Chapter 2

Intonation

No fundamental problem facing the conductor poses a greater pitfall than that of tuning. When intonation is erratic in an orchestra, it is difficult to make any aspect of performance convincing. Perhaps the greatest damage done by such intonation, other than its own offensiveness, is the negative effect it has on orchestral tone. In order to achieve good tone quality in an orchestra, it is necessary that the acoustical fundamental tones of two notes be in tune, in order that the overtones of those fundamentals also be in tune. And since it is the overtones which determine the character of sound of an instrument, out-of-tune overtones do not blend, and the ensuing results are displeasing. Beauty of tone is thus impaired by poor intonation.

In addition, ensemble and articulation are obscured by faulty intonation, balance becomes a more serious problem, and interpretation a great frustration. One out-of-tune wind player in a professional section can undermine the spirit of an entire section of pitch-conscious players until they lose their desire to perform in that section.

Curiously, some conductors who possess otherwise strong musical qualifications in other fundamental areas (tone, rhythm, interpretation) are rather indifferent to tuning problems, and they assume that the musicians will work out their own tuning differences. It rarely turns out that way in such an orchestra, and there is a general lack of clarity because of the faulty intonation.

Tuning is such a complex problem that it plagues major symphony orchestras as well as junior high school bands. Although the problem has been a major orchestral frustration throughout the orchestra's history, our highly developed technology of today—influencing instrument construction and providing electronic tuning devices—has made it possible to eliminate at least the most serious problems of tuning an ensemble. However, unless the conductor provides the leadership which encourages individual players to use whatever means are available to improve their intonation concepts, the orchestra will not sound "clean." Again, the orchestra reflects the *conductor's concept* —this time of pitch.

Deficiencies of intonation such as impure octaves, a melodic line in which the woodwinds are out of tune on just two or three notes, a brass crescendo which becomes increasingly sharp, chromatic chordal relationships which require greater accuracy on the part of string players, a trumpet sustaining a slightly sharp, low concert C, and a major triad with the fifth played sharply, must be the conductor's alarm signals. He must immediately stop and correct any such deficiency before continuing. Too often the conductor overlooks such problems because he is not disturbed by them. An orchestral player who is conditioned to expect to be stopped for such intonation errors will eventually begin to correct the problems himself.

Of course it should be understood that not all problems can be corrected in one rehearsal. However, if the conductor makes it known that faulty intonation is an ever-present evil spectre, he can make it one of his major points of emphasis in each rehearsal, and this type of effort will gradually wear away the rough edges of pitch. A conductor who does not stress intonation in each rehearsal is like the carpenter who strikes the nail so carelessly that he leaves hammer marks in the finished woodwork. True, his cabinet might be still functional when finished, but the pitifully poor craftsmanship destroys the beauty of his product.

REHEARSING INTONATION

Every orchestra should begin each rehearsal by playing something which is not too technically involved, such as a chorale-like movement. Each chord and each unison should be perfectly tuned in the process. Through this, intonation can be stressed at each rehearsal without concern for technical problems, with the players devoting nearly all of their attention to intonation. The orchestra can then produce its very best intonation *at least once* in each rehearsal. This will assist the development of improved intonation concepts among both the conductor and his musicians.

With a very young orchestra, certain pitch problems can never be completely eliminated, but no conductor should avoid a sustained effort to eliminate them all. Particularly with a younger orchestra, the problem will have to be approached firmly, but not so incessantly that the players lose their interest through a lack of opportunity to get enough involved in performance.

Almost all musicians will respond positively to a conductor who is pitch-sensitive and who is making an improvement in the orchestra through this sensitivity. The degree of tact and pacing which he uses in his attempts to achieve good pitch are a problem of personality and intelligence.

A-440—THE ORCHESTRAL PITCH STANDARD

There often exists a perennial disagreement between the oboist, who wishes to use the standard tuning A, based on 440 cycles per second, and the string player, who prefers his A a bit higher. The string players have a strong tendency to insist on the higher pitch, since the increased tension on the strings also produces a more brilliant, intense tone quality. The use, by the Boston Symphony Orchestra, of an A of 444 cycles per second and other professional orchestras tuning at 441, or 442 cycles per second, tends to make higher pitch a fad among conductors who are not capable of dealing with the resultant problems.

