LECTURE VI.

GENTLEMEN:—Since our last session I have completed repair-work, re-touching work, and now present this worn old violin in playing order. As you observe, the marks of age and wear are much less in evidence. From your seats, the patch-work upon head and peg-box cannot be seen. The worn areas upon sounding-board, back, and ribs are recolored, and the entire exterior is re-finished. Indeed, this old violin no longer appears as a "worthless old thing." But, the exterior work, compared with the interior work, is a trifling matter. At the time of building this violin, its exterior surfaces were given a quality of varnish-protection sufficiently durable to last to the end of time. Gum mastic, while long in drying, and never drying hard, is the most elastic, and the toughest gum coming under my observation. In my hands, gum mastic, with oil required the time of one year for drying; and even after ten years, it is not dried hard. [As you know, violin varnish is a subject arousing endless discussion. I do not intend to arouse discussion upon this point. I shall only state facts as they appear to me. It is a fact in my observation that any varnish whatever, which dries hard, proves itself to be a serious damage to violin tone. It is within my experience that varnish interferes with independent action of sounding-board fibers exactly in proportion to its rigidity when dry. As an experiment, many times have I "tied up" tone by application of rigid-drying gums to the sounding board. Equally as many times have I "untied" tone by removal of such varnish. I do not find that application of rigid-drying gums to the back plate and ribs results in any damage whatever to tone. I have known violin users who prefer the "tied up" tone. To satisfy the taste of such violin users is an easy matter, and of certainty in attainment. Such certainty is due to the fact that varnish action, or rather, lack of action, is a constant factor. Because the action of wood is not a constant factor, therefore, the amount of varnish necessary to "tie up" the tone of any given sounding-board can only be determined by trial. It is a fact that in playing upon a violin having the "tied up" tone, less care is necessary in handling the bow. As a sequence, one may therefore more easily pass as a skillful violin player. Of course such tone fails in the long-distance test.]

The soft varnish upon this old violin, notwithstanding its age and use, would be to-day in perfect condition had it but received proper care. As an example of correct care for the violin I know of none surpassing that of the renowned violinist, Bernhard Listemann. That Listemann is a gentleman of the old school needs no more than an introduction. That he is an artist the world knows. That he is a connoisseur, and collector of old Italian violins, is in evidence at the moment he opens his fire-proof vault. As he lifts one of those violins, his care is in evidence thus: His left is holding the neck; his right thumb and index finger is holding the tail-pin. As he presents it to you, he politely says: "Please sir, hold it thus, and do not touch the varnish." Upon his violins you do not see a speck of dirt, nor a speck of rosin, nor a scratch from button or finger-nail, nor a greasy imprint from the finger-tips. Such is proper care of the violin. With such care continued, the brick and stone walls of the Listemann mansion will be flying dust ere the exterior of those violins shows sign of disintegration. Now I'm not, in the least degree, going into ravings over Cremona varnish, nor Cremona colors in Cremona varnish. I never rave without at least 50 per cent. of absolute in mine. Thus when I do rave, it is for "good" reason. Again, because of peculiarities in my optic nerves, (for which I'm not in blame) "aerial dust" from the Cremona period does not affect my eyesight. Therefore, clear gum copal, tempered down with clear gums of softer nature, appear just the same to me whether lying upon the Maggini, the Guarneri, the Amati, the Stradivari, the Montagnani, the Francisco Ruggeri, or lying upon the Franklino Robinsoni, (Frank Robinson), but, in the matter of using colors, some of those old violin builders, (not all,) did possess a rather unusual development of color-sense. Because color-sense is usually a matter of growth by cultivation it therefore follows that this sense will not be possessed by all in an equal degree. Although all of the older makers might have employed the same gums, yet, in coloring such gums, widest results might be anticipated.

It is evident that the person who colored the varnish applied upon this old violin was largely devoid of color sense. That his selection of gum was excellent is in evidence by the resistance to wear while yet being soft.

(That any one could for a moment, entertain belief that gums can be made to permeate wood, upon which they are laid as varnish, is to me something astounding. Even were permeation by gums a possibility, nothing but ruin of sonority could follow. Such ruin is easy of demonstration. Many times have I ruined sonority of the sounding-board by applying thereon a material which does permeate through the wood. After every such soaking, by whatever agent, the tone thereafter remains dead. Several violins, ruined by soaking the sounding-board have been brought to my notice. For their dead tone I know no remedy other than a new sounding-board.) Work upon the interior surfaces of this old violin is of vastly greater importance to its tone. Those slender linings, and light corner-blocks are replaced by others having more than two times greater mass. That solidity of linings and corner-blocks adds to tone-power is also easy of demonstration. By removal of the linings and corner-blocks from any violin of good tone-power, the proof thus obtained affords ample evidence. To the great original thickness of this sounding-board may we attribute remaining tone value of this violin. Had its original thickness been reduced to equal thickness with the Strad of 1707, (given by Simoutre as 2 and 8-10, down to 2 and 7-10 *mm*,) this sounding-board would be to-day in a hopeless condition. The amount of disintegration from those destructive forces, heat and moisture, would now be sufficient for total ruin. Its re-graduation is copied after the Strad of 1707. First, I will give you opportunity to judge of its tone, and thereafter describe the grain and color within the sounding-board. As you observe at nearby distances, the power of its tone is not great; but, its other tone-qualities cannot be excelled. Particularly observe the power of harmonics. As you have observed, power of harmonic tones, from different violins, is a varying quantity. From dense sounding-board wood I have not been successful in securing great harmonic tone-power. Harmonics are of value to the solo violin. Indeed, than harmonic overtones and harmonics *a bassa*, as I like to call them, resultant tones, as text-books call them, there cannot possibly be more beautiful sound. As previously shown, to these beautiful sounds must be credited the "rich" violin tone. In my experience, audible resultant-tones are difficult of production. So difficult of production are they that, from many violins, I have not been able to produce them at all. Only from sounding-boards yielding absolute purity of musical sound have I produced them in marked degree. In all cases where those shadowy creations exist, I believe the tone of such violins to have reached the limit of tone-value. To make audible resultant tone requires two other tones in exact chord. Exactness in chord of the generic tones is wherein lies the difficulty. At the least perceptible variation from exactness, those filmy sounds instantly disappear, and no coaxing whatever can induce them to re-appear until after exactness in the generic tones is established. (Text-books state that, as a rule, resultant tones are pitched two octaves below the generic chord; but, exceptions to such rule are also noted. Thus: The resultant tone, produced by the third and tonic above, is not two octaves below either third or tonic, but, is two octaves below the fifth of that particular scale. As an example I draw out the tones B, and its tonic *g* above the staff; therefore the scale is G major, and the fifth therefore is D. In this case the resultant tone is two octaves below D; and, to find its pitch, we divide the pitch of D, 600 by 4, equals 150. The harmonic overtones of B and *g* are respectively, one octave above. Thus: B equals 500; its harmonic, 1000; *g* equals 800; its harmonic 1600. Again I call your attention to the fact that the combination of such five tones of widely varying pitch is the cause for the "rich" violin tone.)

Yes, in truth, I have carefully scrutinized those sounding-boards yielding the "rich" tone. I have even re-opened such violins for no other purpose than to re-examine the sounding-board. As you know, my work upon the violin as been chiefly given to such as have been in use; therefore the "finish" prevents accurate determination of physical qualities from examination of outside surfaces. To the best of my ability, I will now describe such physical qualities and the color thereof. First: The grain follows a straight line, with no deviation whatever, nor wherever. Second: The yearly growths are neither widest nor narrowest: and measure on an average, 18 to the inch. (Extremes are 16 to 20.) Third: There is no appearance of fat whatever. Fourth: There is no sap-wood, nor black-wood spot. Fifth: The wood is brittle. Sixth: The whole grain is rather soft than dense. Seventh: A keen, smooth cutting tool is necessary to leave a smooth surface. Eighth: The color is the deepest yellow of butter with more red than in any sample of butter. Ninth: This depth of color extends through the sounding-board.

From all evidences in wood-craft that I am able to muster, such sounding-boards only come from the older and larger trees.

Both plates, and linings, and blocks of this old violin are now hermetically sealed. It is therefore expected that never again will those terrifically destructive agents, heat and moisture, show their presence within this violin. Therefore, whatever of tone value it now possesses, it will possess centuries hence. That its tone is beautiful, after such interior protection, yourselves may verify. You may also verify to the beautiful tone of 59 other used violins having similar interior protection.

Someone has stated that the average longevity of the used violin is 80 years. Upon this point the difficulty in securing accurate statistics is apparent. To the violin student, the average period of violin usefulness is a topic possessing much interest. As a premise, I will state that enthusiasm, plus power of bow-arm are potentialities affecting violin longevity not to be omitted from consideration. Thus when stating that I wore out a good violin sounding-board in 30 years you will first look at my eyes to see whether I mean it or not. Next, you will undoubtedly look at my 200 pounds of humanity and mentally "size up" my 16-inch biceps, plus enthusiasm. Both will stand inspection.

It seems to me that because my violin has nothing of the romantic, nor mysterious, nor spectacular about its origin, therefore its history must be refreshing. Certainly 'twill be unique. As an importation, my violin came from Luxembourg. In this fact there's nothing extraordinary. Haller, himself a Bohemian, said my violin was undoubtedly made by a herder of sheep on Tyrolean mountain. I say good for the sheep, good for the mountain, better for the herder of the sheep, and best of all for me, for that violin possessed a tone. That's why I wore that violin out. That's why Haller, himself my violin tutor, thrice counted out $100 for it. That's why I wouldn't sell it. That's why I think all good violin makers don't hail from Cremona. That violin had tone-power to give away. But, its value lay not in tone-power. Its tone-intensity was marked to a rare degree. Its value was not in intensity. It was both brilliant and sweet. Not there its value. Other violins possessed power, intensity, brilliance, and sweetness of tone, but compared with my violin, were valueless to me. I am now come to something which is extraordinary. My violin possessed human-like tone-quality. Its tone could weep in despairing sorrow, in contrition, in joy; it could pray in deepest devoutness; it could laugh in utmost abandon; it could sing sweetly as a bird. In these tone-qualities lay its value.

Sell my violin?

Starvation first!

Even then I'd have worked the "hand outs" to the limit.

In thirty years use that powerful, intense, brilliant, sympathetic, human tone went down into *piano*. At first I did not discover the reason. I attributed the reason to first one thing and then another. I tried strings of different sizes; finger boards at different heights, of different densities, of different weight; bridges of different mass, of different density; posts, ditto; but all were of no avail. Hitherto in moments of triumph, my violin had always brightly looked up into my eyes for approval. I always granted all it asked of me. But now I noticed a change in its look. In place of its wonted brightness, there was sadness. Pityingly it looked up at me now. The deep despair on its sweet face brought enlightenment to me. Upon discovery that the caresses of my bow were crushing the life out of my pet, the pain at my heart was something I would like to forget. Gently I laid it in its case nor opened that case in two years.

I couldn't.

I am but an ordinary violinist. I never could play anything behind nor on top of the bridge, nor but little in front of it. With that violin I didn't have to do much myself. It did best when I meddled least with its moods. Often I gave way to those moods. Then it was in delight. Then it would lead me a chase through the shadows and sunshine of melody in a way at once my despair of representation by notes. Years have rushed past. To-day memory rushes me back to days when I lived in the little city of C. In a large majority, its people came from the thither Atlantic shore. Each of such had experienced the heart-ache in family partings. Each of such, loving liberty, firm in purpose, buoyed by hope, had left loved ones and set out for that bright western star whose symbol is known to the world as U. S. A. Each of such, knowing, the rustling, jostling, pushing, human activity, the crushing, whelming, human pain at departure, asked my violin to paint that scene abandoned by artist-brush in lack of color for the pain of brother parting from brother, parting from father, parting from weeping, dear old mother; for the pain of sister, alone, braving the sea for a home with the free; for the pain of father his family leaving, for the sound of gong, for father's tender tone in "good bye, son," "good bye, daughter," for his heart-aching tone to wife, "Mother" he calls her, (gong), for the silence as his arms enfold her, "Mother," 'tis but a whisper, gone her voice, (last gong), for the smothered sob from father's pain-heaving chest, for his unsteady step, as blindly he follows the sound, for the thud of "Mother's" falling, for the hissing of steam, for "all aboard," for the fainting shout of fading friend, for the crashing of pounding billow, for the storm demon's maddening shriek, calling for human victims daring his fury, for the quiet of returning calm, for the relief of human tension in 3-4 rythm, for the hum of returning animation in rollicking 2-4, for the joyful shout, "Land, ho!"—yet, my violin accepted such invitation.

I loved that violin.

Poor Patti! She, the one bright star of us elderly folk, at 65 weeping—weeping because her once thrilling tone has gone down into dotage!

In public I have not wept.

In private, the handkerchief in my right is yet convenient.

Strange how this idol of wood can find its way down into deep recesses of human heart, thence defying all comers!

Occasionally, in unexpected moments, and in unexpected places, one reads fragmentary statements about this thing, or that thing, able to restore violin tone. After the tone of my violin had gone down into dotage, one such statement attracted my attention. The writer, without attaching signature, stated that oil varnish, applied to worn out violins, had power to restore tone. At that time I neither could affirm nor deny such statement because of having no experience with oil varnish. Although this statement bore little of sound logic, yet, being something not tried upon my violin, I therefore decided upon giving oil varnish a trial. From a friend, I procured a quantity of such varnish, together with instructions in the manner of its application. With strings and bridge in position, I began the work of applying oil varnish by the "rubbing" process. As this method of applying varnish was new to me, I could not determine how much varnish I was using, but thinking if there's good in little, there's good in more, I gave a whole day to rubbing it on.

(At this moment, I think of the truth in, "How little we know without experience." I also confess to an attack of "quick return" fever. You know what "quick return" fever is. It is that "can't wait" feeling. Humanity in general may be attacked with this fever; but, its most virulent form is manifested upon such as handle the violin.)

Of course, at the moment of completing this days work, I was filled with anxiety, buoyed by hope, and pulled down by doubt. Hope in the possibility of restoring tone to my de-throned violin made me over-anxious for returns. Therefore, I threw down the rubbing pad, picked up a bow, and drew from the G an octave of the "deadest" tone imaginable.

