unable to communicate any definite ideas about music.

It is exactly the same with our present topic. For a trained physicist, the words *force, momentum, energy, velocity, action* all have very precise, and entirely different, technical meanings; and all those terms are necessary in order to describe precisely how things move. For one without this training, all those words have, vaguely, the same meaning as the word *motion*; and he uses them indiscriminately when talking about anything moving. The result is that, lacking a common vocabulary, they are unable to communicate to each other any definite ideas about how something moves.[†]

But the problem is even worse when the movement occurs in playing a musical instrument, because not only are the meanings of the technical terms needed to describe

[†] There is a book on piano technique in which the author fails to distinguish between the words *force* and *energy*, so we can make no sense out of what he is trying to say.

motion blurred, the very distinction between what is happening *objectively* in the hands and instrument and what is felt *subjectively* in the mind of the player, is equally blurred. Indeed, this is almost sure to happen even if the player does have scientific training, so all of us need to take extraordinary precautions to counteract it. Our communication can be blocked for two equally troublesome reasons, either one potentially fatal.

So this is the difficult task we have set ourselves: how to explain to a person with musical training but not scientific training, what is actually happening in a played musical instrument and in the arms and fingers of the player, and what this means for acquiring good technical control over the instrument.

What Use is Mechanical Knowledge to a Musician?

But why is it important to convey this information? After all, musicians have been getting along without it for Centuries (in fact, since long before scientists knew it), and one can point to many highly accomplished musicians in every generation. Obviously, there is nothing a scientist could tell Paganini about a violin, or Liszt about a piano, that would have given them any better technique than they already had; and for 'Paganini' and 'Liszt' the reader may substitute the names of his own favorite contemporary virtuoso performers. Some, noting this, even express the fear that scientific knowledge of what is happening might be actually harmful to musical values, because that would distract one's attention from the music.

The truth is just the opposite. It is the musician whose technical control is shaky who is obliged to worry constantly about the mechanical details of what is being done. Before one can think about how a difficult passage should be played from a musical standpoint, it is necessary to get the technical control that enables one to play it at all – hitting the right notes at the right speed. The more complete one's technical mastery, the more automatic the correct technique becomes; this mechanical knowledge becomes, so to speak, transferred from the brain to the fingers. Then the musician, instead of being preoccupied with those mechanical details, is at last free to *concentrate conscious attention entirely on the music*.

It is perfectly true, as all the evidence of history tells us, that with enough musical perceptiveness (so that one knows whether some change in technique has made things better or worse) and enough persistence, one can by trial–and–error, without any conscious understanding, acquire both great musical and technical facility on an instrument. But we raise three points, which apply equally well to all instruments:

(A) How long did it take to acquire that technical facility? In the beginning stages – perhaps the first year of study – the pupil is hardly concerned with musical aesthetics. The immediate problem is simply mastering the mechanics of the instrument – how to handle it so as to get any acceptable musical sound at all out of it. At this stage, conscious understanding of the mechanics involved can speed up one's progress. A beginning violinist might require a long period of trial–and–error to happen on the right bowing technique (combination of bowing point, velocity, and pressure on the string needed to produce the desired loudness, duration, and tone), because that correct technique seems at first wrong and counter to what one would have expected.

But will not the teacher supply that information? Not necessarily! A violin teacher might know perfectly well how it feels *subjectively* to play correctly; and yet not be consciously aware of what is being done *objectively*. But subjective sensations cannot be communicated† accurately to another person, so such a teacher could never explain proper violin technique to a pupil, only demonstrate it by example. But a little understanding of exactly how the string moves under the bow (too fast for the eye to see) would have made the correct rules of technique obvious; and most important, would make it easy for a teacher to explain it so the pupil understands *why* this is the correct technique and what are the predictable and inevitable consequences of *failing* to obey it.

(B) How many musical talents have been lost for this reason? That is, how many students, who had fine musical perceptiveness and might have become excellent musicians, abandoned the field because their undirected trial–and–error just never happened to hit upon the right mechanical technique, and so they never reached the level of technical skill that permitted them to concentrate on the music? How many others stayed in music but never developed their full musical capabilities? Put differently, how many music teachers failed to train their students adequately because, lacking this mechanical understanding, they were unable to explain proper technique to them?

(C) Even after one has acquired good mechanical facility on an instrument, a conscious understanding of what is happening will almost surely enable one to get those results with less effort and therefore greater control and less fatigue – and therefore achieve a better overall musical effect. The human anatomy is equipped with various different sets of muscles, any of which can produce, after a fashion, the correct movements. But they differ greatly in strength, fineness of control, and endurance. The coaches of athletes who win Olympic Gold Medals have long since taken full advantage of this knowledge. A musician who is consciously aware of it can take equally good advantage of it, for a higher purpose, as we shall see in Chapter 6.

