PHYSICS

Why Is a Crooner? Science Seeks Answer

Tests Show That Good Voices Are Likely to Be Loud Voices, Too; Overtones Important to Quality

USING instruments that turn sounds of the singing voice into electrical impulses and make possible voice "photographs," science is at last trying to find out what makes the mystic "good singing" voice. And what acoustical difference there is between the voice of an operatic star and a radio crooner.

At the Peabody Conservatory of Music in Baltimore, Wilmer T. Bartholomew is collecting data which may soon take some of the dogmatic tradition, cut-and-try methods and mysticism out of voice teaching. He wanted to find out if the usual system of mental imagery, in which the voice student is told to sing by "getting it up," "forward," "against the teeth" or "all through the head," really helps. The results are reported in the *Journal of the Acoustical Society.*

The musical research indicates that while the attempt to sing "all through the head" improves the singing tone it has little effect on the production of good quality. The mental imagery is good psychology and physiology but not physics. It is good pedagogy, but a trial-and-error and not a scientific pedagogy.

All the attempts to make the pupil sing from particular spots in his head or throat help singing by relaxing the tongue and jaws and the enlargement of the pharynx. In general, music teachers find, a "yawning sensation" tends to help voice quality while the "swallowing sensation"—a much more frequent physical act—tends to harm voice quality.

From an acoustical standpoint a "good" voice must possess vibrato, that is, it must wobble but do its wobbling evenly about six or seven times a second. And the vibrato should include a regular variation in pitch, intensity and timbre. In a good voice this unconscious varying of tone is more marked the louder one sings.

Popular opinion to the contrary, it appears that the person who has good quality of voice can sing louder than an individual with poor quality. A large throat which usually produces a good singing tone is also able to go to higher intensity of sound by allowing freer vibration of the vocal cords.

A good voice, too, should have what music teachers call a low formant; the low frequencies of sound should be strong in proportion to the higher ones. Any note sung consists of a fundamental frequency plus overtones or "partials." A good voice can produce the fundamental and plenty of the second partial. Thus for middle C, 262 cycles per second, a good voice has plenty of the second partial at double the frequency, 523 cycles per second. Poorer voices sing the fundamental but mix in with it the third, fourth and fifth partials, the pleasing second partial being weak.

Finally a good singing voice has also a high formant consisting of frequencies between 2,800 and 2,900 cycles. Most of the energy in the good voice, in fact, appears to be expended in creating these higher pitched sounds even when the singer is producing low notes. In a baritone singing a low note the high formant sounds may be equivalent to the 25th partial.

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MILITARY SCIENCE

Machine, Not Horse, Will Make Kings of Tomorrow

WILL warriors of tomorrow ride into kingships on the backs of machines, as the warriors of past ages rode into their kingships on the backs of horses?

Latin "rex" and Sanskrit "rajah" both derive from a common original word meaning "horseman," indicating that it was the borrowed power of the horse that raised these rulers to their thrones. Will our present-day Duces and Fuehrers, who live by the borrowed power of machines, eventually evolve into "mechanarchs," or something like that? Is the mid-Twentieth Century to get, if not gods out of the machine, then at least kings?

One is tempted to speculate. Most great kingdoms of the past have been built on the skill in the art and science of war possessed by relatively small groups of men loyal to a single magnetic leader: Alexander's terrible cavalry and that impregnable fortress on foot, the spear-bristling Macedonian phalanx; the ruthlessly triumphant legions of Rome; the mailed knights of the Middle Ages. All these, and their parallels elsewhere in history, pitted small numbers of skilled, disciplined men, whose life profession was arms, against masses of half-trained, indifferently-armed citizen soldiers, volunteer or conscript. They plowed through them, mowed them down, made them subjects or slaves. The skilled soldiers of the little armies became aristocrats, their leaders kings.

Gunpowder, that great equalitarian force, for a time made skill in the old handicraft of war of less avail. The democratic armies of Gustavus Adolphus had two kinds of front-rank soldiers, musketeers and pikemen. A nameless clever armorer in Bayonne showed how the pike-point could be fastened onto the musket, and thenceforward for some three centuries all foot-soldiers were equals, armed with a gun to shoot, and a bayonet for pike-