(Not many of us go through life without seeing ghosts; at least we thought so at the time, which amounts to enough for a story. The point is, the ways of ghosts are sudden. Their coming is never announced by shrieking whistle nor clanging bell, nor grinding wheel, nor sounding horn. Suddenly they come. Suddenly we go; that is, so soon as our suddenly vanishing breath permits of going. The suddenness of ghostly appearance is not more startling than the phenomenon appearing upon the sounding-board of my violin as I removed it from beneath my chin.)

This phenomenon consisted in a large number of crater-like openings, or upheavals, in the oil varnish I had just put on. Some of those openings were 3-16 in diameter, and running from that diameter down to mere points. The crater-like openings were so near together that the edge of each touched that of its neighbor. In this varnish phenomenon, the point of greatest interest is its location. Doubtless you are familiar with the theory of the French philosopher, Savart, upon the question, "How the violin operates to produce sound." You remember those elaborate, scientific experiments, and his conclusion therefrom; that the top-plate, back-plate, and ribs, all join at once in striking those blows upon contained air resulting in the production of sound?

(From N. E. Simoutre's book, 1885, I infer that Savart is yet regarded in France, as an authority upon this question. From other sources, I learn that Savart's theories are considered as exploded. Up to the moment of this varnish phenomenon, I was a follower of Savart. His drafts on science looked genuine, and, in no guide book could I find either affirmation or denial of his position. I therefore fell in with his conclusions without attempting any demonstration myself. Really, after German and English philosophers dismissed violin tone with *sui generis*, (self-generating,) thereby practically abandoning the problem as unsolvable, I had no hope of ever finding, or seeing such solution. I do not claim such solution to exist now except as a partial solution. From my point of view, the evidence afforded by this phenomenon, together with other demonstrations, to be given later, are ample proof of error in Savart's theory of how the violin operates to produce sound.)

There is not a shadow of doubt about the cause of this varnish disturbance. The upheaval of this soft mass is wholly due to oscillations, or vibratory movements, (synonymous terms,) of the sounding-board. I applied the bow only upon the G string. The point is, can you, or I, or anyone whatever, pre-determine the location of this disturbance by any existing theory of how the violin operates to produce sound? It is at once self-evident that such disturbance must exist over the entire violin body, did the entire body act with equal energy in producing sound. The varnish I applied was equally distributed over the entire body. The area of disturbance is limlted. In length, this area equals 2 and ½ inches; its width, 1 and ½ inches. The larger craters are at the center of such area. From the center, the size of the craters diminishes down to mere dots. It is self-evident that the widest sounding-board oscillation occurred directly beneath the wider craters. It is also self evident that this point of greatest sounding-board oscillation is the center of a certain area responsible for G-string tone. I call attention to the fact that the G-tone of this violin was once noted for its power. I call attention to the fact that the location of this area of varnish disturbance affords a valuable cue in tone-regulation of the violin; also, to the fact that the finding of the area responsible for G-string tone led to finding the areas responsible for D, A, and E-string tone; also, to my conclusion that the violin sounding-board is wholly responsible for violin tone. I mean that to the blows delivered by the sounding-board upon contained air do I now attribute violin tone.

(This statement does not include violin tone-modifiers; as the strong back-plate; the weak back-plate; imperfect inner surface of the back plate; position and area of exits; model of violin; position, length, density and diameter of post; position, density, height, and mass of bridge; height, weight, and under surface of finger-board; diameter and quality of strings; amount and quality of varnish. These modifiers of tone will be considered at a later date.)

I will now consider the location of varnish disturbance. The center of this area is half-way from the position or the bridge to upper edge of the sounding-board, and ½ inch to the left of the bar. Possibly none will view the location of this area of varnish disturbance as I view it. As I view it, this varnish phenomena, and its location, turned a flood of light directly upon the sounding-board areas responsible for tone of each violin string.

During more than ten years of continuous work, since occurrence of this accident, (I call it accident No. 2.) I have used this index in tone-regulation of used sounding-boards without once meeting disappointment. Therefore am I convinced that this index is reliable. From this index I learned where to find, and how to correct sounding-board errors injurious to tone of all strings, or only injurious to any single string. Therefore I consider this index of exceeding value to the violin. I also acknowledge this index to be the triumph of accident. Science has no part whatever in its existence. Science can only come along with a *post facto* explanation. It is my belief yet, that science cannot build a violin. I mean that by no scientific formula can you, nor I, nor any person whatever, pre-determine violin tone throughout the list of violin tone-peculiarities.

I call attention to the fact that this index greatly simplifies the work of tone-regulation; also, to the fact that such regulation may be directed wholly to, and upon, the sounding-board. In this matter, the evidence afforded by accident No. 2 may be accepted as corroboration of the facts many years known to violin students. In the last ten years of my work, the back-plate has been wholly ignored as a tone-producing agent. I have only treated the back as a tone-modifier during the time mentioned. All I now ask of the back-plate is that its inner surface be absolutely perfect for the reflection of sound-waves, and that its rigidity be sufficient to withstand, without a tremor, the charge of molecular movement originating at the sounding-board. I am aware of the fact that many good violin makers continue to treat the back-plate as a tone-producing agent. Such violin makers may continue to produce good violins.

(This question seems to possess a tenacity to life equal to the tenacity in the question of planting potatoes. The enterprising Circassian, although finding the American aborigine enjoying potatoes, failed to find traditional authority pertaining to the proper phase of the moon for planting potatoes. Such omission entailed a seemingly perpetual division in Circassian ranks. Yet, strangely, both sides to the controversy grow good potatoes.)

As I view the location of this varnish disturbance, it also affords a demonstration for the power of sympathetic action. Briefly, as a law in physics, it may be stated that the power of sympathetic action diminishes inversely as the square of the distance. Therefore, that part of the sounding-board nearest the string must receive greater impetus from string-action than the part farthest from the strings. Therefore we might pre-suppose the greater varnish disturbance to be located upon the upper-half of the sounding-board. As I held the violin beneath my chin I could plainly feel sounding-board vibration at that point, as was usual. Therefore, I know that the sounding-board acted in nearly its entire length at the moment of causing the varnish disturbance. But, that such action was of less power in the lower-half of the sounding-board is proven by the fact that no varnish disturbance whatever appeared on the lower-half.

(Within the limits of my observation, sympathetic action, excited in the sounding-board by string-action, has not heretofore received attention. For that reason I am desirous of your opinion thereon. Indeed, in giving my conclusions in this matter, I expect to be favored by the opinions of other students of violin tone. Because this new question is brought before us by accident, I therefore entertain no feelings of proprietorship. It is yours as much as mine. Nothing but the presentation of the question happens to belong to me.)

I do not find the laws governing sympathetic action to be complex. On the contrary, such laws are easy of comprehension. Up to this moment I can call up only two facts as bases for such laws:

(1) Equal susceptibility to force.

(2) Proximity of bodies.

That equal susceptibility to force is a condition necessary to sympathetic action may be demonstrated by attempting to excite such action in bodies possessing widely varying mass, density, and rigidity. Such attempts are failures because such widely varying bodies are not excited to vibratory action by an identical force. As a ready-to-hand means for demonstrating unequal susceptibility to force, I employ this violin. As you observe, each string on this violin yields powerful tone. These strings are carefully selected guage 2. The rigidity of sounding-board beneath each string has been carefully reduced until the force in the blow of each string, at concert pitch, is ample for production of vibratory action in the sounding-board and corresponding to the action of each string. I remove this G and replace it with this E. In its new position the E-tone is weak. Now, the sounding-board beneath the E is not susceptible to identical force with the E. Hence there is no sympathetic action between these two bodies. In its proper position, the tone from this E is powerful; and such tone-power is due to the fact that the E, and the sounding-board beneath the E, are susceptible to an identical force. Hence sympathethic action exists, and its existence augments tone-power.

(Often in re-toning work I demonstrated the value in "Let well enough alone." Thus, after determining length of strings to be used, after determing length by position of bridge, after adjusting length, mass, and position of post, after determining mass and height of bridge, after testing the tone and finding slight weaknesses here and there, and positively knowing such weakness to be due to too much sounding-board wood here and there, after reducing thickness in such places with my utmost precaution, after securing even power for all strings, then idiotic-like, instead of letting well enough alone, I have lost my work by trying to do better than "well enough." The "Elgin," adjusted to temperature, position, isochronism, and running "well enough," is not more susceptible to idiotic treatment than the finely adjusted violin. With not more safety can we file off metal at any point on the periphery of the Elgin balance wheel, than we can change the pitch of strings, diameter of strings, length of strings, height of bridge, mass of bridge, density of bridge, length of post, mass of post, position of post, and sounding-board rigidity of the finely adjusted, tone-regulated violin. 'Tis no use to cry about spoiling my work. Crying but adds "baby" to "idiot." With expressions more or less colored, I jump up, seize the red pencil and write upon the wall, "Let Well Enough Alone.")

The familiar, fun-provoking broom-stick fiddle is not without a lesson of value. Although its one violin D-string arouses no "sympathy" neither from the audience nor from the broom-stick, yet, it has an opportunity to demonstrate its tone-producing power when totally unaided by sympathetic action.

Proximity of bodies, as a basis for law governing sympathetic action, may be demonstrated in a variety of ways. As an imperfect way, and only because of convenience, I remove all strings upon this violin to a greater distance from the sounding-board by replacing this bridge with another ⅛ of an inch higher. As you observe, tone-power of all strings is perceptibly diminished. Although faulty, yet, this demonstration shows that sympathetic action diminishes as distance increases.

It is evident that distance may annihiliate sympathetic action. *Per contra*, proximity augments sympathetic action. From these facts I conclude that sympathetic action causes wider amplitude of oscillation in the upper-half of the sounding-board; and, to such wider oscillation, with its augmented power, do I attribute the location of this varnish disturbance. From the same facts, I also conclude that the upper-half of the sounding-board, to a limited distance either side of the bar, is responsible for G-string tone-power. From the same facts do I conclude that rigidity should be less in the lower-half than in the upper-half of the sounding-board. Distance certainly diminishes the force of sympathetic action as the square of the distance.

(Knowing that every sentence in the description of this varnish phenomenon, together with my conclusions therefrom, will be subjected to the limits of scrutiny, I have therefore called upon my utmost ability for clearness of diction. Should you find lack of clearness upon any point, and should you desire further elucidation thereon, you need only to notify me. In advance, I request your opinions on my conclusions. I admit the fact that "two heads are better than one." I admit that your opinions may be better than mine; therefore your opinions will be received with pleasure.)

I have now completed the presentation of varnish phenomenon No. 1. Varnish phenomenon No. 2 will be presented upon a later occasion.

LECTURE VII.

GENTLEMEN: At this hour I present varnish phenomenon No. 2. As you remember varnish phenomenon No. 1 occurred on the exterior surface of my violin. Varnish phenomenon No. 2 occurred upon the interior surface of another violin. The latter violin is the first in a list of sixty wherein I applied an interior surface protection, and the latter phenomenon is due to two errors: (1) Crudity in application of material. (2) Assembling and testing tone before the material becomes dry.

[Thinking that some reader may wish to do interior surface work upon the used violin, and desiring that such person may not meet with disappointment, I am therefore careful to note my own mistakes. It is quite safe to assume that, in all lines of human activity, mistakes are made. In knowing such mistakes, they may be avoided. After ten years of effort in protecting interior violin surfaces from disintegration and thinking that I succeeded in affecting such protection without injury to tone, yet, I do not know or claim, that the details of my surfacing work cannot be improved. I shall be heartily glad to know that my own efforts have received improvement.]

Crudity in application of material is shown thus: (a) By failure in preparation of wood-surface. (b) By application of an excess of material. After my experience in this interior surfacing work—after observing the intensity and brilliance of tone without loss of sweetness whatever, I find myself wondering why I did not sooner understand that interior surfaces of the violin ought to be equally perfect with interior surfaces of the flute, clarinet and horn. In the latter instruments, intensity and brilliance of tone are modified, for better or worse, by the degree of interior surface perfection. I am now fully satisfied that the same condition affects violin tone. In every method of applying transparent finish to wood, swelling of grain is a difficulty to be met. Coming directly to the point, I know of nothing causing less swelling of grain than boiled linseed oil. But, I find there is a right and wrong way to apply oil. I do not find that oil alone, or in mixture with the slowest drying gums, penetrates even the softest pine or white cedar when applied in such attenuated layers as is possible to the "rubbing process." I find that wood surfaces must be carefully prepared in order to secure the greatest attenuation of oil, either alone or in mixtures. In used violins I have never found interior surfaces ready for the reception of finishing material. The interior surface of the used sounding-board usually presents a series of ridges and valleys caused by the swelling of the connective tissues between the denser fibers. The depth and heighth of these ridges and valleys varies with the amount of water vapor absorbed. As previously shown, different samples of sounding-board wood absorb different amounts of moisture owing to variations in the caliber of sap carrying capillary tubes. The interior surface of the hard wood back and ribs very often present uneveness from unequal shrinkage in the transverse markings; the denser part standing as a low ridge, the tubular part as a shallow depression. The point is to level down all such ridges and remove all moisture before applying any protecting material whatever. I find artificial heat quite often a necessity for removal of moisture from used violin wood; also a necessity for continuing the employment of artificial heat until after surface work and the application of finishing material becomes accomplished facts.

For leveling down ridges, I prefer to use sandpaper over a block of wood rather than held over the fingers. The finger palps, being soft will cushion more or less, and thus continue cutting away valley surfaces, whereas, the block, being rigid, only cuts away the ridges. For such block I employ any firm wood, 7/8 inch thick, 1½ inches in width and 2½ in length, having one edge curved and slightly oval. Upon the sounding-board, the ridges are leveled down by working across the transverse markings. Sometimes this work upon the back plate requires considerable time to cut down the dense ridges. But, in my hands, the scraper is a dangerous tool for such work because of tearing out pieces of wood, and especially dangerous in old, brittle wood. For such reasons I patiently continue with the sandpaper until the brown surface of the valleys appears new. I next remove sandpaper marks with powdered pumice and polishing pad of felt having one surface slightly moistened with boiled oil, only using sufficient oil to hold pumice to its work. The final preparatory work is done with the "bone." The "bone" is a piece of hard ebony, of a size convenient to hold, having one end, or edge, slightly curved and oval, and polished to the limit. With this "bone" the surfaces are rubbed until they are of a mirror-like smoothness, whereafter they are ready to receive the protecting material. Upon surfaces thus prepared, oil, alone, or in mixture, may be rubbed on in coats of the greatest possible attenuation, and with imperceptible swelling of grain. The inner surface of the ribs, the blocks, and the linings, receive the same careful attention.