Most orchestras tune at either 440 cycles, or slightly higher—perhaps 441 or 442. The danger of a higher pitch than 442 lies in the tuning of the woodwind instruments. Most woodwinds are constructed with 440 cycles per second as a standard to which the entire tempered chromatic scale of the instrument is related. If a wind instrument is forced to tune much above or below that standard, the various registers will be forced apart or together. A higher pitch also forces the wind players to "pinch" and produce a smaller, constricted tone.

Perhaps the Boston Symphony wind players can travel to Paris or to their own repairman or manufacturer to have their instrument adjusted or constructed to their specifications so that they can use the higher pitch standard without impairing their performance. This is an unusual situation, however, and fortunately most orchestras are not trying to "upstage" the Boston Symphony with 445 c.p.s. or higher. For the conductor of a school or community orchestra, the wisest course is to stay as close to 440 as possible. John De Lancie, first oboist of the Philadelphia Orchestra expresses his resistance to a pitch above A-440 with the question, "Where does it end?"

Again, it is the conductor who must first decide on the best pitch for his orchestra, and then demand that the oboist, or an electronic tuning signal, produce that pitch, and that all members of

the orchestra adhere to that pitch standard. The conductor who refuses to become involved while players battle over several concepts of the tuning note is inviting a very aggravating situation. And if he allows the orchestra to perform without resolving the conflict, thereby allowing more than one concept of pitch to exist simultaneously, he perhaps would be happier with players who are also not so concerned with the pitch problems. Such orchestras do exist, but they do not inspire a great deal of praise. Most serious orchestral musicians feel that unless the conductor constantly agitates for adherence to the pitch standard, even the finest orchestral players cannot solve the problems of tuning in the orchestra.

It should be understood that especially in a school orchestra, the students will look to the conductor for their leadership, and the leadership with regards to pitch can only come from the conductor of such an orchestra. Even the idea of a pitch standard might be foreign to the members of a student orchestra, and it is in such an orchestra where a fine concept of pitch can begin. It does not occur, however, unless the teacher/conductor is sensitive to pitch, and unless he continually keeps his students aware of the importance of listening and adjusting to each other.

USE OF AN ELECTRONIC A-440

The question of the source of the tuning note also arises. The tradition of using the oboist is questionable, since so many oboists, particularly among amateur players, do not produce a consistent A-440. Some conductors have taken a positive step towards solving the problem by using an electronic instrument to produce the tuning note. There are several such instruments available (see page 16) and they are far more reliable than most oboists. They also offer the additional advantage of taking the pressure off of the oboist. Most oboists welcome the relief. Leopold Stokowski, during his tenure as conductor of the Philadelphia Orchestra, used a mechanical tuning device with the orchestra at the Curtis Institute as early as 1938. The device had to be pumped, and had a tuning range from A-436 to A-442. Mr. Stokowsky used A-438.

Some conductors feel that it is not as "professional" to use such an artificial tuning note, and there are conductors who balk at using an electronically produced pitch even though their oboists might produce a different A at each rehearsal. Apparently, it is more important to such a conductor to "appear professional" by using an inconsistent oboist than it is to sound professional by having a consistent tuning note. It is my understanding that several of our major U. S. orchestras now use such an electronic A. It seems logical that each conductor must determine as best he can with what degree of consistency his oboist produces the tuning "A." If not to his satisfaction, then the conductor must insist on an electronically produced A. It is immensely important that the tuning note be consistent, not only from rehearsal to rehearsal, but from hour to hour in each rehearsal.

There are many orchestras—particularly community orchestras—in which the attention given to the tuning note is dreadfully lax. In such situations the oboist may give an accurate A, but many of the players use the A merely as sort of a perfunctory signal that the concert is about to begin. A renowned guest conductor remarked to the cello section of a community orchestra, "You might at least tune your open strings." This was not meant to be sarcasm. He had hit upon one of the great weaknesses of the orchestra. After the oboist had given the A, there was immediately a loud blast of A (A?) from all instruments, and the strings never had an opportunity to tune their open A string and the other open strings before that blast from the rest of the orchestra. Any orchestra, other than a fully professional one, will have a few string players who are not totally confident about tuning the open strings, and frequent checks by the conductor serve to impress on them the importance of striving for perfectly tuned open strings. Wind players are frequently even more careless. Not unusual is the situation in which the wind player arrives at the rehearsal too late for adequate warm-up, and his matching of the A is merely a momentary phase. Within a few min-

utes his pitch is much above 440, and in many situations the player makes no attempt to pull back to the standard.

