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CITATION FOR PROFESSOR ANDRZEJ RAKOWSKI

Anybody who has even a passing interest in auditory perception is familiar with the work and publications of Professor Andrzej Rakowski who is an internationally acclaimed authority on musical acoustics and psychoacoustics. This citation serves as a symbolic tribute to Professor Rakowski on the 50th anniversary of his scientific career.

Andrzej Rakowski was born in Warsaw, Poland, on 16 June 1931. In 1957, he received a Master of Science degree in electronic communication from the Warsaw University of Technology and a Master of Arts degree in music theory from then the State School of Music in Warsaw, now called The Fryderyk Chopin Academy of Music, in 1958. His contributions to acoustic research began during his postgraduate fellowship at Durham University, King's College, Newcastle upon Thyne, in England (1958/59), where he studied acoustics of musical instruments with E. G. Richardson. He received a doctoral degree in electronic communication from the Warsaw University of Technol-

ogy in 1963, a second doctoral degree (*habilitation*) in art sciences (musicology) from the University of Warsaw in 1977, and became a full-professor in 1982, as conferred by the President of the Republic of Poland.

Professor Rakowski's career spans over a half of a century. During that time he served as a researcher, teacher, chairperson, member, and consultant in academic institutions, scientific organizations, and various experts' panels. From 1953 until his retirement in 2001, he was associated with the Fryderyk Chopin Academy of Music, Warsaw. Between 1972 and 1974, he served as Deputy Rector for Scientific Affairs and was elected as the Rector of the Academy for two terms: 1981–1984 and 1984–1987. Professor Rakowski is the founder of the Musical Acoustics Laboratory at the Fryderyk Chopin Academy of Music, which he had headed for 34 years, from its inception in 1968 until 2001. From 1987 until 2003, he was also associated with the Institute of Musicology, University of Warsaw. Currently, he is a part-time professor at the Institute of Musicology, Adam Mickiewicz University in Poznań, Poland. Since 1994 Professor Rakowski has been an associate member of the Polish Academy of Sciences and he served as the President of the Committee on Acoustics of the Academy from 1996 to 2007.

As a visiting professor, he lectured at numerous renowned universities throughout the world including: Stanford University (USA), University of Illinois (USA), McGill University (Canada), University of Alberta (Canada), Hebrew University (Israel), University of Hamburg (Germany), University of Cologne (Germany), and New University of Lisbon (Portugal). During the academic year of 1977/78 he conducted research in psychoacoustics at the Central Institute for the Deaf in St. Louis, USA.

Professor Rakowski's early research was focused on the acoustics of musical instruments. In his doctoral dissertation he investigated attack transients produced by woodwind instruments. In the 1960s and 1970s, he carried out both basic research studies and numerous applied projects for the music industry in Poland. He also organized the Music Instruments Laboratory at the Fryderyk Chopin Academy of Music that served as the research and development department of the Polish Music Industry Association for many years.

In the mid 1960s, Professor Rakowski began extensive research in psychoacoustics and music perception, the areas in which his achievements have been recognized widely. A substantial part of his work in psychoacoustics was focused on pitch perception. His first remarkable accomplishment in that field was the finding of the sensation of pitch produced by low-pass noise with a sharp spectral edge. This effect was reported at the 6th ICA Congress in Tokyo, in 1968. His paper presented at the next ICA Congress, in Budapest, in 1971, ignited heated discussion around the problem of the difference limen for pitch. The results he reported in Budapest indicated that the difference limen for pitch measured for a 1-kHz tone in extensively trained subjects might be as low as 0.5 cents, i.e., 1/200 of a semitone. This finding was received with disbelief as the lowest differential thresholds for pitch known at that time were by about one order of magnitude larger. In his later studies, Professor Rakowski proved that the low threshold values obtained in his experiments were due to the subjects' tasks requiring a compari-

son of pitches of two successive steady tones. Such a procedure was different from those used previously in which the differential thresholds for pitch had been inferred from the measurements of frequency modulation detection.

Another pioneer idea of Professor Rakowski was the concept of pitch strength, first described in the Catgut Society Newsletter in 1977. Pitch strength manifests itself in the precision with which a listener can discriminate the pitch of a sound. Professor Rakowski proposed a procedure for the measurement of pitch strength based on the assessment of pitch discrimination. According to that procedure the pitch strength is inferred from the dispersion of multiple pitch adjustments of a test tone to the pitch of the sound under investigation.