In this work there are two important objects to keep in view. First to only apply sufficient material to cover the wood. Second: To produce a perfectly smooth surface. For this work, the brush cannot secure the attenuation of the material that is easily secured by the rubbing process. Fluidity of protective material is something to avoid, especially in the first coat. The dry wood will absorb moisture from the fluid applied by the brush, thus defeating the object of hermetically sealing up DRY WOOD. The case is different from that of applying protection to the outside surface of the violin plates. Should absorption of fluid occur at the outside surface, it may escape from the interior surface, and no precaution against admission of moisture into the wood can be too great. When hermetically sealed, moisture can neither enter nor escape from the wood. Hence the necessity for doing this work in a dry atmosphere and the employment of a material containing the minimum of fluid. I know of no protecting material affording less of moisture absorption than boiled linseed oil. That this oil does not penetrate the softest wood, when applied by the rubbing process, and in attenuated coats, will be shown at a later moment. But, after observing that when a mixture of oil and gum copal, tempered down with softer gums, is employed, the oil, drying with less rapidity, and being largely forced out of the mixture, and lying upon the surface, I have since employed this mixture for interior surface-protection to the exclusion of all other agents. With the oil thus forced out, I have tried two methods for its disposal. First: Allowing it to remain and dry as part of the finish. Second: Removing it with a soft cloth at the expiration of twelve hours after application. The gums, then being semi-solid are not roughened by careful removal of oil. The latter method has an advantage in greater smoothness of surface, and greater rapidity in drying. With surface oil removed, the gum will dry in 24 hours. With surface oil remaining, time required for drying will vary as to the amount of oil, from 4 to 7 days.

For application of protecting material, the details are as follows: In my experience, heavy, fine, long-knap cotton flannel has proven the best material for the rubbing pad. I cut out a piece 2x4 inches and fold it once, end to end and knap outside. To insure the use of but a small quantity each of varnish and oil at one time, I resort to the following means: One 2 oz. phial is filled two-thirds with varnish; one 2 oz. phial is filled two-thirds with boiled oil. Slightly moisten one surface of the pad with oil, (allowing no swimming whatever of either oil or varnish,) then hold the center of pad over the mouth of the varnish phial, invert the latter, then rub the pad on the wood with a circular motion to avoid sticking and consequent roughness of the varnishing surface. The pad should be firmly held and with the end of the index finger pressing down upon its center. When this amount of material has become spread to its limits, then return the phials for more oil and varnish, thus continuing until the surface of the plate is coated. The amount of material used for one coat may appear surprisingly small. It is small. It ought to be small. It ought also to be small upon the exterior surface of the violin. In either case I only use sufficient material to cover the wood. So far as I am aware, this method of application commands the minimum of material and the maximum of surface perfection. When carefully applied, and the last coat becomes dry, then do final polishing with dry, powdered pumice stone, using a fresh pad of the same cotton flannel. Of course experience is necessary for skillfulness in this work.

I have placed correct details before erroneous details for the purpose of making such errors stand out in glaring colors. To crudity in application of material is due the failure at my first attempt to protect interior violin surfaces; and to the same cause is due varnish phenomenon No. 2 as will now appear.

Varnish phenomenon No. 2 contributes nothing to the value of the violin, and nothing of interest to the violin student further than a description of erroneous details in the work of interior surface protection. Knowing the amount of prejudice existing towards protection of any kind whatever, for interior surfaces of the violin, I am therefore careful to minutely describe both the correct and incorrect methods of applying such protection. After ten years of experience in this work, I am fully convinced that existing prejudice against violin interior surface protection is due to erroneous details in application of protection material. As an argument against protection, I remember hearing that it "sharps" tone. I now offer evidence that such protection may be applied in a manner causing "dead" tone.

[Than the violin, I know of no historical subject offering greater confusion of evidence. For some occult reason, the violin neither seems nor sounds alike to two different persons. This fact is a phenomenon without explanation.]

Rated upon tone value, the violin, in which varnish phenomenon No. 2 occurred was worth $25. This violin had been used five years at the time I selected it for application of interior-surface protection. For access to its interior surfaces, the sounding board was removed. No preparation other than brushing off the dust, was given to those surfaces. Upon them I poured a quantity of boiled oil and transparent, tempered copal varnish. I spread these materials about with a mop. As is well known in housekeeping physics, the mop is caused to act by reciprocal motion; circular motion being employed only upon parties tracking the floor." Not having to contend with the latter difficulty, I brought my mop into action by reciprocal motion. Of course the mop "stuck" at each reverse of motion, while I "stuck" to my job by pouring on more oil and varnish. After "mixing it" thus until the mass looked as if it were "laid on" (oh!) I pronounced those surfaces amply protected. My glue being hot, assembling work was quickly accomplished. Two hours thereafter, "quick return fever germs had driven me to insanity. That 'can't wait" feeling soon became master—I applied the bow.

[Sheridan's ride to Winchester—his changing defeat into victory, has been pictured by able historians—even poets have tuned their lyres to the tatoo of his horse's feet. Sheridan's fame spread around the world in a few hours. In my case, several years elapsed before I dared look into the face of either historian or poet.] I can't say much for the tone of this violin. Truthfully, it has not any tone worth mentioning. Its tone is not only "dead" but 'tis "buried." The only value in its tone is an example of how not to do interior surface work and as a warning against quick return fever. To apply the bow before protecting material upon either surface of the violin plates becomes dry is an act of insanity. Had the historian received access to the "sticky" facts clinging to the inside of this violin, then the violin student today would be reading that interior-surface protection for the violin is a failure. Had I myself abandoned effort after this disaster, I would now believe that such protection causes "dead" tone. I did believe it during the next half-year. Then in a moment of idleness I picked up this discarded violin and again applied the bow. Surprise was lying in wait for me. In the qualities of intensity and brilliance, its tone now surpassed former rating. Quickly I again removed the sounding-board.

You who have read the description of varnish phenomenon No. 1 may think yourselves prepared for a description of varnish phenomenon No. 2. Let me warn you that you are not prepared. You remember that the varnish disturbance in No. 1 took the form of crater-like openings. Only in one point is there similarity between these two phenomena—both are located upon the sounding-board. As I view this fact, it affords further proof of the dominant part taken by the violin sounding-board in the production of sound. Both of these varnish disturbances point to greater amplitude, and greater power in sounding-board oscillation as the cause for their existence.

Varnish phenomenon No. 2 is in the form of pendant drops, and hanging from the inner surface of the sounding-board like stalacities from the dome of Mammoth Cave. These drops are not found over the entire sounding-board. They only exist in the central area, and within lines drawn over the center of the exits. The graduation of this sounding-board is 2 and 8-10 *mm* down to 2 and 7-10. Why these two phenomena vary so diametrically in physical appearance is beyond my understanding.

From this crude beginning I continued until feeling that defeat is turned into victory. In the experimental stage of this work I tried various substances for interior surface protection. One of these substances or combination of two substances, although discarded as valueless, yet possesses interest because of showing the effect upon violin tone from bending the sounding-board. This mixture is composed of boiled linseed oil and transparent glue. The union of these two substances is but mechanical. The presence of oil causes flexibility in the mass when dry. So great is the flexibility that, when dried in thin lamina, they may be indefinitely bent upon themselves without fracture. Because of such physical quality, I gave extended trial to this mixture. In this combination the proportionate quantity is 25 drops of oil to one fluid ounce of glue having the proper consistence for being applied with a brush.

There are two objections to this mixture as a material for violin-interior-surface protection. Either of these objections is sufficient to condemn its use upon the violin. First: Moisture from the glue is drawn into the wood. Second: In drying, this mixture shrinks with sufficient power to bend the sounding-board. By repeated coatings, the "cuppings" of the sounding-board may be deepened until arching is raised 1-4 inch. With the sounding-board thus bent. the tone undergoes a a surprising change. Such changes are manifested by short duration and, by strident quality, (as the croupy voice,) and, by increased brilliance, or distinctness in passage played *rapidament.*

There are violinists pleased with the shortened duration of tone from the bent sounding board. These are players whose forte lies in rapidity of execution. As is well known, there are violins only producing a confused jumble of sound in rapid passages. Comparing such violins with those having this strident, but brilliant tone I prefer the latter. But, the strident and brilliant tone, by no means, compares with the natural and brilliant tone, as I view this matter. The strident is a thin tone, and therefore an unnatural tone.

For some occult reason, different violin tone-tastes more nearly approach infinity than tone-tastes for any other musical instrument.

My amateur violin-making friend, J. D. O'Brien, Pittsburg, Pa., during his last European tour, had the pleasure, or rather the pain of seeing five worn out Stradivari left in care of Hammeg, violin maker, Berlin. One of these violins was once presented to Dr. Joachim, by his London admirers.

In late years I have asked, "Why do we never read of the worn out Amati, or the worn out Guaneri, or the worn out Maggini, or even the worn out Da Salo?" I receive no answer thereto. Supposition seems to be the only source for an answer. As heretofore stated, that sounding-board yielding the most agreeable tone is the first in succumbing to the disintegrating forces of heat and moisture. Of course the violin yielding the more agreeable tone is likely to receive the greater amount of use in any given period of time. But alone, legitimate use cannot account for rapidity of disintegration. Were my name Hammeg, before one hour older, those worn out sounding-boards would be subjected to tests for density of hard fibre and connective tissue between.

Today I entertain conviction that every worn out sounding-board, taken in time and given correct interior-surface protection, might have retained all original tone-value to an indefinite period. Upon this point, I have made ample, practical demonstration, and have satisfied myself that such conclusion is based on safe reasons. I have given both correct and erroneous details for interior-surface protection that you may satisfy yourself with much less trouble. You may ask yourself the question, "What logic is there in protecting one surface of violin plates while leaving one surface without any protection whatever?" You will receive various answers to this question. In all probability you will receive positive replies from parties who practically know nothing about this subject of interior-surface protection for violins, that such protection locks up secretions in the wood. Certainly it does lock them up—that is, if there is any secretion therein. If you have read me closely, you observed that I am careful to repeat the fact of only applying interior-surface protection to used violins—violins having had time to complete the process of shrinking after leaving the builder's hands; and that I am careful to further dry out the wood with artificial heat when necessary.

Should you do interior-surface protection work, carefully following correct details, surprise will lie in wait for your bow. Augmented intensity and brilliance of tone will be something new to your old violin; and, if its tone was valuable before the interior surfaces were protected and made perfectly and permanently smooth, you will enjoy the fact of knowing such increased tone-value to be also permanent.

Permanence of violin tone-value is a very desirable quality.

It is yours for the asking.

Possibly you may not entertain sentiments identical with mine regarding the inanity in certain statements concerning the Cremona violin varnish. As students of the violin, your attention has been called many times to this subject. You have read of it in books; in booklets; and in periodicals; even in newspaper "interviews." Possibly, such reading did not make the same impression upon you as upon me. Nothing in life is more patent than the fact that mental impressions may vary as the number of minds. In early life I read something about the beauty of Cremona violin varnish. I then thought the writer really referred to gums composing the varnish. In middle life, I began to read that to Cremona varnish is due the superiority of Cremona violin tone. In advanced life, I began to read that Cremona varnish, in some way, permeated the wood; also, that Cremona violin varnish suddenly, mysteriously, disappeared from commercial channels. Strangely, I've read nothing about the disappearance of other furniture varnish. 'Tis passing strange that fate should select violin varnish for annihilation! Beyond all degrees of strangeness is the fact that but a limited number of Cremona violins are, or ever were celebrated for superiority of tone. Pointing directly to the two most famous Cremonese violin builders, Stradivarius and Joseph Guarnerius, reliable "experts" have said to me. "They did not make every violin of equal tone-value."

"Why not?"

They had access to Cremona varnish!

Really, we may now expect an "interview" from some London "expert" (trade promoter rather,) wherein he states that Cremona varnish was so dear (oh!) that none could afford to use it except in a limited way.

Perhaps he's right.

The use of a varnish which soaks into the wood must require a lot of it.

Italians are now, and for a long time have been meritoriously noted for superiority of color-sense. But, even in violin color-work, they did not make all violins equally beautiful. I by no means pose as a color artist, but, from my experience in color-work upon wood, I am confident that no one can make what is called a beautiful violin without having beautiful wood as a pre-requisite. Even then failure is easy. Six times have I removed color-work from a single violin before finding the right combination to match that particular sample of wood; and a long interval may elapse before that combination will be equally effective upon another sample.

People exclaim, "What beautiful varnish!"

The beauty is not all in the gums.

'Tis all in the combination of colors.

Not one iota would I subtract from the rightful merits earned by the "old masters." Neither can I give them unearned credit. For those empty statements, intended only for "trade promotion" in Cremona violins, I entertain nothing but contempt.

Doubtless my contempt for those London "interviews" and for those London authors whose animus is plainly "trade" is quite paralleled by their contempt for the Americans. The Londoners estimate of the Americans is clearly shown in the following words credited to Kipling. 'Twas on board a sailing vessel from Calcutta to London. One morning, when off the west coast of Africa, the watch reported being passed at daybreak by the largest sea-serpent on record. The watch stated that their attention was first attracted to the monster by a steam-like hissing as it came up under the lee counter. Its forked tongue was eight feet long. Its head was ten feet in length from the point of the jaw to the single fiery headlight eye. Its head was carried fifteen feet above water. Its body was longer than the ship. While listening to this sailor yarn, a New York newspaper man, busy with pencil and note-book, remarked to Kipling that upon arrival at London he would report this remarkable incident to the press. "Don't," said Kipling. "Why not," replied the New Yorker. "My friend," replied Kipling, "let me tell you something which you don't seem to know. England was gray headed before you were born. Keep this story until you reach home."

