The Geometrisation of the Fingerboard.

1.- Introduction. The Purpose of The Paper.

This paper falls into the line of laying scientific bases to playing the violin. It establishes connections with certain branches of mathematics and physics using well known terms of these fields.

One should not regard this as an attempt to annihilat the artistic elements involved in playing the violin, but as a guidance, a support meant to facilitate the way to the artistic heights.

The paper will attain its purpose if it succeeds to deliver the performer from certain technical difficulties and to let him concentrate on the musical expression, the supreme purpose of the art of sounds.

2.- The Necessity of the Paper.

From the physical point of view each sound (with the only exception of empty strings) is obtained by shortening the string while pressing the fingers of the left hand thus produci a knot.

A biunique correspondence between the point of pressing the string and the height (frequency) of the sound is established as the sound with the same height will be produced in the same place.

While studying the height of the sound depending on the place where the knots are produced, we must consider the other factors on which the emission of the sound depends as invariable. The point of contact between pressure and speed are factors that must be well mastered by the right hand becaus together with intensity and quality they influence the height of the sound. I will no longer refer to the factors depending on the right hand in this paper, supposing they are invariable.

Thus I have shortly explained what intonation in playing the violin is from the point of view of physics.

The accuracy of determining the points of the knots, in other words the correct intonation is one of the greatest p blems of the technique in playing the violin. This problem was much written about and it preoccupies both the beginner and the great performer.

In his work "The Perfect Accuracy of Intonation", S.Eberhardt shows that the assimilation of fixed positions is not a great problem, the true difiiculty arising with the connection between positions."The modern artist must have a perfect mastery of the entire fingerboard as a sine qua non condition, being well known that contemporary violin literature requires more certainty of movements on the entire fingerboard than within a single position". (S. Eberhardt - The Perfect Accuracy of Intonation. Edition A. Fürtner Berlin - Paris).

Mostras in "Intonation in Violin Playing "points that" the mastery of the fingerboard, the assimilation of positions, the levelling of sonority in each position may become an efficient means for obtaining a good intonation in all the registers of the violin". (Mostras - Intonation in Violin Playing.)

I agree with both assertions but they seem to me incomplete as they do not give any solution for solving or easing difficulties.

I do not claim that this paper will completely solve these difficult problems but it might be of great help for any violonist.

3.- The Role of Sight in Orienting the Left Hand While Playing the Violin.

It must be said from the beginning that it is not my wish to contradict anyone. I only intend to set forth a few things meant to facilitate the left hand's orientation on the fingerboard.

Everything that has been written in this field up to now refers to the tactile sense and muscle sensations that must be educated and mastered with a view to attain a correct intonation. I acknowledge the great role of the tactile sense but at the same time I consider that it might be much helped by sight.

It is known that sight, of all man's senses,provides 70% of our knowledge of and orientation in the environment. As far as playing an intrument is concerned let us consider the example of the piano where each key almost cries out its name by its colour and position within the keyboard.

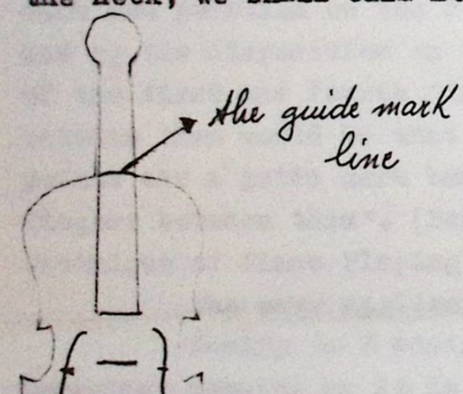
Different from the piano players nobody indicated a spacial - visual guide maark meant to facilitate the accuracy of intonation for the string players.

The most frequent changes of position are at the intervals of second, third, fourth and fifth and these become automatisms by practice for most violonists, raising no more problems. On the contrary the changes for sixth, seventh and eighth that are less frequent raise many problems.

The difficulties of these changes will be much simplified by finding a guide mark meant to reduce, according t the mathematic model, a new and difiicult problem into one that is already known and solved.

In the case of playing the violin it means reducing the changes of sixth, seventh and eighth intervals to changes o second, third and fourth intervals that are familiar to the performer.

It is my belief that this guide mark exists in the very structure of the violin and it can be identified in the line that represents the body of the violin at the insertion of the neck; we shall call it guide mark line.



This guide mark line belongs to the plane determined by the face of the violin. The fingerboard wit the four strings will be considere as forming another plane (the slig converxity of the fingerboard at this point will be neglected). The guide mark line does not actually meet the strings and therefore we shall consider the imaginary point of intersection obtained through t performer's perpective.

The determination of these intersection points is useful only for the performing position, for these points are completely different for the spectator and even for the violonist if he is looking at his intrument from a position that is not identical with the performing position.

