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Are You a Musician?

Professor Seashore's Specific Psychological Tests for Specific Musical Abilities

By Harold Cary

WHILE the sciences of physics and chemistry have become fine arts in which accurate measurements are not only possible but required, the attempts to measure the various capacities of the human mind have doddered along so far behind and remained so inaccurate that they have never been taken with too much seriousness. The best that psychological tests have been able to do in the past has been to show indications and determine rough averages. The famous army mental tests, which have been described in this magazine, were good, sound experiments which laid the groundwork for years of work by the mental experts, but even the most enthusiastic psychologists claimed no more for them than that they were rough indications.

Out of the jungle of ignorance of ways and means for precise determinations of mental abilities great things are to come in the next few years. How much we can expect is shown by the excellent work done by Professor Carl Emil Seashore. Most psychologists are agreed that he has done more and gone further to establish precisely certain particular abilities of the human mind than has any other student. His work in measuring musical talent is well-nigh flawless in so far as it goes—and he has gone much further than the layman can have dreamed possible as yet. He does not work with averages but with particular individuals. He is able to test any given subject and to say definitely how much musical talent that person has in relation to the average talent possessed by the group of persons already tested and numbering more than 5000. This is far different and far more important than determining the average talent of the 5000.

Musical performance of any kind has two sides: the mechanical one and the artistic or emotional side. To be an author or an executive you need in the way of tools only a place to work and pencil and paper. To be a musician you need physiological characteristics which cannot be purchased at the stationery store. Professor Seashore can tell you, with the aid of scientific instruments of excellent precision, whether or not you have the physiological tools which you need in order to be a musician. He has further tests for your ability to express yourself emotionally aside and apart from your tools, but these tests have the same inherent drawbacks that ordinary mental tests have. They are good, but they are not precise. Therefore it is the tests of the musician's tools that are of so great importance and it is because these tests are so well done that psychologists everywhere have hailed Seashore's work as something at last scientifically exact enough for them to stand upon as professionals.

It would be easy indeed to determine a person's inherent musical talent if music were entirely dependent upon some one physical characteristic such as the ear. There are those of us who can carry a tune or distinguish tunes and those of us who cannot. But so far we have not even stumbled over the threshold of investigation. One of the greatest of our classic composers was stone deaf! A man whose ear for pitch was relatively poor might play the piano beautifully. On the violin he would probably play sharp or flat continuously. He could not lead an orchestra.

Physiological musical talent is a hierarchy of talents impinging and overlapping upon each other. It has been Seashore's task to analyze and break down the sum total into its parts, examine these parts and put them together again intelligently. Incidentally it has been necessary to observe the effects of training upon these specific abilities and to determine whether or not a poor musical ear is improved by exercise. The answer is that the best training available does not change the results of the fundamental tests. A child of ten will make the same relative score ten years later after intensive musical training during the entire period.

The simplest tests which Seashore has devised are now being used in hundreds of educational institutions to rate the capacities of children. For instance, in Des Moines, Iowa, five tests, which have been incorporated into a set of phonograph records, are given to all children in the public schools in the fifth and sixth grades. These five fundamental phonograph tests are for pitch, memory, rhythm, consonance and dissonance, and intensity.

The record for pitch is placed upon the phonograph and played through. The sounds are in pairs and the subject is to record on a ruled sheet whether the second sound is higher or lower than the first. The phonograph record is played through and the subjects make their notations. At first the differences between pairs is marked—almost a half tone. As the record goes on they become more and more difficult. The reverse side takes up the test at the point of least difference and becomes easier until it is finished. At the least difference Professor Seashore makes the two tones $1/108$ of a tone apart.

The man or woman or child who can make a perfect score in this test has an abnormally fine sense of pitch, yet it does not mean that he has great capacities as a musician. It might mean merely that he would make an excellent piano tuner or adjuster of phonograph motors. The person who makes an exceedingly bad test is not out of it yet either. He probably could never be a composer; but he might be a pianist, for the notes of the piano are fixed.

The test of time is similar to the test for pitch in method. Three clicks made with cocoanuts are recorded, to make each individual test. The subject is to state or write down whether the interval between the second two clicks is shorter or longer than the interval between the first two. This is not a complete test of the sense of rhythm in that you might have a perfect score on this record and still not

possess other qualifications necessary to rhythmic action, but if your percentage was bad you could be very suspicious of your ensemble of musical talent. Incidentally it might teach you the fundamental reason why it was difficult for you to learn to dance.

