A motionless body is said to be at the point of rest. When a body moves to a certain distance from the point of rest, thence returns to the point of rest, thence passes to an equal distance in the opposite direction, thence returns a second time to the point of rest, such body is said to be in vibration, or, in oscillation, whichever term is peferred. The distance traveled by such body from its point of rest is the amplitude of its oscillation.

[It is of interest to note the fact that English and German philosophers differ from ~~with~~ French philosophers as to what movement of a vibrating body completes one vibration. The former hold that one complete vibration consists in one complete movement each way from the point of rest; whereas, the latter hold that one movement from the point of rest with one return completes one vibration. Thus, from the French method of expression, concert pitch is given as A equals 900 vibrations per second; whereas, from the English and German method, concert pitch is given as A equals 450 vibrations per second.]

Attaching these strings separately to immovable blocks, and to separate pegs, equal tension is applied. Application of a violin bow causes string A to wind rapidly around its long axis; and, such winding continues in one direction until elastic energy in string-fiber exceeds bow-friction; whereupon, the string unwinds itself, only to be instantly wound up again. Such rapid winding and unwinding delivers forceful blocks upon contiguous air molecules, and, as such molecules are elastic spheres, and, as such spheres touch each other, therefore, the blows from the string arouse sound-wave movement; and; as such movement reaches our *tympani,* (ear drums,) we become conscious of a tone proceeding from the string; and, as such tone is produced by action of the entire length of the string, therefore this tone is of the lowest possible pitch for a string of this length, and, with this tension; therefore this tone is the fundamental tone of string A.

[Although this tone is fundamental to string A, yet, we may not suppose that no other fundamental tone can be produced upon string A, because, when shortening the string by "stopping" it, as with pressure of the finger, a new tone of higher pitch is produced; and such new tone may be rightfully called the fundamental tone of a new key; and, the same holds true of all other tones of higher pitch.]

The action of string A, at once causes the appearance of absorbing phenomena; one of which consists in the string describing a circle around its long axis. We observe that such circle is smallest at the ends of the string, and, greatest at the half-way point. Without any reasoning whatever, it is clear that the greatest force in the blows of this string are delivered at the point of its greatest amplitude of oscillation; and, that the least force in its blows are delivered at the points of least amplitude of oscillation. It is also clear that the point of greatest amplitude of oscillation cannot occur at any other than the half-way point.

[Acting upon this fact, when graduating the sounding-board for maximum tone-power, thickness, from bridge-position and from the ends of the plate, slightly diminishes to the half-way point; and, for the purpose of increasing the amplitude of oscillation at such point. From the action of the string, it is clear that equal amplitude of oscillation cannot be secured at any other point between bridge-position and the ends of the plate.

Another phenomena. observed upon string A, directs attention to nodes, ventral segments and harmonic overtones. Lightly stopping the string at the half-way point, in either direction therefrom are seen several points where the string is at rest. These points of rest are called nodes. They are equally distant from each other, and the space between two nodes is called a ventral segment; and, we observe that each ventral segment acts precisely as the whole length of the string acts; that is, the widest amplitude of ventral segment oscillation is at its half-way point; and, that the action of these ventral segments produces a musical tone. As the ventral segments are of similar length, therefore the tone of each segment is of the same pitch as the tone of its neighbor: and, as the pitch of such tone is in harmony with the fundamental tone, therefore such tone is called a harmonic overtone, and joining with the fundamental tone, produces what is called "rich" tone—a rare quality of tone—a quality of tone highly valued by the violin soloist—a quality of tone in which no other musical device approaches the "best" violin —a quality of tone impossible to the sounding-board of structural imperfections; and, the reason will be demonstrated by the action of structurally imperfect string B.

[Applied to music, the terms "consonant," and, "dissonant" vary in meaning as widely as "saint" and "devil" applied to humanity. Consonant harmonic overtones, and, harmonics *a bassa* are the causes for enchanting beauty of violin tone. They lie between such terms as "sweetness," and, "richness." To them we are indebted for the crown which we so enthusiastically offer to "The King." But, we are reminded, very often reminded, that there are other crowns. Satan wears one. Strangely, Satan's crown may come from the violin; and yet more strange, Satan's activity in cornering material for his crown is supplemented by such SCIENTIFIC violin makers who ignore structural perfection in sounding-board wood.]

Applying the bow to string B, the dissonant overtone, (chief gem in Satan's crown,) stands out clearly for perception by the sense of hearing; and, the cause stands out clearly for perception by the sense of sight. We observe that the nodes upon this structurally imperfect tone-producing agent exist at varying intervals; therefore the ventral segments are of varying lengths; therefore the tones from these ventral segments are of random pitch; therefore many of such tones are not in harmony with the fundamental tone of the string; therefore the sound from this structurally imperfect tone-producing agent is NOISE; and, for the same reason, the tone from the structurally imperfect sounding-board is NOISE; therefore the lettering on Satan's crown is N-O-I-S-E.