We must admit the truth in Kipling's remark. England does hold a monopoly of gray heads. 'Twill not be her fault should a single gray head ever appear in any other country. Something over a hundred years ago she received a hint from Americans that we desired to live our natural lives whether or not that life might be long enough to reach the gray head stage. From signs of the present, there is hope for us. From Portland to Seattle, from New Orleans to Duluth, there are those who no longer swallow the London expert's "varnish permeation-of-the-wood" story. Today the London expert, "interviewing" himself bewails (!) the prohibitive prices for the few old violins permeated by the lost Cremona varnish. Judging by the past, what harm in prophecy for the future? Entertaining conviction, I confidently predict that, within the present century, for the best violin, Europeans will search throughout America.

Why not?

Cremona violins, penetrated by varnish applied only upon a single surface, will soon be out of the market. It is certain that a few American violins, penetrated by varnish applied to both surfaces, will then be on the market. Why not picture descendants of the present London expert as then interviewing themselves about prohibitive prices for American double-permeated violins? There is one American gray-head who would immensely enjoy that picture.

LECTURE VIII.

GENTLEMEN: We are approaching problems in violin tone which are not only difficult of solution, but are also difficult of enunciation. Silently I sat at my bench many years, thinking, working, but never writing. During these years I was favored at long and brief intervals only by the companionship of persons who cared for the philosophy involved in violin tone. As is well known, much talking on any subject greatly facilitates the selection of precise words to make our meaning stand out in a clear light. Being deprived of such benefit, and receiving little or no direct benefit from either text-books of philosophy, or from books of general reading, I therefore find this task of precise diction to be a matter of difficulty. My age and infirmities also handicap my pen. Therefore, should I fail in the matter of precision, 'twill cause no surprise to myself. I am comforted by the assurance that each succeeding generation becomes brighter in intellect, hence more capable of precision in enunciation of both principles and solutions. Because that problem in the arching of violin plates securing maximum concentration of molecular movement at the exits is abandoned by physicists as insolvable, by no means do I lean back and say that this problem never will be solved. I firmly believe a solution for this problem yet will be forthcoming. To deny such possibility is equally as absurd as saying that the violin reached perfection 200 years ago. Within my observation, violins are made today of greater tone power, and greater evenness of tone than at any other period in violin history.

[Galilleo did not discover the Americas, but, Galilleo's enunciation of principles made their discovery possible. After Columbus had demonstrated that Galilleo's principles were correct, it is related that a vaporous party at the dinner table jumped up to remark that this discovery was an easy matter—any one could have made it—nothing in it except the matter of sailing west until stopped by land, then sailing back again. Calling for an egg, Columbus asked each person present to make the egg stand upon its smaller end. After all had failed, Columbus, striking the egg upon the table with sufficient force to partly crush the shell, made the egg stand firmly upon its smaller end. This mythical story is here told for a purpose.

Should I succeed in even cracking the shell of some difficult problem in violin tone, then that party who later succeeds in making such problem "stand on end" I shall designate as Columbus if he but hints that my name is Galilleo.]

'Tis well enough to smile while having a chance, for soon we shall enter a territory wherein dryness precludes the possibility of smiles. After crossing this "dry district" we will try to find moisture for our parched lips and duly celebrate our "passover."

Uniformity in violin tone-values is considered one of the unsolvabe problems. We can truthfully say that this problem has successfully defied solution during 400 years. That this problem ever will be solved, we can only hope. In attempting a solution of this problem, I accomplished something, but not enough. Only in a limited number of violins have I succeeded in securing such uniformity of tone-values as to prevent me from determining the tone of each one when played while hidden from sight. In this respect, violin tone is as the voice of singers. Only at rare intervals do we hear two singers possessing identical vocal qualities.

In the solution of this problem, what immeasurable value to the violin!

'Tis a value defying arithmetic.

Feeling certain that this problem is of interest to the violin student, I therefore describe details in my work for the production of uniformity of tone-values. First, I select violins as nearly uniform in dimension as possible. It is at once apparent that much lack of uniformity in cubic capacity must defeat uniformity of tone qualities. Thus, when two violins vary much in length of perpendicular air columns within the body, it is a difficult matter to bring their tone to uniformity in pitch.

[I do not mean difficulty in tuning the strings to what is called "unison," but do mean the difficulty in preventing the ear from distinguishing the presence of two sounds varying in tone-pitch.]

Second, I select violins having wood as nearly uniform as possible in maturity, density, and width of grain. These latter points exert much influence in the the quality of violin tone. After thus selecting a half-dozen violins, I remove the varnish therefrom. Such removal is necessary because both quality and quantity of varnish operate to raise tone-pitch and to diminish volume of tone. These violins are next opened and necessary work is applied to their interior surfaces. This work may vary in each violin. Some of them may need re-barring; some need re-graduation; some need both re-barring and re-graduation; possibly some may need heavier linings and corner blocks; and in all, the interior surface is made perfectly and permanently smooth by means of elastic varnish applied in such attenuation as is only possible to the "rubbing" process previously described. Of course in the re-barring and re-graduation, account of varying degrees of density in sounding-board fiber must be considered. After assembling, comes adjustment of the finger-board. Its hollow under surface, beginning at the base of the neck, is made so straight that the straight-edge touches at all points in the length of the hollow.

[The philosophy for thus fashioning the under surface of the finger-board will appear later in the discussion of tone-modifiers.]

The under surface of the finger-board is placed at a uniform height throughout the half-dozen instruments. The weight and density of the finger-boards are as uniform as possible. While these violins are yet in "the white," bridges of equal maturity, density, and width of grain, and guage 2, six-strand, hard-twisted strings, each of even diameter are adjusted, and the preliminary test for uniformity in tone values is made. This test is made prior to varnishing the exterior surface for the purpose of retaining the opportunity for working upon such surface to lower the tone-pitch where found necessary. Thus, after applying the bow upon each violin, I select one having an average tone-pitch—not highest nor lowest in the lot—then raise the tone-pitch of those below, and lower the tone-pitch of those above this selection. In the work of raising tone-pitch, I now have three, or, counting varnish, four means for assistance, thus:

(1) Enlarging the exits.
(2) Position of bridge.
(3) Position of post.
(4) Quantity of varnish.

For the work of lowering tone-pitch, I have three means, thus:

(1) Diminishing sounding-board thickness.
(2) Position of bridge.
(3) Position of post.

[As a matter of fact, a fifth means for raising tone-pitch may be found by counting diminished depth of ribs; (See Rule VI) but, being unncessary work except in extreme cases, I do not here find myself compelled to employ it.]

The philosophy involved in this work of lowering tone-pitch is reserved for a later date; therefore at the present moment it is sufficient to state that after the tone-pitch of these violins becomes so nearly identical that my sense of hearing fails to distinguish the pitch of one from another when played while hidden from view, they are then dismantled and varnish, of equal quality and quantity, is applied upon the exterior surface and by the "rubbing" process. When again ready for use, they are taken to the open field for their intensity test heretofore described. Before giving results of the long-distance test for intensity, (carrying power) I will mention the fact that in the qualities of tone-pitch and intensity of tone is shown the nearest proximity to equality of tone-values in these violins as now prepared. At near-by distances there is yet a notable difference of harmonics *a bassa* and consonant harmonic overtones. Thus, their tone varies in "richness." Again, there is a difference in response to bow-pressure; and particularly observable in greater or less distinctness of tones played *rapidament.*

I now return to the long distance test in the open. Prior to the herein described treatment, the record shows intensity of tone in these violins as straggling along from 400 to 800 feet. After preparation, as described, the record shows an increase in intensity of tone up to 1,100 and 1,200 feet, averaging 1,175 feet—an increase of 80 per cent in distance; and an increase, in uniformity of tone-value upon this isolated tone-quality, of 62 per cent.

I know of no way to describe precisely the per cent of increase for such tone-qualities as volume, evenness, richness, freedom from dissonant overtones, sympathy in concert, response to bow, agreeability of double-stop tones, brilliance of tone, and power of harmonic tones. In a general way, and in my opinion, the latter tone qualities are increased equally with intensity, and in the majority, I believe the per cent of increase to be greater than the increase of intensity.

There is yet another tone-value in this lot of violins. It is a value difficult of accurate description. I refer to the effect produced by playing these violins in unison. I believe that my experience in listening to violins thus prepared has no parallel. This belief causes me to hesitate before attempting a description of such effect. In this description, I cannot find support by way of comparison. I am obliged to find words descriptive of a new impression upon both the sense of hearing and the sense of feeling.

The first word to come out of the mist is solidity. When saying that any certain object is "solid," we mean that such object possesses weight. As a rule, the word solid is used only to describe objects which can be seen. Yet, I am inclined to use that word in describing the combined tone of this half-dozen violins. Certain it is that while listening thereto, and while at a distance of more than 1,000 feet, I seemed to feel sound-waves striking against my person. As you remember, the long-distance test is made in open air, under a cloudless sky, winds at rest, temperature from 70 to 90 degrees Fah., water vapor at, or below the normal point, (never above) and at the hours between 10 a. m. and 4 p. m., (hours wherein sound-waves are propagated with the greatest difficulty upon any given date) and, upon level ground, and with no surrounding objects capable of reflecting lines of molecular movement. Under such circumstances, you at once observe that the position occupied by these violins, during such tone-test is at the center of a circle whose radius is greater than 1,000 feet. You also understand that, under the above conditions, sound-waves from these violins reach the periphery of this circle at all points.

I fully realize at the present moment, that my statement concerning the "solidity" of the tone from these violins, prepared as herein set forth, has no corrobation. I therefore ask you to make such trial yourselves. In all matters of practical application to violin tone, my work is finished. Yourselves, being alive to the fact that in certain conditions where sound-waves are propagated only with difficulty, and knowing the complaint of not hearing first-violin tone, will take up this work where I leave it and demonstrate its value in both the small and large orchestra.

In this work, I cannot give assurance that any one can succeed without experience. As I glance backwards at the years I've devoted to violin tone-peculiarities, and note the difficulties upon either hand of the violin-builder's path, I am constrained to say that success depends largely upon experience. The spirited horse can be goaded into mad action by a galling ill-fitting harness. The violin sounding-board can also be driven into mad action by an ill-fitting sound-post, by an ill-adjusted finger-board, by an ill adjusted bridge, by an ill-assorted set of strings, and, by a worthless bow.

When all of these ills combine, imagination fails.

So long as one-hundredth of an inch in variation of sounding-board thickness, in string diameter, in bridge-thickness and position, in sound-post thickness and position, in area and position of exits, in depth of rib, in diameter of bow-hair, affects violin tone, so long will success defy the hand-ax. Not more can a carpenter succeed in violin-making than a blacksmith can succeed in watch-making. Do not understand me to say that a carpenter may not become a violin maker, nor that a blacksmith may not become a watch maker. That is another proposition. But, I do say, emphatically, that both must serve an apprenticeship.

To illustrate the truthfulness in the latter statement, it is necessary only to call up a single difficulty encountered by the violin builder. This difficulty lies in variations in sensitiveness of sounding-board wood. These variations are wide enough to cause not only profound surprise, but also, profound disappointment. I know of one sounding-board, and but one for that matter, which is not affected by five times the amount of varnish necessary for mere protection. Again, I have handled sounding-boards so sensitive that but a single attenuated coat of varnish plainly caused damaging effects upon tone. In view of these facts, it is evident that only such judgement as must come from experience can secure best results. My experience causes me to believe that every good violin, built upon hard-and-fast rules, is but an accident.

It is my desire to be of assistance to all such as attempt the work of violin tone-regulation. To this end, I can think of no way more effective than pointing to such facts as endanger success. 'Tis of value to know how not to do any certain kind of work.

In the matter of applying protecting material to interior surfaces of new violins, I have no experience to offer. In my judgement, this matter hinges upon the degree of dryness and completion of the shrinking process existing in each sample of wood. Manifestly, it is inadvisable to hermetically seal up violin wood prior to the completion of drying and shrinkage. In our climate, the presence of water vapor in air operates to prevent both complete shrinkage and drying of wood. When surrounded by water vapor, the capillaries of violin wood are bound to draw in and hold more or less water. It is also manifest that the presence of water in the capillaries diminishes resonance of every violin. No other conclusion is possible. Again, it is manifest that hermetical sealing up of violin wood effectively prevents further entrance of water. Thus, violin interior-surface protection, aside from its value as a perfect reflecting medium, is also valuable in permanently maintaining resonance. I repeat the statement that, prior to hermetical sealing, violin wood should be absolutely dry by artificial means. In our climate, we may not expect absolute dryness of wood when left to nature. Observation of unequal shrinkage in violin plates, subsequent to leaving the builder's hands, leads me to the opinion that, for the reason of certainty in new violins, the plates, nearly reduced to correct thickness, should thereafter be allowed one or more years to complete the process of shrinkage before being assembled.

By no means do I desire that you understand me as advising uninterrupted effort to produce violin-tone of maximum volume and intensity of tone. The necessity for violins of "big tone" only exists in a limited way. The total number of auditoria, creating necessity for "big tone," is a small number in comparison. As the object of all musical interpretation is the pleasure of the listening ear, it therefore follows that both disagreeable tone quality, and the tone so feeble as not to be heard at all, defeat the object of musical effort. Thus, the mistake of employing the violin possessing "big tone" for studio, parlor, or the small auditoria is only parallelled by the mistake of employing the weak tone for the large auditoria. In small rooms, the "big" tone is painful; in the large room, the weak tone is disappointing. This proposition has two sides; one, æsthetic, the other, "business." It is quite safe to assume that all patrons of music halls expect pleasure from first-violin tone. It is also quite safe to assume that either disagreeable first-violin tone, or inability to hear first-violin tone operate to reduce patronage. In this matter, the patron is nowise to be blamed for withdrawal. He parts with wealth for expected pleasure and finds but disappointment.

It is evident upon either hand that the great majority of violins are used only in comparatively small rooms. In view of this fact, 'tis wisdom to build and tone-regulate the great majority of violins minus maximum volume and intensity of tone. To-day the skillful violin maker can come nearer producing violin tone "to order" than at any other period.

I present the following factors as proving themselves reliable in diminishing both volume and intensity of violin tone:

(1) Control of sounding-board action by varnish.

(2) Control of sounding-board action by bending.

(3) Control of sounding-board action by thickness of wood.

(4) Control of sounding-board action by arching of plates.

(5) Control of sounding-board action by the bar.

(6) Control of sounding-board action by the post.

(7) Control of sounding-board action by the bridge.