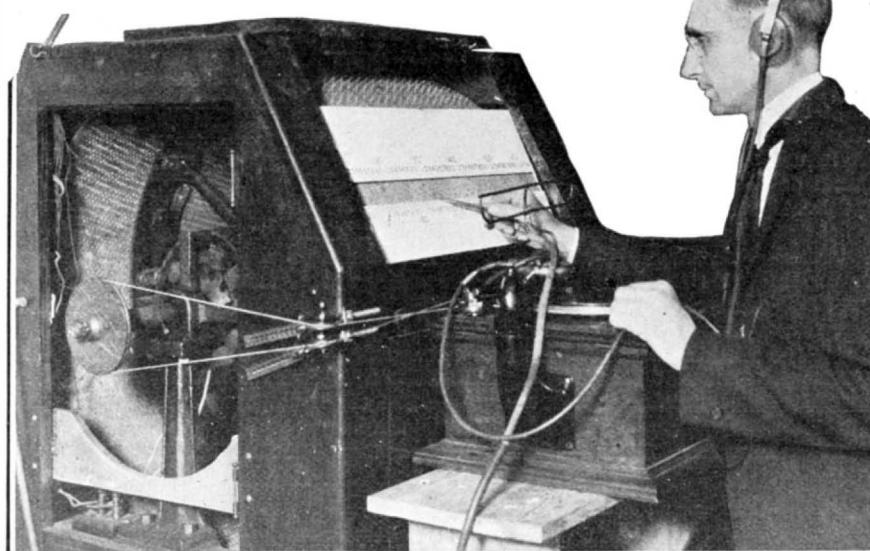
The volume test is to tell whether the second of a pair of sounds is louder or softer than the first. The value of this ability is obvious. All the finer shades of musical expression are dependent upon the musician's ability to distinguish and then produce fine shades of difference in intensity, not only of whole passages but of particular notes.

Consonance is tested by playing pairs of chords, with answers as to whether or not the second of the pair is better or worse than the first. This is a test, not of your taste, but of your ear. Dissonance may be pleasant to your ear—it is often used in classic musical compositions; but you should nevertheless be able to tell the difference between chords which clash and those which are smooth.

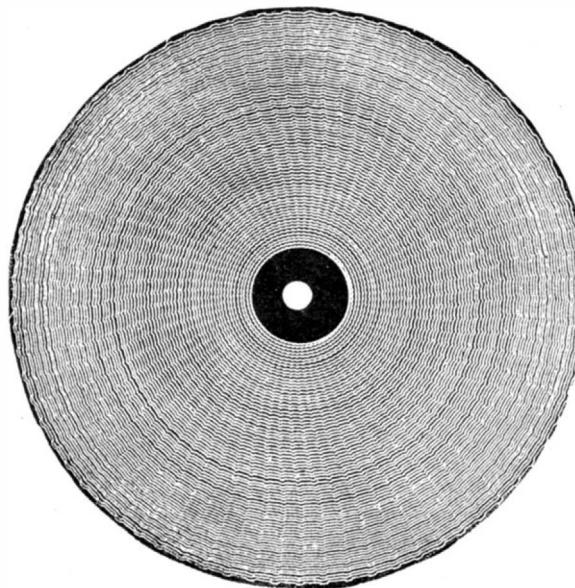
To test memory, the record sounds a series of from two to six notes and then repeats the series with but one change. As the series is being played the subject counts: one, two, three, four, five, six. This is to place by association each note played, for the second time through the little series one of them is to be changed and the answer is to be: "Number four," or whatever note you think has been changed. Musical memory is obviously of great importance. It does not necessarily accompany musical intelligence, but to a great degree the accomplished musician must have a well-developed

memory of this character. This is "absolute memory." It cannot be developed to any great degree, although useful memory is a faculty that can be improved to some extent according to many scientists.

The enormous economic importance of such tests as these lies in the amount of money which is wasted upon children in the United States who can never become musicians. It has been estimated that the people of the United States spend more than \$40,000,000 a year *more* for musical training than for all high school, normal, professional and college teaching. The thousands of tests which have been made show that the good and bad receive training indiscriminately. Moreover, the difference between the good and bad is enormous. Quantitatively the good pupils have ten-fold, fifty-fold, even a hundred-fold better tools.

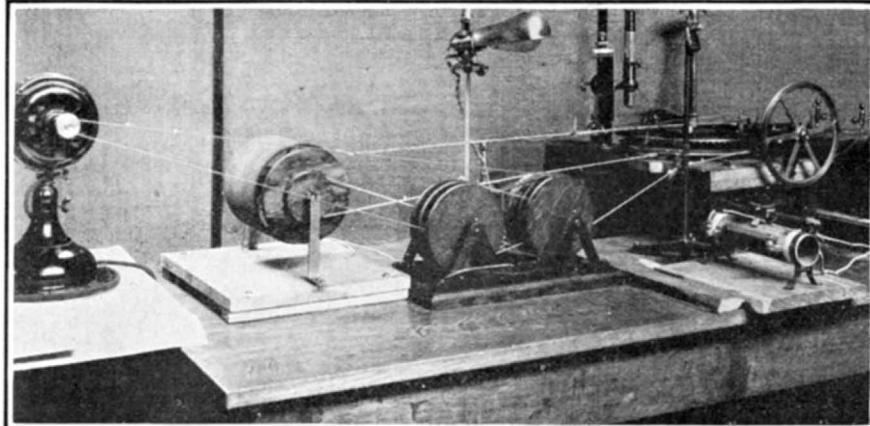


The tonoscope for analyzing the pitch of the tones on a disk phonograph record



Each wave represents $1/100$ second of the disk's motion. A discrepancy of as much as $1/10$ wave in two successive circles would mean only an error of $1/1000$ of a second in the motor's rotation; but there is scarcely a place where even so small an error as this appears