PITCH AND TEMPERATURE

It must be remembered that the pitch of a wind instrument will rise more rapidly than the pitch of a stringed instrument because of the wind instrument's contact with the breath of the player. When the wind instrument is cold, it cools the air coming from the lungs, and sound travels slower in cold air, producing a lower pitch. The pitch rises with the temperature of the air inside the wind pipe.

As the instrument is warmed by both the room temperature and by the warmer temperature of the breath, the pitch rises higher than it does on a stringed instrument. The wind player must consequently be even more alert than the string player to changes in pitch resulting from a sustained playing situation and changes in temperature.

TEMPERED TUNING AND THE WIND INSTRUMENTS

An even more acute problem among some wind players is their failure to realize the importance of tempered tuning. Does a wind player use equal temperament (tempered tuning or the tempered scale) in playing in an orchestra or does he tune to pure intervals? The experienced wind player is aware that both systems of tuning are used in ensemble playing. The less sensitive wind player might answer that he tunes exclusively to pure intervals, (the term pure interval referring to ratios of 3/2, 4/3, 5/4, 6/5, etc., for the perfect 5th, perfect 4th, major 3rd, minor 3rd, etc., respectively), and that he has no need for equal temperament. As a system of tuning there is that somewhat unsavory aspect of equal temperament—its impurities—which makes such a player believe he should shun such a system. And he is correct insofar as he is applying this reasoning to a sustained harmonic situation involving traditional chords constructed in thirds. However, most wind passages in the orchestral literature rule out the possibility of tuning with pure intervals. (This applies to all levels of orchestral and band literature.) First, other than in very slow and sustained harmonic passages, the movement is too fast to allow most musicians to make any adjustment to pure harmony. Second, many melodic passages are also too fast to permit adjustment. Third, one of the greatest intonation challenges for the wind player is that of playing in unison or octaves with other wind players, which precludes the use of pure intervals in moving melodically from one note to the next, because, again, the passage is usually too fast, and there would be a need for both players to adjust with a common concept of the melodic interval. Finally, most current contemporary music, serial music in particular, rarely offers anything so "homey" for tuning as a major third. In such music, the player must rely on his concept of the note as it appears in his chromatic scale.

In each of the situations described above, wind players with a well-tuned tempered chromatic scale simply rely on that scale as their common ground. A remarkable event takes place when two extremely conscientious wind players from different parts of the country, both of whom have a finely tempered chromatic scale based on A-440 c.p.s. play together for the first time. Tuning problems are rare, and each player has an immediate respect for that aspect of his colleague's musicianship. Such a unified concept of intonation creates an unusually fine atmosphere for making music.

THE SOMEWHAT WELL-TEMPERED WIND INSTRUMENT

In addition it must also be noted that for good reason, instrument manufacturers, in striving for the most perfectly tuned wind instrument possible, always seek as their standard the tempered

chromatic scale. For various acoustical reasons which a conductor should know, manufacturers never quite succeed (in spite of commercial claims), but they occasionally come close enough so that a sensitive wind player can learn to adjust such an instrument to a tempered scale. However, no two wind instruments—even two Heckel bassoons of the same series—will have the same discrepancies in their tempered scale. The wind player must get to know the discrepancies of his own instrument and the required adjustment necessary to achieve a well-tempered chromatic scale.

School band directors in particular must be aware of the importance of a wind instrument being tuned as closely as possible to the equally tempered scale. Most school musicians—certainly on the pre-college level, and perhaps even most musicians on the college level—do not develop a real sensitivity to pitch. Such pitch awareness would enable the student to adjust his instrument when necessary in correcting flaws in his instrument's tempered scale. A carelessly replaced pad on a saxophone can turn a half-step into a quarter tone, and this occurs more often than we would like to believe. Also, most valved brass instruments are played by students who do not understand the tuning slides, which should be used to get the best approximation of a tempered scale.

Beyond such problems as the difficulty of keeping the instrument in condition and properly adjusted, is the problem of trying to adjust to pure intervals, a problem which is discussed in more detail later in this chapter. In view of such problems within a school band we are faced with the additional harsh fact that most instruments owned by school musicians are not constructed according to the highest professional standards of pitch. And although the quality of wind instruments used in schools has improved considerably in recent years, there are still examples of "mail order house" purchases of instruments, "hand-me-downs" from a relative, instruments which are desperately in need of overhaul, even some companies which turn out questionable instruments, and the fact that the professionals get first choice of the best instruments made by the best companies.

Certainly with all of these pitfalls facing the conductor of a school band or orchestra, he should search for an instrument which has as few built-in tuning problems as possible.