The most obvious guide mark points are on G (Sol) string exactly in the place where the neck is inserted into the body of the violin; another F (Fa) sound on E string in the eighth position is situated at the point where the fingerboard is inserted into the body of the violin; on D string we can recognise the C sharp (Do) as an intersection point and on A string the A (La) sound.

Thus a key-position for the superior half of the fingerboard is created:

String	Sound
G	F
D	C sharp
A	A
E	F.

Starting from this position we shall build a reference system meant to facilitate orientation for the superior half of the fingerboard. Knowing the place for the F sound on G string, the sounds F sharp, G, G sharp, A, A sharp, B will certainly raise no intonation problems since practice establishes a correlation between the fingers so that by fixing one of them (the first finger in this case) all the others know their places.

"Passing from one position to another we can locate each new position on the fingerboard both by auditive perception and by the disposition on the fingerboard and the correlation of the first and fourth finger on the string, as if the distance between them would be that of a perfect fourth. These extreme points are a guide mark basis for moving the second and third fingers between them". (Berezovski - Bardas. Psychology of the Technique of Piano Playing).

The same applies to D and A strings.

Coming to E string we enter upon an extremely important chapter as it is well known that one seldom plays in high position on D and A strings while on G string and especial on E string the high position are frequently used.

Establishing the F sound as a guide mark point with the first finger F sharp, E, G sharp, A, A sharp, B will raise no more problems.

It would be a mistake to believe that the performer has to concentrate very attentively on the guide mark line or that this model of orientation forces the performer to have an unchanged position throughout his performance. We all know that this is practically impossible and that each violinist has a certain position of the violin (let us call it basic position) for which he can determine the key position for the superior half of the fingerboard, position that he can take whenever necessary.

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Distributive attention is an important quality that should be educated in all violonists for self-control during practice as well as during public performance. The knowledge of the guide mark points increases efficiency in visually controlling the left hand without requiring more attention than usual.

Let us consider two of the most frequent situations in the violin literature (these situations have already been mentioned in some works on intonation in violin playing).

A. In his book "Intonation in Violin Playing" Mostras says: "the essential moment that troubles the sensation of interdependence in the intonation of musical sounds is formed by stops. Such stops that trouble the continuity of the left hand and its contact with the fingerboard are empty strings and natural harmonics. The fingers of the left hand feel a temporary cessation of activity and a disturbance in their connections".

Mostras recommends to regard stops not as a cessation of any activity but as a reason for preparing the next movement. The main thing is continuity of action and of hearing.

These suggestions are very useful but at the same time it seems to me that they need to be completed by sight and by the use of the above mentioned guide marks.

B. Starting from the assertion that "the change of position is taken with certainity not at random", (Berezovski-Bardas Psychology of the Technique of Piano-Playing), it is much easier to learn it by means of visual orientation in order to avoid or reduce the wrong movements inherent for great changes of position; "it is repetition of the succesful movements that leads to fixation of the motor innervation".

Remark

Because of the different position of the violin (some violonists hold it higher, others more laterally on the shoulder or frontward, the length of the arm is also different) the same sounds will not be found in the same points for all violonists. But the fact that the points of intersection between the guide mark line and the strings exist for anybody is generally true; each violonist must eastablish his own guide marks and thus build his own reference system for the superior half of the fingerboard.

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The geometrisation of the Fingerboard.

In our attempt to find guide marks for the orientation of the left hand on the fingerboard we have used intersections between straight lines (the strings) and a curved line (the guide mark line). This makes us think of analytical geometry in which a point is frequentely expressed as an intersection of two lines. (in our case the strings and the guide mark line).

Hence the idea of geometrisation of the fingerboard, that is presenting it as a plane in which orientation is achieved by means of a reference system. Each string becomes an axis and the points of intersection with the guide mark line become origins (points from which distances are measured in both directions). We consider as positive direction the ascending one from the intonational point of view.

The other sounds (that are thought of as points in this system) will be expressed by reference to origins on each ax

The unit of measure for the orientation on the axis will not be expressed in centimeters, because it is known that the distance between two sounds at an interval of second is greater in the first position than the same interval of second in the sixth or fifth position. A mathematic relation between an interval in the first position and the same interval in another position has not been established yet and even if it were established it would not be useful in practice.

Therefore we shall have to use something specific to the violin technique: the semitone (more precisely the distance on the string between two sounds at an interval of semitone.)

The semitone is constant from the point of view of the difference in height (frequency) between the sounds of this interval.