(8) Control of sounding-board action by the finger-board.

(9) Control of sounding-board action by the diameter of strings.

(10) Diminishing volume and intensity of tone by the condition of interior surfaces.

(11) Diminishing volume and intensity of tone by the area and position of exits.

(12) Diminishing volume of tone by the depth of ribs.

Either of these factors, alone, is capable of producing perceptible diminution of both volume and intensity of violin tone.

(1) Control of sounding-board action by varnish, in all cases except the one case herein mentioned, has proven to be possible, and quite easy of accomplishment. The only difficulty that I have found in diminishing volume and intensity of violin tone by means of elastic varnish was wholly due to inherent variations in the action of sounding-board wood. These variations are so wide as often to defeat tone-regulation by "hard-and-fast" rules. In my hands, the greatest effect from varnish, in controlling sounding-board action, has been shown upon wood of soft fiber; and the least effect has appeared upon wood of dense fiber. Thus, in the employment of a certain quantity of varnish upon each violin, its effect upon tone varies as the degrees of density in sounding-board wood.

I have not found that any amount whatever of varnish, applied upon the back, operates to diminish tone in any degree whatever. On the contrary I have observed a slight increase in tone-power from heavy coats of varnish applied upon back plates whose thickness had been reduced to that point causing tone-weakness. Without doubt, any amount of varnish increases rigidity of violin plates; and, upon the sounding-board, any amount of varnish also operates to diminish independent action of contiguous fibers. Thus, varnish, upon the sounding-board, operates to diminish both volume and intensity of tone. Often have I observed violins having greater power in single, than in double-stop tones. In all such cases, I have found increase of power in double-stop tone following removal of varnish from the sounding-board. To demonstrate that varnish, upon the violin sounding-board, operates to diminish both volume and intensity of tone is a matter easy of accomplishment.

In its effect upon violin tone, varnish possesses an esthetic side. There are many musicians who prefer the natural tone from untrammeled wood. When such tone possesses beautiful quality, there can be no objection from any one. The beauty in such sound is impossible of enhancement by any means known to me. But, herein lies the difficulty. Inherent capriciousness in the action of sounding-board wood produces tone from the extreme of beautiful down to the extreme of coarseness. This matter wholly lies in the domain of nature. Man can only modify it. There are a limited number of musicians who profess pleasure in coarseness of violin tone; but, the great majority prefer such coarseness to be modified by varnish, and content themselves for the loss in volume and intensity by the loss in disagreeable tone-quality.

(2) Bending the sounding-board into position is a powerful factor to diminish, not only volume and intensity of tone, but also, to diminish duration of tone. Violinists, whose forte lies in rapidity of execution, are sometimes satisfied with the shortened and lifeless tone from the bent sounding-board. The influence upon volume, intensity, and duration of tone from bending the sounding-board is in exact proportion to the degree of bending. For diminishing these tone qualities, my own taste does

not approve of the bent sounding-board, because of a certain "dead" tone-quality. I prefer to diminish the area of the exits, while leaving the action of the sounding-board free; thus, preserving liveliness of tone. The difference in tone-value is vastly in favor of the latter method.

I do not find that bending the back into position operates in any degree whatever to diminish power of tone; but, on the contrary, bending a back plate, already too light in wood, increases the tone-power. But, such increase in tone-power does not hold good indefinitely. Here is the reason. Upon opening the violin with bent back, and within but a few years after leaving the builder's hands, I find the bending transferred to the sounding-board.

This result might be expected did we but give it thought; and the two factors, causing loss of tone-power to accompany such transference of bending, might also became apparent with thought. The trouble is to keep up to the point of hard thinking. 'Tis exhausting. Facts are easiest made known by stumbling upon them. Stumbling costs nothing but picking one's self up, and remarking.

(3) Control of sounding-board action by thickness of wood is a factor of great importance. This factor has received more attention than any other single item in the list of violin tone modifiers. Only the effect of diminishing volume and intensity of tone by thickness of sounding-board wood will receive attention.

[Upon a later occasion, and in the discussion of maximum evenness of tone, this important tone-modifier will be given further attention.]

It is evident that the thickness of the violin sounding-board must be governed by the diameter of strings to be employed. When not otherwise specifically mentioned, I refer only to guage-2 strings.

[As previously stated, my experience compels me to the belief that the function of the violin sounding-board is to originate those sound-waves eventually reaching the ear as musical tone. Previous to varnish phenomenon No. 1, I directed work upon the back plate as if it also were a tone-producing agent. To such work I now attribute ruin of tone-value to a number of violins. After confining the work of tone-regulation wholly upon the sounding-board, I met with no failure attributable to my work. By placing new, strong back plates upon violins having suffered serious injury to tone from attempted tone-regulation upon that plate, I succeeded, to a satisfactory degree, in restoring lost tone-value. I do not wish to be understood as saying that loss of tone-value may not also follow erroneous work upon the sounding-board. On the contrary, I do say that that tone-value may be easily lost by erroneous work upon the sounding-board. What I do say with positiveness is that, after confining the work of tone-regulation to the sounding-board, I met with vastly greater success in securing tone-value in such tone qualities as intensity, brilliance, and sweetness. Volume of tone, at nearby distances, I could obtain with certainty by work upon the back plates alone; but, such tone invariably fell far short in the long-distance test out in the open; whereas, with a strong, unyielding back plate, I could secure equal volume of tone and vastly greater intensity and brilliance of tone by work directed to the sounding-board. This fact I have demonstrated by many repetitions of the long-distance out-of-doors test. As previously stated, this test affords evidence based upon actual measurement, in lineal feet, of intensity (carrying power) of violin tone. It is a test settling this question beyond the shadow of doubt.

In diminishing volume and intensity of tone by thickness of sounding-board by no means have I found the same difficulty as is presented in the work of securing the maximum of those tone qualities. In securing the maximum of volume and intensity of tone, the work, from a certain point of thickness, must proceed with caution in the matter of measurements of thickness, and removal of wood; and because of the reason that in every sample of sounding-board wood there is a certain degree of thickness yielding such maximum, and, below this degree of thickness means weakness of tone, whereas, for the production of diminished volume and intensity of tone, the thickness may run from 16-64, down to 10-64, or even lower with wood of dense fibre. These great thicknesses invariably operate to diminish both volume and intensity of tone, but not in equal degrees; the greater diminution appearing in volume of tone. These great thicknesses also operate to raise tone-pitch.

It is a fact in my observation, that every inherent disagreeable tone-equality in sounding-board wood developes and becomes apparent as thickness of wood diminishes to the point productive of maximum volume of tone. I regard the knowledge and consideration of this fact to be of value to both the violin builder and those violin users who prefer quality of violin tone before quantity of tone. In my observation, there are many violin users who entertain such preference. It is also a fact in my observation, that for all occasions and circumstances, a violinist can become equipped only by having at command a number of violins possessing varying degrees of volume and intensity of tone.

(4). The arching given to violin plates defies the pencil of that physicist who would write down its solution. Yet, 'tis an easy matter to demonstrate the fact that such arching may add to, or diminish both volume and intensity of tone. I know of no single item in the list of violin tone-modifiers affording greater interests to the violin student than the item of plate-arching. In practical application, there is no diminution of interest from the perfectly flat plate on up through every degree to a height of arch equaling 1 inch. Other dimensions remaining equal, power of tone increases, from no arch at all, up to a certain height of arch; and from this certain point on up to that height equaling 1 inch, power of tone steadily diminishes. Other dimensions not remaining equal, as increasing the area of exits, increasing sounding board thickness together with an increase of string diameter, power of tone may follow to a higher degree of arching than in the first proposition.

It is apparent that the diameter of strings may safely govern the height of arching. In my observation, using the guage-2 string, and distributing the arching equally from either end of the plates to the position of the bridge, the greatest volume of tone is reached at that height of arch equalling $\frac{5}{8}$ inch, while the greatest intensity of tone is reached at that height of arching equalling $\frac{1}{2}$ inch. I desire that the above statement be taken with the understanding that the area of exits, in either of the above heights of arching remains precisely equal, and that such area is neither large nor small, and that the width and length of the body and the depth of ribs be not greater than that of "full size"; also, that the distance between the exits, at their upper extremities, be exactly 1 and $\frac{1}{2}$ inches. These conditions are absolutely necessary in determining the influence of arching upon volume and intensity of tone.

I present this violin as an example of the influence exerted upon tone-power by plate arching. You observe that the exits are of medium area; and that their position is neither "high", nor "low." As you look at this violin in profile, you observe that its waist line is aldermanic; that its height of arch, at the position of the bridge equals $\frac{7}{8}$ inch; that the distribution of the arch is equal from the ends of the plates to the bridge; that the quality of wood, varnish and workmanship is good. As I apply the bow, you observe that it has a tone-power equalling the tone-power of a pewee; and even that tone is "all inside".

In attempting an explanation for this great loss of tone-power, due to such formidable height of arch, we are left with nothing but supposition. We know the fact, but positive assertion can go no further. Although knowing mere surmise to be uninteresting, yet, I'll take the risk of presenting my surmise for an explanation of this defiant problem if you'll not charge me with positive assertion in the matter. I fully understand that assertion, without corroboration, proves nothing. Therefore, I begin by saying thus: I think loss of tone-power from high-arched violin plates, other dimensions remaining equal, is due to the fact that the exits are not in the line of wave sound movement.

"Why not?"

"Well, now comes the defiance."

If, by possible means, we could place ourselves within the body of this violin while the bow excites the strings to action, and if our vision were quick enough to follow the line of travel taken, by any single wave-movement as it originates upon the interior surface of the sounding board, then we would know why such movement indefinitely continues to travel "all inside;" then we would know why the great majority of such movements fail to pass out through the exits made and provided, especially for the egress of sound waves.

I can safely say that those "if's" have used up the last grain of plumbago in many a pencil.

LECTURE IX.

GENTLEMEN: At this hour the presentation of violin tone-modifiers, operating to diminish volume and intensity of tone, is resumed. At the close of the preceding hour we were yet considering the great influence upon tone from the arching given to the plates. In continuation, I present this violin as another example of arching, which invariably operates to diminish tone-power. As you view this violin in profile, you observe that the entire rise of the arch is given to the first two inches at either end of the plate; that between such abrupt elevations, the plates present a straight line; that other dimensions remain as usual. Application of the bow demonstrates the fact that the tone-power of this violin, while perceptibly greater than the tone-power of the higher arched violin, yet lacks much of the maximum. As I view this model of arch for violin plates, it is a model affording but a a few degrees of greater tone-power than no arch at all. Were it not for the slight concentration of sound-waves at the exits due to the lateral, or cross-section arch, there would be no difference whatever in tone-power. Thus the greatest diminution in volume and intensity of tone due to arching, other dimensions remaining equal, is found at the extremes; that is, the perfectly flat plate, and the enormorous arching previously indicated. In stating my belief concerning the cause of such diminution of tone-power, I acknowledge inability to furnish proof. Were there but a single arch in the violin plates, the proof would be forth-coming in but a few moments. 'Tis the presence of the lateral arch that adds complication to this problem. With but the greater arch, (from end to end of plates) to contend with, the line of travel followed by sound-waves, originating at the sounding-board, could be accurately traced on paper. The physical laws explaining sound-wave movements, are easily comprehended.

The two laws concerning this problem are: (a) Sound-waves, at the moment of origin, travel at a right angle from the agent producing them. (b) Sound-waves, after striking a reflecting surface, travel therefrom at an angle equal to the angle of incidence. It is obviously an easy matter to draw on paper a line at a right angle to any given point upon the interior surface of any given arch. It is also obvious that a line of sound-wave movement, originating from any point on the arched violin sounding-board, will not strike upon the back at a point perpendicular to its origin, but, will strike the back at a points nearer the exits. So far 'tis easy; but, the next move of the sound-wave is wherein lies the difficulty. 'Tis now the lateral arch makes its presence known. 'Tis plain, that after striking the back, the wave will be reflected; but, in what direction will the reflection travel? It is the intention of the arches to direct and concentrate wave movement at the exits. It is also the intention to place the exits in the line of wave movement. It is evident that such intentions are defeated by enormorous degrees of lateral arching, and also by no arching at all. It is apparent that when no arch whatever is given to the plates, there can be no direct progression whatever of wave movement toward the exits. Hence, the tone from such plates is diminished in power. It is evident that sound-wave lines of travel, within the high-arched violin are directed away from the exits to a great extent. In this case the question is, "Where should the exits be located?"

[Inasmuch as the violin is but a product of experience, therefore we may continue expecting violin tone-improvement only to follow experience. With this idea uppermost in my mind, I call up some experience connected with a barrel of new cider inadvertently left out in the hot sunshine dur- a whole day. Being employed as an inspector of this particular barrel, and, the barrel being tightly closed up, I directed a moderate tap from a hammer to the vicinity of the bung; whereupon, and without warning, that bung flew into my face *allegro con fuoco et cider-o-so.*

Now (vengefully) I do suggest cutting a bung hole in the sounding-board between bridge-feet as the proper thing for all violins having an aldermanic waist-line.]

(5) Control of sounding-board action by the bar is easy of accomplishment, very easy; I feel like saying, "Too easy." Experience in wrestling with the problem of the violin bar may cause equal disappointment with experience at any other "bar" whatever. In either case, "loading up" to heavily is bound to prove disappointing. The violin bar is a powerful factor in

modifying G, and D-string tone. The bar may be too great in length, too great in thickness, too great in depth, and of too great density in fiber, and too light in mass. The G and D-string tone, from the finest sounding-board, may be easily marred by any one of these faults, and completely ruined by their combination. The position of the bar also may seriously injure G and D-string tone.

[Desiring that my statements carry proof with them, and also desiring that benefit may follow such statement, I therefore call up the case of a certain violin suffering loss in tone-value from unbearable "wolf" on open G, and caused by mal-position of the bar. This violin is made of valuable wood, and, in all other respects, its tone-value is high. Its builder is A. F. Anderson. In my opinion the mechanical work on this violin cannot be excelled. The varnish is of the toughest, and most elastic variety. In my opinion, judging from the mal-position of ths bar, and the graduation of the plates, Mr. Anderson builds violins upon hard-and-fast rules. As Mr. Anderson is a high-class workman, therefore it is hoped and expected that he will be pleased at having an error pointed out in his otherwise faultless work.]