Illustrating the extreme accuracy of the phonograph motor



Wave recorder for use with disk phonograph; the lever, acting like a pantograph, traces the waves on a revolving smoked drum

These dragnet tests for use on any and everyone are but a beginning. To go more deeply into the capacities many more abilities must be investigated. For these tests many special instruments have been devised or adapted for special use by Professor Seashore.

For performance upon any musical instrument (and in this category the use of the voice in singing may be regarded as a performance upon a musical instrument) one of the chief requirements must of necessity be adequate motility. This might be called the ability of the muscles to do quickly and accurately what the brain tells them to do. A tennis player needs good motility; so does an expert typist. A simple way to test your own motility roughly is to try to see how many dots you can make on a piece of paper with a pencil in five seconds. Try it as many times as you wish for practice and then make your test. You will make somewhere between twenty and sixty. After months of practice you might improve your record, but some other test would put you in the same class that this test puts you in before you practiced on it. More accurate results may be attained by use of a recording chronoscope made in any of a number of forms. The graphic record here shows the regularity of the action in addition to the number of movements performed.

Physicists who are students of sound have pretty well proved that timbre is due to overtones. It is these which make the difference in the character of sounds produced by the saxophone and the flute, or any other instruments, including the voice. The person who is to be a real musician must have an inherent sense of timbre. For testing this greatly varying talent a set of tuning forks in harmonic series is used in conjunction with resonators. The overtones of these forks can easily be emphasized or subdued; and comparative quantitative tests show the value of the particular ear in its ability to distinguish these mutations.

One of the most interesting instruments which Seashore has devised is the musical-touch audiometer. We speak of one pianist as having a better touch than another. We know that the touch of Hofmann is very different from the touch of Paderewski and yet at the same time a little reflection will quickly determine that this characteristic is a most difficult one to define. The audiometer, however, does a beautiful job of testing because it determines how closely an individual is able to approximate an effect which he wants to produce; yet at the same time, no matter how skilled a musician he may be, he has never before attempted to play such an instrument as this one.

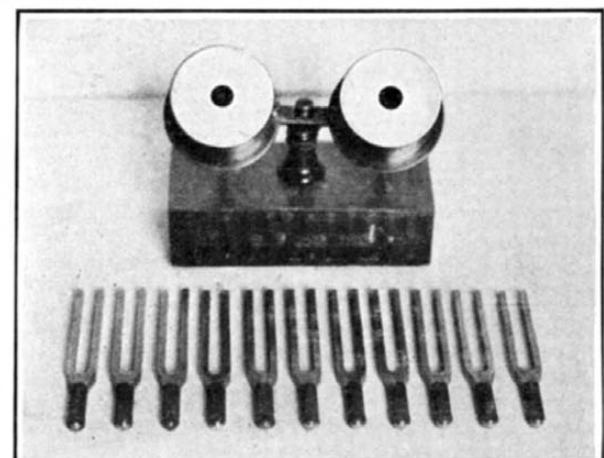
An electrical tuning fork is placed in a circuit with thirty-five different steps of resistance to produce a note ranging from inaudibility to a sound which is disagreeably loud as heard in a telephone receiver. A contact rider is placed in the hand of the subject and the tester. The subject is blindfolded. The tester slides his contact along the posts with a sweep of the hand which takes about one second, ending on a certain note which he has determined to use. This he sounds for a full second, and again and again to enable the subject to fix it in his mind. By ear alone the subject tries his hand at it. After he has had

fifteen practice trials to get the hang of the test he is given fifty tests, ten different intensities being used to vary it.

Research on this test, showing its value in establishing the quality of touch, was made among a large number of music-school students of the piano. The teachers were asked to make independent ratings of all the subjects and these ratings were compared with the scores made upon the audiometer. The two ratings were so similar as to prove beyond doubt great reliability of the mechanical test.

One of the most valuable instruments for use in analyzing musical ability is the tonoscope which has been described in a previous issue of the SCIENTIFIC AMERICAN. By means of this instrument a motion picture of the tones being played or sung, in relation to their pitch, is shown before the eyes of the performer. A person playing the violin may see exactly how many vibrations per second he is out of tune. A singer may see his whole method of tone production.