A Case History

A good example of these points is provided by the most famous of all pianists, Franz Liszt (1811–1886). His contemporaries have testified about his playing in some detail. Charles Hallé remarked about the perfect articulation and clarity of his playing, while his pupils remarked at the *smoothness* of his playing; however well they had prepared a work, Liszt would, immediately, play the same work in a way that made their own execution seem rough and jerky. Put more specifically, among his many accomplishments Liszt had the most perfectly smooth, uniform legato execution, at any speed, of passages such as scales and arpeggios that require repositioning of the hand (usually, passing the thumb under the palm of the hand). At the same time, he managed this with the most perfect clarity, every note being heard.

But Liszt did not come by this facility naturally; even after he had been famous for ten years – first as a boy wonder, then as one of the greatest virtuosos – he had not yet perfected this touch. But the shock of hearing Paganini, and suddenly realizing the

† For example, try to explain *in words*, to a person with no musical experience, the difference in sensation between a minor third and a major third.

difference between being a very good performer and having *total technical control* over an instrument, made him resolve to do for the piano what Paganini had done for the violin. He retired from public life for a year, to achieve that control by intensely hard practice, mostly scales and arpeggios. After this, he returned to concertizing and his greatest triumphs, with a totally new level of accomplishment – what has come to be called his "years of transcendental execution".

Then the secret of this technique was nearly lost. Having achieved this touch for himself by trial–and–error, Liszt was unable to teach it to his pupils. He knew perfectly well what it felt like *subjectively* to play correctly, but he was not consciously aware of what he was doing *objectively*; so again he could not explain it, only demonstrate it. His pupils were trying desperately to acquire his technique; yet in his lessons he said nothing about technique, instead offering only comments about interpretation.

While Liszt inspired his pupils by giving them incontrovertible proof that this technical control was *possible*, it was left up to them to discover for themselves what specific mechanical actions of the hand are required to *actually do it*. Accordingly, some of his pupils (d'Albert, Tausig) managed to acquire that touch reasonably well by their own efforts, but most of them never did. And those who did acquire it were in turn unable to pass it on to their pupils.

As it turned out, one who observed Liszt's hands very closely could have learned what he was doing (he was bending his wrists sideways in a way that feels wrong and unnatural at first, but which moves the fingers smoothly and automatically into the correct position for the next note, making quick jerky changes of hand position unnecessary – and, incidentally, promoting high accuracy). The first person to realize this was his American pupil Amy Fay (1844–1928), about whom we shall have a great deal to say in Chapter 6. It is pleasant to record that Liszt himself appreciated her written account of this so much that, in almost the last year of his life, he sponsored its translation into German and publication in Germany; so for those who knew where to look and had the wit to understand her message, the secret was not lost after all.

Retraining

We have already noted that in the beginning phase of study, conscious knowledge of what is happening mechanically, far from destroying musical values, helps to make the correct technique automatic, so that one can arrive more quickly at the level where one *can* concentrate on the music. But now we add that real instruments always have individual imperfections, and when even the most accomplished musician is obliged to use a different instrument, a new short learning period, calling again on this conscious mechanical knowledge, is necessary before one is able to compensate for its shortcomings in an automatic way.

No two pianos have exactly the same feel of the keys, the same variation of stiffness and loudness across the bass–treble range, or the same variation of tone with loudness on any one key; and so when one changes instruments one must adjust to this. A person who is obliged to practice on an upright piano will tend to produce a muffled sound – booming bass and weak treble – on a grand piano until this re–training is done to compensate for their different dynamics. Indeed, after every tuning your own piano responds differently

than it did before, and a short re–training period is necessary before you can again produce the sound you want.

The writer's own experience is with the piano; but the same phenomenon is undoubtedly even more true of the violin and its relatives. We conjecture that it must be true also of woodwinds and brasses, but have no direct experience of it; therefore we must refer interested readers to the treatise of Arthur Benade (1976) for this kind of information.

These general observations are, of course, not limited to the playing of musical instruments; they apply equally well to any athletic or other coordinated activity. An automobile driver who understands consciously what the brake and accelerator pedals are doing, can learn the correct way of handling them far better and more quickly than one who finds their mode of operation mysterious and bewildering. Therefore one arrives more quickly at that expert phase in which one's attention is concentrated on the road conditions and the right things are done automatically – even in an emergency – without conscious thinking about mechanical details. But when one is obliged to drive a different automobile, it will surely respond differently to the controls, and that conscious mechanical understanding needs to be called upon again, to become aware of the difference quickly and adapt to it so that it becomes automatic. Every time the writer rents an automobile at a distant airport, he is obliged to go through a half–hour of this retraining before being able to drive it in a confident, automatic way.

In addition to understanding the mechanics of particular instruments, one of our secondary goals is to share a common cultural background that both musicians and scientists ought to have, concerning the origins of musical instruments, how much conscious technical knowledge went into their design, and what defines our scales, whether tonality and the diatonic scale are forced on us as a prerequisite for harmony. Accordingly, the next three Chapters supply a bare minimum of this and guide to the literature, after which we turn to what science has to tell us about proper playing and adjustment of the violin and piano, speculations on future musical instruments (in particular, is there any hope that we may have a truly satisfactory piano in the next Century?), and comments on musical aesthetics. However, the following Chapters may be read in any order; although there are many cross–references, the early ones are not prerequisites for the later ones.