Details are premised by the statement that I objected to opening this violin. My disinclination was due to the fact of uncertainty as to the cause of this "wolf" tone. By no means could I assume a cure in this case. Never before had I encountered a wolf on the fundamental tone of the G-string as an isolated tone-fault. Many times I had been successful in driving a "pack of wolves" from violin tone, but "wolf" in an isolated tone is a different proposition for solution. Once I had been asked to remove "wolf" from the E-string of an old violin. 'Twas a case of "wolf" on *g*, and *g* sharp in alt.

This old violin bore ample evidence that generations had devoted their time to moving the sound-post. In this work, the right edge of the right exit has been worn away ⅛ inch; and both plates were bruised in a circle 1 inch in diameter by the shifting ends of the post. Not being able to determine the cause of "wolf" by use of the bow, I removed the sounding-board. To all appearances, the workmanship within this old violin was faultless. I could not see any cause for "wolf;" yet, I positively knew "wolf" existed, and, as above indicated. Being curious to know the graduation of this sounding-board, I employed the calipers, and thereby found reasons for "guessing" at the cause of "wolf" tone in this case. Here is what I found by the use of the calipers: The builder, exercising the extreme of caution in reducing thickness of wood beneath the E-string, had gone beyond the limit of safety in such work; but, only a very little beyond. Under such meteoric conditions as heretofore have been carefully and repeatedly described, the intensity of tone, belonging to the E-string of this violin surpasses all other E-strings which I have subjected to the out-of-doors test. The tone of this E-string carried to the great distance of 1480 lineal feet.

[Bear in mind those meteoric conditions, because a change in the single item of greater amount of water vapor present at the moment of making the long distance, out-of-doors test, might double, and even quadruple this distance.]

The greater power of tone possessed by this E-string concentrates interest in two factors.

(a) Graduation of sounding-board beneath the E-string.

(b) Enlargement of the area of the right exit.

Briefly, I will describe the graduation beneath this E-string: At the position of the bridge, thickness equals 7-64 inch; thence gradually diminishing down to 4-64 at a point half-way from the bridge to the upper end of the plate; from this point to the end of the plate, thickness gradually increases to 9-64. Evidently, this form of sounding-board results in the production of two tapering springs between the bridge and the upper end of the plate. Practically, these tapering springs are attached to each other at their thinner extremities. It is evident that the spring farthest from the bridge is the stronger. It is well known that the stronger spring acts with greater rapidity than the weaker spring. It is evident that action of either of these two springs must excite action in the other spring. Because of differing degrees of thickness, it is evident that such action must vary in numbers per second; therefore, these two springs, striking upon contained air at differing number of blows per second, produce two simultaneous tones; and, these two tones, being pitched at inharmonious keys, operate to produce "wolf." There are two methods available for remedy: (a). Equalizing spring action by reducing thickness of the stronger spring. (b). Equalizing spring-action by shortening the weaker spring. Because of the danger of weakening tone-power by the first method, therefore I chose the second. Should the second method prove unsuccesssul then I would know the necessity for employing the first. But, the second method proved successful. Practical application of the second method consisted in gradually moving both the bridge and sound-post upward, or forward. A curious phenomenon appeared upon E-string tone as the bridge and post approached their final resting place. That phenomenon was presented by shifting of the "wolf" from *g*, and *g* sharp to *g* sharp and *a*, thence, to *a* and *b* flat, and, at the next move the "wolf" disappeared.

[Enlargement of the right exit in this violin, not being in point, need receive no further notice at this moment.]

I return to the Anderson violin.

Upon opening this violin, the cause for "wolf" was not apparent at the first glance. Without employment of the calipers, I could determine that graduation of the sounding-board was not the cause; yet, upon the sounding-board must the cause be found. While looking at the interior surface, and feeling quite uncertain of success in this case, I noticed an unusual obliquity in position of the bar.

[Sometimes the doctor's diagnois of an obscure malady must depend upon negation; 'tis not this, nor that, nor the other, and so on by exclusion until there remains but few, or but a single probable cause. But to the doctor, there's a difference between the fiddle patient and human patient. In presence of the former, the doctor need not trouble himself to "look wise."]

By measurements, I found that the upper end of this bar crossed the line of the G-string, crossed the line of the D-string, and reached a point between the D and A-strings. Because of not finding any other detail appearing as a probable cause for "wolf" upon open G, I therefore removed this bar and placed another bar with the center of its thickness directly beneath the center of the left bridge-shank, and with an obliquity equaling obliquity of the G-string, not greater nor less.

When again in playing order, there was no "wolf" whatever upon any string.

In attempting an explanation for this case of "wolf," I can submit nothing more than an opinion. Thus: Believing that certain sounding-board fibers, beneath each string, act to produce all possible tones upon each string, therefore, in this case, I think the great obliquity of the bar caused "wolf" upon the open G tone, and my reasoning is as follows: The graduation of this sounding-board, being a modification of Stainer, therefore greatest thickness was at the position of the bridge, and thence thickness diminished down to 4-64 at all points near the edges and at the ends of the plate. Thickness at the bridge equaled 10-64. Therefore the thinnest part of this sounding-board, beneath the G-string, lay above the bar; not above the upper end of the bar, the upper end of the bar lay at a point between the D and A-strings. Bearing in mind the great obliquity of this bar, it is evident that sounding-board fibers beneath both G and D-strings are shortened from left to right. Thus, the longer fibers are beneath the G, the shorter fibers are beneath a point between D and A. It is evident that when these varying lengths of sounding-board fibers are aroused to action producing sound, that there must be more than one sound, or one tone. I know no way to determine the exact number of these sounds. I surmise that some of them, being at an inharmonious pitch with open G, operated to produce "noise," or "wolf" tone thereon.

The cure was complete.

In my experience, increasing the length of the bar beyond 10½ inches operates to diminish tone-power, also, to diminish duration of tone. This statement is made with the understanding that the amount of wood in both bar and sounding-board has been accurately adjusted for the production of the maximum of tone-power. Keeping this fact in view, I state that shortening the bar, other dimensions remaining equal, operates to lower tone-pitch, to increase volume of tone, and to diminish intensity of tone; also, conditions as above, adding to either thickness, or depth of bar, operates to raise tone-pitch and to diminish tone-power. The position of the bar may operate to increase tone-power of the G-string, and, at the same time, to diminish tone-power of the D-string. Thus, when the distance between the upper end of the exits equals 1 and 5-8 or 1 and 11-16, then, placing the left side of the bar flush with upper end of the exit operates to increase G-string power while diminishing power of the D-string.

LECTURE X.

GENTLEMEN: There are violin users who prefer such unequal tone-power. It is my experience that too great prominence of G-string tone is not most agreeable to the listening ear, especially when appearing upon the solo violin. I deem this point to be of sufficient importance to warrant repetition of a previous statement that the beautiful harmony from evenly balanced strings, played in double-stops, is the chiefest attraction in solo violin music.

(6). The post is at once the most aggravating, powerful, indispensable, innocent appearing thing within or without, around or about the violin. It does not fall down so often as it makes us fall down. Had it but ability to laugh, 'twould be the chief "monkey." To the violin user, the post is the chief object of solicitude. Its power for good is angelic. Its power for evil is Satanic. Can this innocent-appearing thing command the power to diminish both volume and intensity of violin tone? Let it but fall down——there you are! Because I enjoy frequent shots at this angel-imp, therefore, as a subject, it will not be exhausted at once. At this moment I will call up but three points connected with the post which operate to diminish volume and intensity of tone:

(a). Mass of post.
(b). Position of post.
(c). Length of post.

In the ordinary condition of the right exit, the greatest effect upon volume and intensity of tone, due to mass of post, cannot be demonstrated. Enlargement of this exit affords an opportunity for entrance of a post having great mass. Although mass of post does not diminish tone-power to the same degree produced by some other factors, yet, such diminution is perceptible. I know of no hard-and-fast rule governing the mass of post. Like many other factors affecting violin tone, that mass of post which is best for each violin can only be determined by trial.

(b). Position of post exerts greater influence upon tone-power than mass of post; that is, upon any mass which I have tried. In early life I remember reading that the proper position for the post is ½ inch below the right foot of the bridge. In later life I learned to unlearn that lesson. I had to learn that the position for the post varies as the variations in sounding-board rigidity. All effects upon tone, due to the post, are manifested principally upon the A and E-strings; and such effects may be largely directed upon either of these strings by position of the post. When that position is found which equally supports the A and E-strings, then, moving the post to the left operates to diminish the tone-power of the E; and, *per contra*, moving the post to the right, diminishes tone-power of A. Again, moving the post downwards, operates to diminish tone-power of both A and E. Again, placing the post above the bridge operates to diminish tone-power of the A and E-strings in an amount equal to the re-inforcement due to sympathetic action between these strings and that part of the sounding-board beneath them. Placing the post above the bridge operates to transfer sounding-board action to the lower-half of the sounding-board; *per contra,* placing the post below the bridge operates to cause sounding-board action in the upper-half. I desire to be understood as referring only to that sounding-board action aroused by action of the A and E-strings; also, that in either of these two positions for the post there is no perceptible change produced in the tone of the G and D-strings.

[Upon a later occasion will appear a practical demonstration for the fact that the lower, right-quarter of the sounding-board does not act to produce sound-waves when the post is placed below the right foot of the bridge.]

Placing the post directly beneath the right foot of the bridge operates to diminish tone-power. In this position of the post, it is evident that a blow from the strings is expended equally upon both plates; yet, as I view this matter, the sounding-board continues to strike the greater blow upon contained air because of its greater proximity to the strings. This view is based upon the fact that sympathetic action diminishes as the square of the distance, or stated in the reverse way, proximity augments sympathetic action.

[To the violin tone-regulator there are experiences with humanity that possess more than passing interest. Indeed, some of those experiences leave an impression upon memory equally as unfading as the impression on "burnt wood." Thus: After you have carefully adjusted sounding-board thicknesses to respond to the action of the guage-2 strings, after the interior surfaces are carefully prepared, after the area of exits has received attention, after the finger-board has been carefully prepared and adjusted, after selecting and testing different densities in different bridges, after selecting the choicest strings, after determining the exact position for bridge and post, after testing the tone for evenness of power in two octaves on each string, testing quality of double-stop tones, testing brilliance of tone, testing pizzicato tones, testing harmonics simple, harmonics melodic, harmonics *a bassa*, after pronouncing your work completed to the limit of your ability:

Enter Mr. Addlepate.

(Mr. A.) "I'm looking around for a first-class violin for my own use. Didn't know but I might find one at your place."

Rather confidently, you place in his hands a completed violin, telling him that this one is about as good as you can turn out.

(Mr. A.) "May I take it home and try it? I'll take good care of it."

"Certainly."

After a month or two, re-enter Mr. A.

(Mr. A.) "Say, this violin hasn't got just the tone I'm wanting——think Sam Jones has got one a little better'n yours."

As you glance at that violin your breath makes a gasp. Your carefully adjusted sound-post is gone. Standing in toward the center, and leaning backward, is a white-oak post, whittled down with a dull jack-knife; a deep notch is cut around near the upper end; in that notch is a doubled-and-twisted dirty cotton string tied fast with a square knot; either end of the string, passing out through either exit, is carried around behind the back, there tied in a bow knot; thence hangs 1-4 yard of festoon.

"What makes you gasp so?"

"Can't be that white-oak post?"

"N—n-o!"

"Possibly 'tis that festoon?"

Under such provocation, there is but one way to manifest patriotism. That one way consists in directing an enthusiastic kick to the seat of Mr. Addlepate's understanding. You can't miss it.]

(c). Length of post, when so great as to bend the sounding-board upward, diminishes volume and duration of A and E tone, but, does not diminish intensity in an equal degree. In fact, the post of too great length frequently operates to increase intensity of tone from these strings. Such augmented intensity of A and E-string tone is considered valuable by some violin users, especially by first-violin players in positions where sound-waves are propagated only with difficulty. The post of great length also operates to diminish power of G and D-string tone.

Thus, the post manifests its power for good and for evil.

(7.) The bridge is a powerful factor in diminishing both volume and intensity of tone; but, its greatest influence is manifested upon volume. The bridge possesses seven features of vast interest to the violin student:

(a). Height.
(b). Thickness.
(c). Span between shanks, or pedestals.
(d). Density of fiber.
(e). Scroll work.
(f). Maturity of wood.
(g). Position upon the sounding-board.

(a). Height of bridge may be either so high, or so low as to diminish both volume and intensity of tone. The problem of the bridge I am unable to solve without a partial solution for the finger-board problem. For the sake of clearness, it is first necessary to consider the finger-board insofar as proximity to the sounding-board is concerned. If the finger-board did not extend over the sounding-board, then the problem of bridge-height could be solved by itself. That part of the finger-board extending over the sounding-board, may operate to diminish both volume and intensity of tone. This fact can be easily demonstrated. Thus: Upon a violin, having a height of arch equaling $\frac{5}{8}$ inch, lowering the finger-board down to $\frac{1}{8}$ inch from the sounding-board causes a weak and thin tone, even with a corresponding diminution of bridge-height. As I view this phenomenon, the reason for such loss of tone-power is as follows: Lowering the finger-board brings its surface line nearer to a parallel with the line of the sounding-board. It is apparent that, were these two lines perfectly parallel, then all sound-waves, originating beneath the finger-board, would be reflected directly back upon the sounding-board; and, because of only traveling a short distance, those reflected sound-waves must strike upon the sounding-board with their initial force; a force great enough to diminish the amplitude of sounding-board oscillation. It is apparent that such diminished amplitude operates to diminish the force of succeeding blows delivered by the sounding-board upon contained air. Hence the loss of tone-power.

The problem of the finger-board involves the line of its under surface, and the placing of such line at the nearest distance from the sounding-board possible while preventing the reflected sound-waves from striking upon the sounding-board in such a manner as to diminish amplitude of its oscillation.

As previously stated, I find the best lines on the under surface of the finger-board to be a straight line at the bottom of the hollow, and that the hollow extends well towards the base of the neck. The latter point should be governed by the graduation of the sounding-board, and the arching. Thus, when the graduation places the thinnest part of the sounding-board at a point half way from the position of the bridge to the upper end of the plate, then the hollow of the finger-board must not extend to the base of the neck, but should extend to a point 2 inches, or slightly more, from the base.