Professor Seashore, to establish the methods of the best singers, arranged the tonoscope to record the sounds made by a phonograph record in graphic form. The pitch factor in artistic singing was thus laid out upon graph paper so that the differences could be studied. No matter who sings the note it seems always divided into three parts: the attack, the sustained tone and the release. Analyses of notes sung for the phonograph by Melba, Gluck, Destinn, Alda and Eames shows definitely the characteristics of these singers... One of them, for instance, attacks one-tenth of a tone low, rises above the true tone and falls again, having gone through a variation of a full quarter of a tone. All of them show similar variations. Several notes, g's, for each singer showed that this note for Destinn and Eames was 390 dv. (vibrations); for Alda, 394 dv.; for Melba, 393 dv.; for Gluck, 398 dv. The tests of these



Set of pitch-discrimination tuning-forks with resonators, used for testing the sense of timbre

upon inherent qualifications of the subject and for this reason can be far more accurate in his judgments than can the man who examines more vague attributes of the human mind.

As Professor Seashore says: "The gift of music is inborn, and inborn in specific types which can be detected early in life, before time for beginning serious musical education."

Specific proof is presented of these facts. Some of Professor Seashore's "discoveries" have been endowed by wealthy persons. They already give promise of becoming brilliant, nationally-known musicians. One boy, whose father wished him to be trained in business in a small Iowa town, was obsessed with the desire to become a violinist. His father agreed to let the decision rest with Seashore as to which course was to be followed. The boy, now twenty years old, is giving a series of violin recitals throughout the country and is being sent next year to Europe for further training. He has been hailed by critics as the "Iowa Kreisler." He came within an inch of being just another Iowa hardware merchant.

The Value of Psychological Tests

IN School and Society for July 29, 1922, Professors S. S. Colvin and A. H. MacPhail present an excellent and important article in which there is discussed the value of Psychological tests, as shown by four years' use at Brown University.

The attempt to measure innate intelligence through the use of intelligence tests has in the last few years assumed a position of predominating importance. The movement is roughly 17 years old. Its earlier developments were relatively slow and its practical significance limited. Not until 1918, with the beginning of the use of group intelligence tests, did the great possibilities of employing mental tests in school administration and educational guidance become clearly understood. Recently the compilation and use of mental tests have grown with astonishing rapidity until today the subject of "mental testing" is discussed more extensively and frequently than any other topic in the realm of education or of scientific psychology.

The authors review recent criticism, both favorable and unfavorable, describe their own work, present several tables, and conclude:

"High" men (i.e., "high" by the tests) have a good chance of graduating, "low" men much smaller chance.

Roughly speaking, three-fourths of the "high" men do satisfactory scholastic work. Only one-third of the "low" men do so.

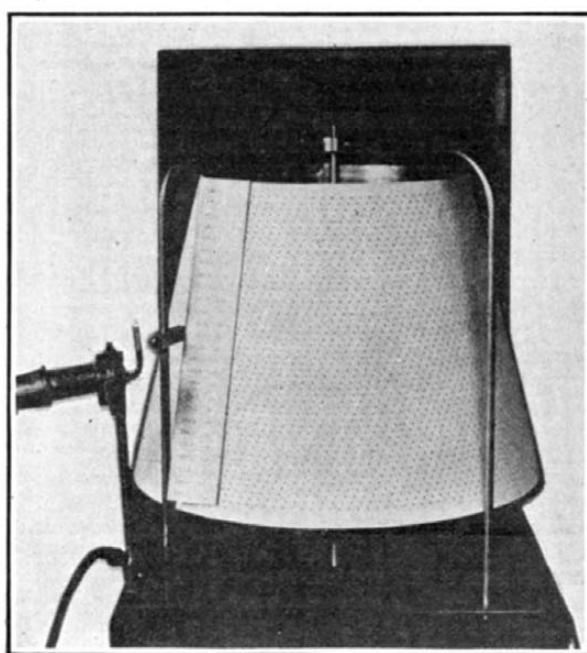
Among the men who receive "warnings" at mid-term the "low" men outnumber the "high" seven to one.

"Low" men are from five to seven times more likely to have poor academic records at the end of the first semester than are the "high" men.

As a group, the academic work of the "high" men is far ahead of the class achievement as a whole and the work of the "low" men is of a distinctly inferior quality.

Coupled with poor academic work at the end of the first semester a low psychological score is a reasonably just criterion for dismissing men from college at that time.

Four times out of five the scholastic honors awarded in college go to "high" men. The rest of the chances belong to the "medium" men, since the "low" man is practically out of the running. He may have about one chance out of a hundred of getting one honor, but almost without exception those who get more than one honor are "high" men.



A simplified tonoscope—a dial mounted on an ordinary phonograph