In text books devoted to the philosophy involved in musical sound, the violin sounding-board is compared with a "bundle of strings;" and, determining by the "rich" tone from the perfect string, and, by the "rich" tone from the perfect sounding-board, it is made clear that part of the vibratory action of the perfect string is duplicated by the perfect sounding-board fiber; also, that part of the action of the imperfect string is duplicated by the action of the imperfect sounding-board fiber. Thus, in the sounding-board of perfect fiber, nodes will occur at regular intervals; therefore ventral segments will be of uniform lengths; therefore, tones from ventral segments will be of uniform pitch; therefore, such tones are in harmony with the fundamental tone; hence, the "rich" violin tone. Thus, in the sounding-board of imperfect fiber, as knots, curls, unequal density, departure of fiber from straight lines, great density and inelasticity of connective tissue, sap wood and black spots, the nodes must occur at irregular intervals; therefore, ventral segments must be of varying lengths; therefore, the tones from ventral segments must be of random pitch; therefore, many of such tones must be out of harmony with the fundamental tone; hence, the noisy violin which defeats science; the violin which defeats the most skillful violin maker; and, when noise is therein suppressed, 'tis the violin of "cold" tone; and the violin of "cold" tone is no longer "The King."

VIBRATORY MOVEMENT: In the violin sounding-board command deep interest from the student; and, such interest is due to the fact that, with other factors at the best, violin tone-values depend upon both normal vibratory movement, which travels along the fibers, and, tangential vibratory movement, which travels across the fibers. These two vibratory movements are the very foundation of violin tone-values. They are the factors which augment the tone of the strings. Without these factors, violin tone-values depreciate to the level of the "broom-stick fiddle." By the presence of dry sand upon the flat sounding-board, both normal and tangential vibratory movements become defined. Uniformly distributed upon such sounding-board, the sand is thrown upward by the force of plate-oscillation; and, is thrown up to a height proportionate to the amplitude of such oscillation. Right here is where we observe astounding variations in the spring-action of different samples of wood. Right here also is shown the vast difference between the action of the structurally perfect and imperfect fiber. Thus: Upon the perfect sounding-board, oscillation thereof, and continued during a period of time varying as the spring-action, forces the sand to leave ventral segments, and, to collect upon the nodes. Thus, regularity in the distance between nodes is determined. Thus, irregularity in the distance between nodes is shown on the structurally imperfect sounding-board.

'Tis true, this demonstration cannot be made successfully upon the concavo-convex violin sounding-board. 'Tis also true, such demonstration is unnecessary. It is self-evident that these facts are similar in these two forms of sounding-board. In either case, the presence of the exits operates to limit transverse vibratory travel, thus: As the blows of the strings are delivered upon the sounding-board at bridge-position, therefore, vibratory movement in the sounding-board begins at such position; and, because of proximity of the exits, it is evident that vibratory movement above the bridge is confined to the normal until after passing beyond the upper extremity of the exits. Below the bridge, on the bass side, the distance to the exit is sufficient for permitting simultaneous action of both normal and transverse vibration. Below the bridge, on the treble side, the post effectively arrests the travel of both vibratory movements, as is satisfactorily demonstrated by splitting up the lower right-quarter of the sounding-board. Basing conclusions upon the evidence afforded by hundreds of used sounding-boards, it is evident that the "rich" tone depends upon the unimpeded travel of normal vibration; also, that volume of tone largely depends upon transverse vibration.

An interesting fact is shown in the record for comparative velocities attaching to these vibratory movements. Thus: In pine, normal vibrations, 3322 metres per second. In pine, transverse vibrations, 1405 metres per second. Therefore, as transverse vibration travels one unit, normal vibration travels 2 36-100 units; but, the evidence from used sounding-boards indicates that this ratio is not a constant quantity, that it is a quantity greatly modified by structural peculiarities of grain in different samples of wood. Thus, transverse vibration is dimished by both extremely soft grain, and extremely dense grain.

United, these vibratory movements become the foundation of both volume of tone, and quality of tone. In the production of volume of tone from the sounding-board, transverse vibration exercises the more commanding influence. This fact is easily demonstrated, thus: With that sounding-board too rigid for the force in strings of certain size, as gauge-2, gradual diminution of thickness from center join to edges operates to increase the distance traveled by transverse vibration; therefore, the area of the striking surface is increased; therefore, an increased number of air molecules within the violin body receive an identical blow; hence greater volume of tone.