[Upon a later date this form for the under surface of the finger board, together with this form for sounding-board graduation, slightly modified, will be described in the production of maximum tone-power.]

It is plainly apparent that the set of the neck may operate to place the finger-board near to, or distant from the sounding-board. It is also apparent that when the point of widest sounding-board oscillation is nearer to the end of the plate, the greater must be the distance to the under surface of the finger-board, because the longer the hollow, the less the obliquity of the line of the hollow, the more direct the return of sound-waves to the sounding-board.

There yet remains consideration of the high-arched plates. In these cases, the under-surface line of the finger-board, and its distance from the sounding-board must be quite the reverse; the lower end of the finger-board must approach much nearer the sounding-board, while the under surface should be flat. At first thought, these facts seem incredible. I confess to astonishment when first seeing and playing upon a Carl Johann Flicker. As you know, this violin is built upon enormorous waist-lines. The hollow at the lower end of the finger-board, (guessing at it) was less than $\frac{1}{4}$ inch distant from the sounding-board. The height of the bridge was correspondingly lowered. Before applying the bow, I expected to hear a weak, thin tone. But, its volume was great enough, and, intensity seemed to be of the average degree for the $\frac{5}{8}$ arch. I had no opportunity to determine the height of arching given to the Flicker plates. I could see that the long arch was quite equally distributed from the ends of the plates to the position of the bridge. Upon studying this situation, it becomes apparent that to raise the lower end of this finger-board to a height enabling its under surface to reflect sound-waves towards the bridge is impractical, not impossible, simply impractical; and because the prodigious height of the strings would cause too great difficulty in playing. The Flicker was not difficult of playing.

Thus is shown the fact that the height of the bridge must depend upon the height of the finger-board, and the height of the finger-board should depend upon the height of plate-arching. In the case of the Flicker violin, the flat under surface of the finger-board, resting upon a high neck, operated to direct sound-waves towards the neck, and apparently, such is only the practical plan for violins having the greatest height of arch. The Flicker exits were unusually large, and appeared to be unusually close together. The spring of arch began directly within the purfing. To these facts do I attribute the unusual tone-power of this violin in comparison with the tone-power of other violins in its class.

It is evident that increasing width of the finger-board increases the number of sound-waves reflected back to the sounding-board; therefore, such increase in width operates to diminish tone-power. The finger-board is a necessity, yet, with best possible adjustment, the finger-board operates to diminish violin tone-power. Thus, the width, the reflecting, under-surface line, and the distance of such line from the sounding-board, are potentialities of the finger-board demanding the closest attention from the violin tone-regulator. Lack of such attention brings penalties. In the matter of distance between the sounding-board and under-surface line of the finger-board, hard-and-fast rules cannot apply only upon the condition that the arching and graduation of the sounding-board govern the rule.

The desired height of the strings from the finger-board, and the position of the bridge upon the sounding-board govern the height of the bridge. Height of strings above the finger-board may quite safely be allowed some latitude to accommodate different taste. My own choice for this height is $\frac{1}{8}$ clear, throughout. Some prefer a greater height for the G, and less height for the E, while some prefer a greater height throughout. I once knew a proficient violinist, having an unusual length of hand and fingers, who placed the strings $\frac{1}{4}$ inch above the lower end of the finger-board. I asked whyfore? He replied, "Because of two reasons; one being the fact that my violin yields greater power of tone; the other being the fact that pizzicato tones are clearer." I do not find his first reason to hold good in all cases; but, on the contrary, I have known tone-power to be weakened by thus raising the strings.

Clear pizzicato tone is very desirable. The snapping pizzicato tone due to string-oscillation receiving interference from the finger-board, is something inadmissable. To secure clear pizzicato tone, while yet leaving the strings at $\frac{1}{8}$, or less, from the lower end of the finger-board, I resort to the following treatment of the upper finger-board surface. With a small block-plane I dress away this surface until its line presents a slight curve from end to end. The least wood is removed from beneath the E, and the greater amount from beneath the G, and because of the fact that amplitude of string-oscillation becomes wider from E to G. The lowest point in this curve, determined by the straight-edge, is not placed higher than c in *alt*, and because of the fact that shortening a string operates to diminish amplitude of its oscillilation.

Further consideration of the bridge will be resumed at the next hour.

LECTURE XI.

GENTLEMEN: Diminution of volume and intensity of violin tone by the bridge is resumed.

(b) Thickness of the bridge may be so great as to become a potent factor in diminishing both volume and intensity of tone. A demonstration for this fact is very easy of accomplishment. Although this fact comes within the daily observation of violin students, yet, because only a small minority of such students trouble themselves with the philosophy involved in tone-modifiers, and, because acquaintance with certain physical laws is of value to the violin tone-regulator, therefore it seems advisable to give consideration to such laws. Certain physical laws are valuable to violin tone insofar as human ingenuity can apply them. In such application lies a difficulty. In all my long-time application there has been but a single result of marked value to violin tone following *a priori* reasoning.

I find the problem of bridge-thickness to be complicated with four inevitable factors:

(a) Height of finger-board

(b) Height of arching.

(c) Diameter of strings.

(d) Density of fiber.

(a) As previously shown, the height of the bridge is governed by the height of finger-board, yet, this statement is subject to modification. Because two violins have precisely similiar height of finger-board, it does not follow, as a necessity, that the bridges have precisely similiar height. This fact is due to dissimilarity in height of arching at the position of the bridge. Doubtless many, if not all violin students have observed that some makers place the highest point in the arching at the position of the bridge, while other makers place the highest point upwards, or forwards from the position of the bridge. It is evident that this dissimilarity necessitates dissimilarity in bridge-height.

[Although not here in point, yet, fear of omission makes me call attention to placing the highest point of the arch, (longitudinal arch) at position of the bridge, Within my observation, placing the highest point of arching at position of bridge, operates to increase tone-power· From my view point, the reasons for such increase are two in number, and thus: First: Diminishing height of bridge permits diminution of bridge-thickness; hence, diminution in the muting effects from a greater mass of wood in the bridge. Second: Placing the highest point in plate arching forwards of, or upwards from position of the bridge operates to diminish the amplitude of sounding-board oscillation beneath the strings; hence, diminished power of tone.]

It is evident that thickness of the bridge may operate to mute violin tone.. It is also evident that diminution in bridge-height permits diminution in bridge-thickness. It is observable that diminution of bridge-thickness, down to the point of sustaining string-pressure without bending, operates to deliver upon the sounding-board a greater force from blows of the strings, Hence, both diminished height and diminished thickness of bridge op-

increase.
erate to ~~diminish~~ tone-power.

[At a previous hour it was shown that proximity of vibrating bodies, susceptible to identical force, operates to augment sympathetic action. For this reason, loss of sympathetic action between the strings and that part of the sounding-board beneath the strings might be considered as one of the modifiers operating to diminish volume and intensity of violin tone; but because the list of such tone-modifiers already reaches the number 12, and, because of failure to find two more such modifiers, therefore I decline to permit sympathetic action, (with its number 13) a chance to ''hoodoo'' my work.

(c) Diameter of violin strings largely, (not wholly) governs downward pressure upon the bridge. It is apparent that the smaller string-diameter causes less downward pressure upon the bridge by reason of less tension demanded in tuning. Therefore, to produce maximum tone-power from smaller strings requires diminution of bridge-thickness proportionate to diminution of string-diameter. The exception to string-diameter governing downward pressure upon the bridge lies in plate-arching. It is evident that, with no arching whatever, downward pressure by the strings is at the minimum; and, because of the fact that the strings are at the least practical distance above a straight line from saddle to nut. At such straight line, the downward pressure being zero, it follows that every degree of bridge-height above this line operates to increase downward string-pressure.

Therefore the higher the plate-arching, the greater is downward string-pressure upon the bridge. Therefore arching becomes a factor in determining bridge-thickness. Thus is shown the fact that hard-and fast rules cannot apply to violin bridge-thickness. (c) The span between bridge-pedestals, or shanks, while not being a potent factor in diminishing tone-power, yet it is a factor demanding attention. By being either too great, or too small, this span operates to diminish amplitude of sounding-board oscillation, and therefore diminishes tone-power.

There are two factors governing bridge-span:

Position of bar.

Distance between exits.

According with my observation, failure in placing the center of the left pedestal over the center of bar-thickness operates to diminish D-string tone-power. Again, placing the center of the right pedestal over sounding-board fibers cut off by the right exit operates to diminish E-string tone-power. The bridge, without pedestals whatever, possesses interest, thus: In those cases wherein a hollow tone of great volume, but of weakened intensity, caused by too great reduction of sounding-board rigidity in its central area, the bridge without pedestals, carefully fitted to lateral curve of the sounding-board, operates to augment A and D-string tone-power; not greatly, but perceptibly. Upon that sounding-board possessing sufficient rigidity in its central area, I do not find that the bridge without pedestals operates to either augment or diminish tone-power of any string. In this respect I find the bridge without pedestals to operate precisely as the re-enforce block glued transversely upon the inner surface of the sounding-board at the position of the bridge.

[In experimental work, I have placed such re-enforce block upon 17 different sounding-boards having varying degrees of rigidity in their central areas. The benefit to tone therefrom was only manifested upon such sounding-boards as were reduced in thickness sufficient to cause weakened A and D-tone. Upon such sounding-boards as produced strong A and D-tone, the re-enforce block neither operated to diminish nor augment tone-power of any string.]

Density of fiber is a powerful factor in the bridge. Either softest fiber, or densest fiber operates to diminish tone-power. Without doubt, this fact is due to failure in transmission of force from strings to the sounding-board. In the case of the violin, it is apparent that force from the strings can be only communicated to the sounding-board by the vibratory action of connecting media, as the bridge, and air. Such transmission is not confined to the bridge by any means. Sympathetic action between strings and sounding-board is wholly due to the presence of air as a connecting medium. The potency in sympathetic action I find to be eminently worthy of consideration by the violin student. I know of no easier demonstration for such potency than as follows: Remove the bridge, and, over the tail-block, place a bridge of sufficient height to maintain the strings at their usual height above the finger-board.

[To make a precise test for the potency in sympathetic action, it is a necessary condition that the strings be not attached to the violin. In either method, tone-power from sympathetic action is surprisingly great when sounding-board rigidity corresponds to string-diameters, in other words, to string-force; but, when such rigidity is too great, then the power of sympathetic tone is diminished, and diminished because maximum sympathetic action between two contiguous, vibrating bodies demands equal susceptibility to force. Such sympathetic tone is also diminished by area of the exits.]

The greatest density in any bridge I have tried is found in one made of bone. The density in this bridge modifies tone in a peculiar manner; both volume and intensity of tone being greatly diminished, while the little tone remaining is remarkably thin, and of an excruciatingly stinging quality.

The bridge of softest fiber to which I have given trial, is selected from soft Michigan pine. This bridge operates to diminish both volume and intensity of tone; but, it also operates to diminish disagreeable quality of tone. Upon the violin of noisy tone, I have not observed failure of improvement in disagreeable tone-quality to follow employment of this soft wood for the bridge. The thickness of such bridge cannot be reduced to the same degree as the maple bridge because of greater ease in bending under string-pressure. Asperity of tone may be greatly reduced by employing such soft wood for both bridge and post.

Scroll-work upon the bridge has a more important mission than mere ornament. It is my experience that the "whole," or "solid" bridge, of any wood whatever, operates to diminish tone-power. Could thickness in the "solid" bridge be diminished until its vibratory action becomes equally susceptible to force as the scroll-cut bridge, then scroll-work would become merely ornamental. But, such diminution of bridge-thickness is impracticable because downward pressure of the strings operates to bend the "solid" bridge when thus reduced in thickness. It is a fact that bending the bridge operates to diminish the amplitude of its oscillation; hence bending the bridge operates to diminish tone-power, and, in precisely the same way as bending the sounding board. Obviously, thickness of the bridge must be great enough to hold the bridge erect under string-pressure. Because string-pressure varies with height of plate-arching and diameters of strings. and, because different samples of bridge-wood present differing degrees of rigidity, therefore hard-and-fast rules for bridge-thickness cannot apply. In this matter, I know of no successful rule other than the usual rule, "Cut-and-try." Experience demonstrates that the "solid" bridge, thick enough to stand erect under 25 to 28 pounds of string-pressure, possesses mass sufficient to appreciably mute the tone. Experience also demonstrates that some part of such mass may be safely removed from certain parts of the bridge without diminishing rigidity to the point of bending.

Such diminution in mass is secured by the familiar scroll-work:

The location and extent of scroll-work upon the bridge by no means should be left to chance; and because mal-position and extent of such work may operate to cause unevenness in tone-power. Thus, after every other minute detail in construction, operating to produce evenness of tone-power, has received the limit of attention, yet, mal-position and extent of central scroll-work on the bridge may remain to defeat the most skillful violin builder whoever felt the impulse of ambition.

As I hold this bridge up to your view, you observe the location and extent of the central scroll, and also the scroll-work at either end. Near to either end, you observe an isthmus, or narrow neck between the central and end scrolls. As you observe, these necks connect the upper and lower-halves of the bridge. It is apparent that all vibratory action in the bridge, aroused by action of the strings, must travel downwards through these narrow necks. It is evident that diminution of these necks operates to modify transmission of vibratory action. It is also evident that inequality in the dimensions of these necks operates to cause unequal susceptibility to force. It is also evident that force in violin strings varies as their diameter and weight. Hence, it becomes obvious that equality in the dimensions of these necks operates to diminish tone-power of the smaller strings. Therefore, for production of evenness of tone-power, dimensions of the neck beneath the A and E-strings should be less than dimensions of the neck beneath the G and D-strings; and, such diminution in mass should be in the same ratio as the diminished diameters of the strings.

Here is a dozen high grade bridges. With a machinist's rule I determine dimensions of their isthmi between central and end scroll-work. I find thickness of those isthmi to be $\frac{1}{8}$; but, in their width, I find variation, from equality, to be 1-16 inch. It is plainly apparent that such variation in mass may be turned to good account in the work of securing evenness of tone-power. Thus: Placing the larger isthmus beneath G and D-strings operates to equalize transmission of force. It is also apparent that diminishing thickness of these isthmi permits the bridge to bend under string-pressure; but, diminishing their width cannot cause such disastrous result. It is also apparent that the dimensions of those isthmi should be governed by string-pressure; and, because such pressure varies with varying degrees of plate-arching and string-diameter, therefore, for such dimensions, hard-and-fast rules cannot apply.