If the conductor experiences unusual difficulties in tuning the winds of his orchestra—usually most evident in unison passages—he must find out which of his musicians have been exposed to the above, or similar ideas on equal temperament. Or in the case of a school orchestra, which of his students' instruments are relatively close to a tempered scale. If there is direct hostility to these ideas, then one must hope that the musicians with such an attitude are extremely gifted, and that they can play unison passages in tune without the aid of equal temperament. (It is my personal opinion that many of the players who reject equal temperament and claim to use only pure intervals, seem to use neither, and use "pure intervals" as an excuse to cover for their inability to tune to the other members of the ensemble. "Everyone is out of tune except me.")

If the conductor is not confronted with such an attitude, he can guide his musicians towards an improved tuning standard, using equal temperament as the guideline for tuning each player's instrument. On all levels of orchestral playing, wind instrument players will perform with a better concept of intonation if they know how near their instrument is to equal temperament.

Two additional points which are significant in regard to tempered tuning are: 1) It is generally accepted that the player tunes the instrument. If a musician is not careful, however, the instrument can "detune" the player. Continual exposure to a slightly out-of-tune note can make the player feel that the note is in tune. An occasional objective analysis of each note on the instrument to test its proximity to equal temperament—the goal which the manufacturer tried to achieve —is very revealing and helpful. 2) In spite of any imperfections which the tempered scale might have in tuning wind instruments, we must be aware that it is our best means of being nearest to acceptable intonation considering all of the keys and all of the musical situations encountered by wind players.

TUNING TO THE CHORD OF NATURE

The preceding dealt with the importance of tempered tuning in the orchestra. I wish to stress the fact that, although tempered tuning is of great importance, never should a conductor overlook the importance of tuning to pure intervals wherever possible.

At a recent state music educators' convention there was on display a model of the Johnson Intonation Trainer (see p. 20). This is one of a number of electronic tuning devices which have entered the market in recent years, and which will have a profound effect on concepts of intonation in the future. It is a small three octave keyboard, each tone of which is easily adjustable. The gentleman demonstrating asked many curious band directors to try their skill at tuning a perfect fifth. Towards the end of the day he lamented the fact that only two out of five of the directors were able to tune the fifth accurately.

A problem of not quite such serious proportions exists in many orchestras in which the conductor tolerates traditional sonorities (i.e., major triads, diminished 7th chords, etc.) played out of tune. A conductor should be aware of the acoustical ratio of the major triad, for instance, and the sound produced when that ratio is accurately produced. One can see and hear this vividly when the major triad is produced by electronic means (variable oscillators) with a connection to an oscilloscope. Until the 4 to 5 to 6 ratio of the root, third, and fifth is produced, the resultant sine wave on the oscilloscope is very disturbed. At the time when the triad is most sonorous, the sine wave becomes still.

The major chord, so tuned, is identical in frequency to the fourth, fifth and sixth partials of the harmonic series, with a ratio of four to five to six. Therefore, the major triad and other traditional chords built in thirds have a scientific basis for tuning, and tuning is less a subjective matter than most musicians think. Such chords cannot be left to chance, or to the vagaries of individual players of the orchestra. The conductor must have a keen ear for such sonorities, and he should not accept anything which is not pleasing to his own ear. Unfortunately, there is an alarming number of conductors—even in some of the most influential conducting positions in this country—who are not disturbed by an out-of-tune major chord.

The conductor will encounter this problem more with orchestral wind players than with string players. From the beginning of the string player's training he is taught to tune intervals without the aid of keys (buttons to push). He begins with unisons and perfect fifths (or 4ths) and must produce every interval with his ear as his only guide. Wind players with the exception of trombones are taught that a pitch is produced by pushing a certain button. Even trombonists are occasionally taught that 3rd position is about 3 and 3/4 inches beyond 2nd position. A perfect fifth between two young trumpet players means E—valves one and two—for one player, and B—valve 2—for the other, and not a certain pleasing sonority for which the ear is listening.

It is, however, possible for the string player to get used to putting the finger down in the same place for every situation, but there is also the initial challenge for him to learn to put his finger down in the first place through the guidance of his ear. As a result, most simple harmonic passages come through quite well in the strings (with the exception of very young string players) and seasoned string players generally play such harmonies with a good feeling for basic traditional sonorities.

Not so with wind players. Unless the player has had exceptional guidance, he has not been trained to adjust, for example, the third of a major chord, or the 7th of a major-minor 7th chord. Every conductor has had to work with wind players who have not learned to adjust intervals even after twenty years of experience.