[It is an easy matter to increase volume of violin tone to the degree ruining intensity of tone.]

The loss of power following use is a matter possessing deep interest to the student of violin tone-phenomena. It is my observation that such loss is due to the following factors:

1. Increasing roughness of unprotected interior surfaces.
2. Disintegration upon unprotected surface.
3. Increasing sounding-board flexibility follow-

ing use.

4. Degree of fiber-density and natural toughness of connective tissue.

5. Amount of use and vigor of bow.

Increasing flexibility is here in point. By reason of inherent rigidity, the hard parts of sounding-board fiber are prevented from transverse bending; but, connective tissue, being elastic in both length and breadth, permits transverse bending; therefore transverse vibration depends upon connective-tissue elasticity; and such elasticity diminishes with use; and the rate of diminution is modified by the degree of bending, frequency of bending, and the natural toughness of connective tissue peculiar to different samples of wood. The toughness of connective tissue in violin sounding-board wood is a widely varying quantity; and for this reason alone, longevity of violin tone-power presents widely varying periods. These known facts may be applied to the violin sounding-board, thus: That sounding-board called upon for only part of its spring-force will last longer than that sounding-board called upon for the limit of its spring-force.

Both violin plates may become springs. This matter depends upon thickness and inherent rigidity. Manifestly, marked volume of violin tone depends upon such reduction in plate rigidity as permits increased distance traveled by, and increased amplitude to transverse vibration; also manifestly, such increased amplitude is accomplished by increased bending of the plate; therefore, loss of spring-force is accelerated.

These facts unmistakably point to the risk in giving marked volume of tone to the new violin, because, such new violin is liable to suffer damaging loss of tone-power at what may be rightfully called premature age. From my viewpoint, it is much the wiser plan to slightly limit both distance and amplitude of transverse vibration and trust something to increasing flexibility of the wood inevitably following use.

[The work of Prof. Pietro Blaserna, Royal University, Rome, is an admirable treatise for persons desiring study of sound in its relation to music.]

POSITION OF THE POST: As the problem of the post has received various interpretations by different philosophers, and as no authoritative ground to stand upon appears in sight, therefore all persons are at liberty to hold and express opinions upon this question as suits themselves. Upon this basis, the following calculations are presented:

As violin string-force depends upon augmentation by normal and transverse vibration in the sounding-board, plus sympathetic action due to proximity of the strings, and, as placing the post below the bridge operates to confine said activities to the upper, right quarter, as is demonstrated by splitting up the lower, right quarter, therefore, position of the post, in its relation to the bridge, governs the location of sounding-board activities augmenting force of the A and E strings; and, as placing the post above the bridge operates to transfer normal and transverse vibration to the lower, right quarter of the sounding-board, and, as distance annihilates sympathetic action, therefore placing the post above the bridge operates to deliver blows of diminished force upon contained air; hence diminished power of A and E-tone follows. As the influence of the post is chiefly exerted upon the A and E-strings, therefore, in selecting a position for the post, certain effects should be kept in view, as, greatest power of tone, and, best quality of tone. It happens quite often that greatest power of tone destroys best quality of tone; therefore, in such case, a choice between greatest power and best quality of tone must be determined; and, in determining upon such choice, it is necessary to consider the post itself regardless of its position.

This consideration is made necessary because such physical qualities in the post as length, density, and mass exert marked influence upon A and E-tone. Either of these attributes may defeat intention. Manifestly, preparatory training here becomes of benefit, in fact, a necessity for securing best results in the work of post adjustment. As in all other matters pertaining to the modification of violin tone, the musical sense of the *post-setter* must be thrown into the balance; and, when such sense is a minus quantity, the failures following attempts at post-adjusting should not be charged up to Stradivarius.

In addition to the physical qualities of the post, its position is modified by each of the following factors:

1. Height of bridge.
2. Height of arching.

3. Thickness of plates at bridge-position.
4. Method of graduation.
5. Spring-quality of the plates.
6. Diameter and quality of string.

Obviously, that position for the post securing greatest augmentation of A and E-tone can be determined only by trial.

From differing methods for setting the post, the following is presented:

Premising that length of the plates equals 14 inches, the bridge is first placed 8 inches from the upper end of the sounding-board for reasons heretofore given.

[This position for the bridge is modified by the method of graduation.]

Applying sufficient tension to the strings to hold the bridge in position, set the post directly beneath the right foot of the bridge, and draw the strings up to either diapason normal, (international pitch,) or up to concert pitch, thereafter maintaining the pitch and the gauge of strings decided upon.