(f) Maturity of bridge-wood, (maturity of tree before being felled) is a powerful factor in the list of tone-modifiers. Such maturity is of equal importance with maturity in sounding-board wood. In the absence of maturity from either lies defeat of tone quality. The reasons for taking sounding-board wood from that part of the log between heart-wood and sap-wood apply equally to bridge-wood.

LECTURE XII.

GENTLEMEN: (g) Position of bridge is an important tone-modifier. So important is it that mal-position may utterly annihilate "richness" of violin tone, even when all other factors are at their best. I recall that case of "wolf" which was completely cured by position of bridge and post. I also recall the fact that harmonics *a bassa*, or *resultant* tones of the text-books, tones assisting in producing "rich" violin tone, will become audible only when length of strings, (from bow to nut, not from bridge to nut) and the active length of sounding-board are equal. Thus: Because the bow practically shortens the strings by one inch, and because the greatest length of sounding-board activity, productive of audible sound, equals 12 inches, therefore, for production of the "rich" violin tone, the length of strings, from bridge to nut, must equal 13 inches. But, in tone regulation work, the above rule cannot be interpreted as a hard-and-fast rule. Within my observation, there is one point, and but one, for that position of the bridge yielding greatest richness of tone; and, by no means am I able to precisely pre-determine such position. Experiment on each sounding-board must be depended upon for precise determination of the best bridge-position.

I close discussion of the violin bridge with the unqualified statement that all bridges of immature wood, (always sap-wood) are best disposed of as firewood.

(8) The finger-board problem comes next in the

list of factors operating to diminish volume and intensity of violin tone. Because of my inability to solve the problem of the bridge until after solving the problem of the finger-board, therefore the finger-board was given priority in presentation. At this moment I cannot call up anything further to say upon this tone-modifier.

(9) The strings are a very important factor in diminishing violin tone-power. Their importance is clearly shown by the fact that sounding-board rigidity must be governed by string-diameters and weight. In my statement concerning violin strings, the wire string receives no consideration further than that it is an evil made necessay by evil situations; that is, situations wherein excess of water vapor operates to quickly ruin gut strings. In all cases where sounding-board rigidity is determined by large strings, then substitution of smaller strings operates to diminish tone-power. It is my observation that in all cases wherein sounding-board rigidity is precisely reduced to correspond with force in guage-2 strings, then substitution of larger strings operates to augment volume of tone while diminishing intensity of tone. Thus, at nearby distances, tone is greater; but is a failure at long distances. I find a satisfactory explanation for this phenomenon to be a matter of difficulty. As an aid to such explanation, I call attention to the fact that larger strings, played in double-stops, cause violent trembling of such sounding-board. It seems reasonable to suppose that trembling of the violin may be so great as to weaken

tone in view of the fact that violent trembling of the horn operates not only to weaken tone, but also, perceptibly to lower tone-pitch. It is a fact of more or less frequent observation that the over-forced tone from any horn in a brass band is out of tune with other horns, and out of tune because of being lowered in pitch. It seems to me that such lowered pitch is caused by the violent trembling of the instrument. That such tone is weakened in intensity is clearly perceptible. Again, in orchestra *ensemble,* tone from the violently trembling violin may be totally annihilated by sound-waves from harmony instruments. For this fact there appears no reasoning so plausible as diminished intensity in the tone of such trembling violin. Again, in the chorus, when any member indulges in violent tremolo, it is at once apparent that his, or her, (too often "her," more's the pity) voice is not only weakened, but, is so much out of tune as to become sickening to the musically trained listener. Again, strings of too great diameter operate to accentuate noisy tone-quality. Thus, whatever may be the correct explanation, the fact remains that employment of strings having too great force for sounding-board rigidity, or for back-plate rigidity either, is but inviting disaster. From my view point, 'tis safer to err in the opposite direction because smaller strings operate to diminish noisy tone-quality.

The "twist" and number of "strands" in the strings may operate to diminish both volume and intensity of tone. Thus, the string of but a single strand operates to diminish tone-power. The reason is obvious. In such string, flexibility being at the minumum, therefore rapidity in winding and unwinding under bow-pressure is greatly diminished; therefore diminished force in blows delivered upon the bridge must follow. Flexibility in violin strings operates to augment rapidity in winding and unwinding; hence the flexible string delivers a blow of greater force. Weight of strings may also diminish tone-power. To be equal in weight, the silk string must be given increased diameter, while the steel string must be given diminished diameter. In all cases evenness of tone is diminished by disproportionate diameter and weight of strings. As a violin tone-modifier, the subject of strings possesses vast interest to the student of tone peculiarities. The tone of the finest violin ever built may be easily ruined by the strings employed. In my observation, the choice in metal for winding the G-string should be governed by the tone-peculiarities inevitable to each individual violin. In equal quantity, copper, silver and gold vary in weight. Whenever I have found a copper-wound string precisely fitting the tone-peculiarities of a certain violin, then substitution of either silver, or gold-wound G has proven to be a disappointment.

In precise adjustment of the G-string, it is my method to make trial of such strings as have different diameters. After determining that diameter giving best results in double-stops, then I select one of slightly greater diameter and give it time to stretch. Then, while in position, and in tune, I proceed to diminish both weight and diameter with an inch-square piece of emery-cloth. With precision as an object, the emery-cloth, folded once around the string, and firmly held by the thumb and finger, is made to travel from bridge to nut, then, slightly turned and made to travel back to the bridge. This operation is frequently interrupted by application of the bow, and for the purpose of knowing the moment when such reduction in diameter and weight has reached the desired point. When carefully done, this method largely removes certain rough inequalities of tone inevitable to all new G-strings. When this method is applied upon a G-string having correct diameter, the result is disastrous. Considering the vast value in beautiful G-string tone-quality, no amount of work thereon is too great.

[Possibly I may be liable to the charge of frequent repetition; but I'll take such risk by again stating that beautiful double-stop tones are the salvation of the violin soloist. With salvation in view, the G-string must not be offensively prominent. It is possible that I may be hard to please in the matter of violin tone-quality; but, whatever I say upon this point is said only as the opinion of an individual, and said with the acknowledgement that my opinion may be in error. In life I know of no fact more potent than the fact that musical taste varies as the number of people. In my opinion, the tone from a set of steel violin strings is only worthy of anathema.

(10) That the condition of interior violin-surfaces

may operate to diminish both volume and intensity of tone requires only a thought. Did I recommend spreading a carpet over the inner surface of the violin back, every reader would doubtless pronounce judgement upon me thus: "That Castle is a fool," or worse yet, "Castle is a fiddle crank." The worst of it is, the "coat would fit." Doubtless many readers think "the coat fits" snug enough when I say that both volume and intensity of violin tone are augmented by a perfectly smooth interior surface. I do say that, and say it with all the earnestness at my command. This problem in violin tone is solved to my satisfaction. If any good quality of tone were injured by the perfectly smooth interior surface, then by no means would this problem be solved to my satisfaction. The question of solving this problem to your satisfaction rests entirely with yourselves. I'd never give you the details for interior-surface work were I "out just for health." On the contrary, I'd keep to myself the secret of changing $5-fiddles into $100-violins. If necessary, I can give the names of several quite competent violinists whose $3-fiddles, (wholesale) are now valued by them at several hundred dollars. Do not understand me as claiming all this change in tone-value to be due to a perfectly smooth interior-surface; but, you may understand me to say that, without such permanently smooth interior-surface, the owners would not have attached those high prices. I can give the name of one such owner, living within 30-minutes ride of one of the world's largest violin markets, who positively declined to attach a price to his originally $10-fiddle.

"Did I give details to those owners?"

"Certainly not."

"Why not?"

"Because of the very prejudice you entertain at this moment."

Here's a "pointer" intended for your benefit: When any person guarantees the tone of his violin to "carry" 1250 measured feet out in the open and under identical meteoric conditions, and in identical hours of the day, and with identical precaution against the presence of sound-wave reflectors that have been heretofore described, just trouble yourself to ascertain whether or not, the interior surface of that violin is permanently and perfectly smooth.

Again, in all old violins which have not been "cleaned out," and many, very many used violins not yet old in years, I assure you of finding their interior surface covered with a "carpet." Such carpet will be found composed of wood-fiber, wood-dust, and dirt. Here is your chance to test augmentation in volume and intensity of tone without injury to any tone-quality, of which I have given assurance in these pages. To all violin users desiring a violin possessing maximum tone-power, I recommend careful application of the details for interior surface protection, together with other details herein submitted. With careful, painstaking work, I am confident of your success.

(11) Area and position of the exits are the most

powerful factors operating to diminish volume and intensity of violin tone. Area of exits alone, is more potent than all other factors combined. Startling as this statement may be, yet its correctness is of easy demonstration. Without exits whatever, the finest violins ever built will not, nor cannot yield more tone than the broom-stick fiddle. In such situation, the strings are left with nothing but unconfined air upon which to expend their force. Hence, instead of concentration of sound-wave lines of travel, there is the widest possible dispersion of those lines. Again, in such situation, string force receives augmentation neither from direct sounding-board action nor from sympathetic action. Without exits, the sounding-board is motionless. Its power is not sufficient to compress confined air. Without exits, the violin descends to the broom-stick level.

Hence, without exits—without violin.

But, a minute opening in the walls operates to permit some action of the sounding-board. Instantly there follows perceptible augmentation of tone-power; and such augmentation follows placing the opening upon the back, upon the ribs, upon the sounding-board, wherever you please, but such augmentation does not follow in equal degrees. Those curved walls operate to direct sound-wave lines of travel. As you look at a violin of good model, you instantly perceive that those interior curved walls cannot direct the bounding ball towards the ribs. Were those ribs of glass, no bounding ball would ever break them. Wherever the bounding ball goes, there, also, the sound-wave movement must go. But, there's a difference in the action of a single ball and countless number of balls touching each other. Air molecules, being balls possessing immense elastic energy, and not moving away from that position occupied at the instant of receiving a blow, operate to produce sound-waves by communicating elastic energy from one to the other; and such communication continues until force in the original blow becomes exhausted. It is evident that increasing force in the original blow operates to increase the distance traveled by sound-wave movement. It is also evident that sound-wave movement may be either dispersed or concentrated; also, that concentration of such movement operates to augment both volume and intensity of tone, but, in unequal degrees; intensity being augmented in the greater degree. It is apparent that interior walls of the violin body not only prevent dispersion of sound-wave movement, but also because of longitudinal and transverse arching of the plates, operate to concentrate such movement. It is apparent that the point of sound-wave concentration within the violin must vary with varying degrees of plate-arching. To precisely determine such varying points is the despair of scientists. It is evident that placing the exits at points of greatest sound-wave concentration becomes a powerful factor in the production of maximum tone-power; also, that placing the exits at a distance from such points of concentration operates to diminish tone-power.

"How may we find those points?

"Don't ask the scientist."

Not more can he tell you than Sam Jones can tell you where heaven is.

By reason of experience alone, the violin builder will cut out the exits obliquely across the sounding-board and trust to luck for hitting those points. Thus, obliquity in position of the exits becomes of immense value to violin tone power. Could those points of greatest sound-wave concentration be pre-determined, then exits in parallelogram form might be employed to augment tone-power.

As previously shown, the exit of small area permits but a limited degree of sounding-board action, therefore it follows that increasing the area of exits operates to permit increased amplitude of sounding-board oscillation; hence an increased force of blow upon contained air; hence an increased tone-power.

We are now arrived at a point in violin construction possessing intense interest to two classes of violin users; the one desiring quality of tone with moderate volume; the other desiring great volume of tone regardless of quality: From my point of view, interest in violin exits equals interest in sounding-board wood and model of plate-arching.

Further consideration of the exits will be continued at the next hour.

LECTURE XIII.

GENTLEMEN: In resuming presentation of violin exits as tone-modifiers, I take occasion to repeat the fact that the exits are more potent than all other factors combined. Therefore, to violin exits attaches intense interest. "Without exits, with- out violin," is equally truthful as, "without sun, without light." From pole to pole, all animate objects love the sunshine. From southern habitable limits to northern limits, humanity loves sweet sounds. All over the habitable world, the area and position of violin exits contributes to the sum of human happiness. In diminished area of exits the æsthetic violin lover may find solace. In enlarged area of exits, the lover of great volume may find enjoyment.

In power to command beautiful tone-quality, violin exits stand supreme and alone. Their power to suppress "noise" surpasses all other tone-modifiers combined.

Blessed are they!

Mr. Builder, in cutting out those exits, I pray thee to use occasionly that keen blade with a sparing hand. Sweet Music, keenly watching your work, will sweetly sing your praises in the ear of your customer. There are yet violin users who will give you an ounce of gold for every pennyweight of wood between the small and the large exit.

[There is a large class of violin users preferring quality of violin tone above mere quantity of tone. Without hesitation, I confess membership in such class; but, do not understand me as condemning quantity of violin tone. On the contrary, I hold to the belief that quantity of violin tone is a necessity in certain situations; and, in such situations, quantity of tone is equally valuable with a gun "out west;" either being a necessary evil for salvation. What I do condemn is the employment of "big tone" in all situations and upon all occasions. Next to the noisy violin, the violin of "big tone" becomes offensive when employed in other situations than where it belongs; that is, in the large auditoria. Offensiveness of tone is a serious matter, whether or not offense is due to too much or too little tone. It is my desire to assist in preventing employment of the violin in situations arousing contempt for both performer and instrument. Thus: To carry an old violin, whose tone has gone down into dotage, into the larger auditoria and attempt tc force its once willing tone to farthest expectant ear is not only an act of inexcusable idiocy, but, is also a display of heartless cruelty. Possibly the later withdrawal of patronage may grow to become an efficient method for preventing continuance of such distressing displays.]

The most wonder-exciting phenomena connected with violin tone are due to area and position of the exits. Even the constancy of these phenomena excites wonderment. There are seven of these phenomena, and four out of the seven do not depend upon inherent quality of wood for existence. Nor hard fiber, nor soft fiber nor no fiber at all exert any influence whatever upon those four phenomena.

The existence of these four phenomena depends