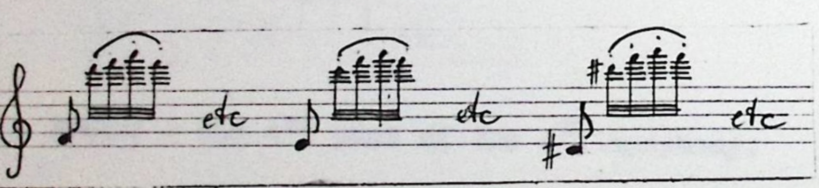
At the same time we should not forget the non-tempered intonation specific to violin. It is known that the difference between C sharp (Do♯)and D. flat (Re♭) that does not exist for the tempered instruments, represents the ninth part of a tone that is less than one millimeter (for the part of the fingerboard this paper deals with). It is obviously impossible to control and correct visually this millimeter, this task havin to be mastered by the bilateral connection between hearing and the tactile sense that this paper has not underestimated.

Thus a reciprocal completion of the two senses and implicitely more certainty while performing is achieved. This unit of measure though not constant with regard to the number of millimeters contained in various positions, presents the advantage of being studied from early age and becomes automatism.

Mention should be made of the fact that the unit of measure itself is not the same for all performers. The main factor that determines it is the size of the instrument and a very good knowledge of one's own violin is necessary. This can be achieved by a careful and long practice.Practice develops in every performer those automatisms we talked about and which help the violonist build his own reference system.

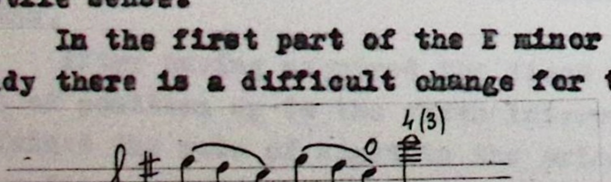
The immediately following interval is the major second, another interval that raises no problems to violinists. Once established the axes, origins and units of measure we can pass on to building and using the reference system for the superior half of the fingerboard.

Let us illustrate with the ninth Caprice by Paganini in which frequent great jumps appear.



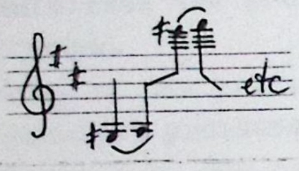
The jump of two octaves between the two F (Fa) notes only requires a careful look over the fingerboard and placing the first finger in the origin established on E string. The following jumps E (Mi) - E (Mi), D (Re) - D (Re) will be thought of as connected to the above mentioned origin and the passage will be solved much quicker than in the traditional method based on the tactile sense.

In the first part of the E minor Concerto by Mendelssoh Bartholdy there is a difficult change for the students:



This interval E (empty string)-G (Sol) can be easily solved by putting the second finger in the established guide mark point that leads to the proper intonation of G (Sol) sound. (If the third finger is prefered for G the procedure is the sam only the second finger is replaced by the first).

Another example is offered by the cadenza of the P.I. Tschaikovsky Concerto.

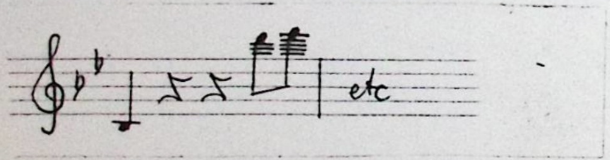


The jump from the A (La) sound to G sharp (Sol) necessarily uses the fixation of the first finger on E (guide mark) or of the second on F (guide mark).

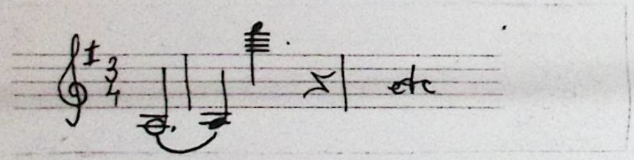
Mention should be made of other violin concertos or pieces composed by Bruch, Tschaikovsky, Paganini, Saint-Saëns, Sarasate, Brahms, Kreisler, Enescu, etc., thus reinforcing the applicability of the geometrisation of the fingerboard.

Great jumps frequently appear in symphonies too.

Schumann - The 4th part of the First Symphony.



Brahms - The 4th part of the 4th Symphony.



The Scope of the Geometrisation.

Generally speaking, geometrisation can be used in playing the violin from the moment the pupil has acquired the knowledge of fixed positions till the moment of giving concerts.

After having acquired the fixed positions and the changes of position up to the fifth interval, the pupil can be explained the role of sight in the orientation of the left hand for the great changes. The correlation between the visual and the tactile sense will increase the possibility of taking a change of position with certainty not at random, a fact that has psychological and motor implications.

In the case of orchestra playing, the correlation between the visual and tactile sense increases the probability of a correct intonation for the whole section. It is known that somebody's failure can hinder the others' success and visualisation considerably diminishes the probability of a mistake for passages with great jumps.

The certainty of the performer will be much increased liberating him of technical problems, allowing him to concentrate on the musical expression, his supreme purpose.

All the other considerations should not be regarded as mere mechanical interpretations or as tools in solving some purely technical problems that are alien to the musical field; in all cases what certainly prevails is musical hearing and its correlation with our movements.