With the post in this position, observe the power of A and E-tone; then move the post downwards by 1-16 inch, and observe the increased power of A and E, and, continue thus until reaching the point where power of A and E. appears diminished. In returning the post to the point most augmenting power of A and E, move it by 1-32 inch.

Upon reaching such point, observe the balance of power between A and E. Should the E possess the greater power, move the post to the left by 1-32 inch, and observe the result; continuing thus until equal power is established. Should the A possess the greater power, move the post to the right.

In this work, defeat may follow from the following fact: With the diameter of the post equalling 3-16 inches, but slight deviation from the perpendicular causes the sounding-board to rest upon one or the other edge of the post. Thus, when the sounding-board rests upon the lower edge of the post, the distance from the bridge is practically 3-16 greater than appearances indicate; and as 1-32, more or less, causes perceptible effect upon A and E-string tone, therefore 6-32 becomes ample reason for defeat.

ANGLES of INCIDENCE and REFLECTION, within the violin body, are important factors in the production of tone-intensity. The influence of these angles is easily comprehended; yet, in no form of arching whatever have these lines been definitely traced.

These angles depend for existence upon a moving body and a solid reflecting surface, thus: The ball, thrown against the wall, travels along the line of incidence; and, as the ball rebounds, it travels along the line of reflection. If the line of incidence is perpendicular to the wall, then the ball rebounds directly to its starting point; thus the lines of incidence and reflection are one; and thus are these lines in the violin of perfectly flat plates. If now, the thrower stands to one side or the other of the line which is perpendicular with the wall, and plants the ball at a point where the perpendicular line touches the wall, then the ball will not rebound on the line of incidence nor upon the perpendicular line, but will travel along a new line having precisely the same angle with the wall as the line of incidence; and thus are lines of sound-wave travel within the violin of arched plates. It is self-evident that such interior walls as turn sound-wave lines of travel away from the exits cause loss to intensity of tone; and *per contra,* such interior walls as direct sound-wave lines of travel toward the exits cause increased intensity of tone proportionate to the degree of concentration.

sapiens

Verbum sat. First, establish the interior walls; later, the exterior walls.

LABEL, VARNISH and PRICE vs SWEET TONE: Johann Holtzhammer is a herder of sheep. His summer home is on the mountain. From early morn till dewy eve, Johann listens to sweet sounds. The song of birds is sweet. The song of the rippling brook is sweet. The rustle of swaying boughs is sweet. The odor of pine is sweet. Even the noisy whirr of industry's wheels is bereft of the noise-wave ere it reaches up to Johann's ears. At the base of detached rock, wild berries offer their sweet appearances and sweeter juices. The mountain air is sweet. The water in the rivulet is sweet. Indeed, life to Johann is one round of sweetness; yet, Johann longs for something to keep his hands employed. With NATURE throbbing all around him, idleness becomes oppressive. What would he do? What could he do? Make a violin? Why not? Here is a fallen, giant pine. Yonder is a dead maple. There's the ax. Here's a jackknife. Where there's a will, there's a way. Those giant logs have been seasoning since Johann's grandsire herded the sheep; but, the ax is keen, and Johann's jackknife is always ready for business. Time is nothing. Result is everything. As Johann works, a nearby lark sings with undoubted approval. 'Tis true, Johann knows nothing of the Pythagorean scale; nothing of the Palestrina scale; nothing of the piano, or temperate scale; nothing of consonant overtones; nothing of harmonics *a bassa;* but, he does know sweet sound. 'Tis all he needs.

Johann stains his violin with the juice of mountain berries.

Enough!

Imitation is defied.

The secret dies with Johann.

The thrilling, enchanting, soulful, sweetly tender tone of Johann's violin had long been the cause for bird wonderment and worship prior to his passing; and, after his passing, each bird on that mountain vied with its neighbor in singing sweet and low upon the recurring date when Johann departed with his violin. Not one bird on that mountain ever mentioned the jackknifed angles upon Johann's violin; neither did Charon as Johann applied for ferriage across the Styx; neither did the keeper of the great gate, as appears in the sequel.

As Johann entered the long avenue, a multitude of shades with downcast mein, were standing at a halt upon either hand. Some of them bore "masterpieces" upon which were conspicuous tickets lettered with the words, LABEL, and, VARNISH, and, a limited number bore conspicuous figures upon the ticket, as, $10,000, and, $12,000.

Although no affair of Johann's, yet, 'twas a wonderment whyfor such halting. As this gate keeper requires only the billionth part of a moment for computing the ad valorem in any invoice, therefore, upon the instant Johann's immortal consignment arrived, the great gate swung open; and, in that brief interval, a glimpse of glory flashed down the long avenue; and, as the great gate closed behind Johann, there came up from the long avenue a sound as the gnashing of teeth.