A special topic of Professor Rakowski's research, particularly important for an understanding of the function of memory for pitch in music, is the phenomenon of absolute pitch. Absolute pitch is the ability to recognize the musical pitch of a tone without an external reference pitch. Professor Rakowski's extensive studies of absolute pitch have demonstrated the existence of two different kinds of absolute pitch. The first one, known as *genuine* or *full absolute pitch*, manifests itself as the listener's ability to identify instantly all twelve within-octave pitches of the musical chromatic scale. Musicians who possess the other kind of absolute pitch, called the *partial absolute pitch*, do not memorize all twelve pitches of the musical chromatic scale in an absolute way. Instead, they recall only a few pitch standards, or in some cases just one standard, from their long-term memory to form reference pitch. The identification of all other musical pitches is done in a relative way by recognizing the musical interval between a given pitch and the reference pitch.

In his experiments on pitch perception, Professor Rakowski also studied the intonation of musical intervals. He conducted a variety of experiments in which musicians assessed the intonation of intervals presented in isolation and in musical context. His studies have demonstrated that intervals perceived by expert musicians as correct usually deviate from mathematically accurate tuning and these deviations are in agreement with intonation patterns that depend on the musical context.

Professor Rakowski has summarized his extensive research on pitch perception in a theory in which he has pointed out various similarities between the perception of music and natural language, and explained how music and natural language function as systems of human communication. In this theory he postulated that the dimensions of the musical system of pitch, i.e., natural pitch (tone height), pitch classes, and musical interval categories with their intonation variants, serve as elements of the communication code in music. The principles of that code are imposed by the characteristics of short-term and long-term auditory memory. Of particular importance are Professor Rakowski's experiments concerning the properties of short-term memory for pitch. The results of his studies indicated that short-term memory has rather extended time-range and the memory is immune to cognitive interference.

Another area of Professor Rakowski's accomplishments is the perception of timbre. His studies of timbre were focused on four closely related perceived attributes of sound: roughness, unpleasantness, sensory dissonance, and musical dissonance. He also

studied other aspects of timbre, mostly in applied research projects conducted for the manufacturers of musical instruments. The most spectacular application of his research on musical timbre was a development of a unique course for sound engineers. That course, called *timbre solfege*, was created together with his close co-workers, Tomasz Łętowski and Krzysztof Szlifirski and introduced to the curriculum of the Fryderyk Chopin Academy of Music in 1976. Its purpose was to expand auditory sensitivity to timbre and the ability to memorize timbre. Similar courses modeled after timbre solfege have been taught at various academic programs in Europe, Canada, and in the USA.

During his long and successful career, Professor Rakowski has published over 200 articles, was granted a patent on a version of a Békésy audiometer, and presented numerous invited and plenary lectures at international conferences. It is also important to stress that Professor Rakowski is acknowledged, both in Poland and internationally, as an outstanding academic teacher. He was a thesis advisor to 16 doctoral students, many of whom have become accomplished scientists and teachers, and mentored numerous masters' theses.

Professor Rakowski has been very active in scientific and cultural organizations in Poland and abroad. He is a member of the Polish Acoustical Society, the Polish Phonetic Association, the Musicological Section of the Polish Composers' Union, the Acoustical Society of America, the European Acoustical Association, the International Society for Psychophysics, and the Catgut Acoustical Society. He was one of the founding members of the European Society for Cognitive Science of Music (ESCOM) and served as the President of ESCOM between 2000 and 2003. Currently he chairs the Experts' Panel for Music Education at the Polish Music Council. Professor Rakowski is also a member of the scientific advisory boards of *Archives of Acoustics*, *Musica Scientiae* and *Music Perception*. He organized numerous sessions on musical acoustics and psychoacoustics at international scientific conferences and served as a reviewer to scientific journals.

In recognition of his work, Professor Rakowski has received a number of prestigious awards: he is an Honorary Member of the Polish Acoustical Society, an Honorary Member of the Polish Phonetical Association, and a Fellow of the Acoustical Society of America. He has also received a Scientific Award from the Polish Academy of Sciences and three Achievement Awards from the Polish Ministry of Culture. For his distinguished service he received numerous Polish state decorations including the Officer's Cross of Polonia Restituta, the Knight's Cross of Polonia Restituta, and the Golden Cross of Merit.

This issue of *Archives of Acoustics* has been prepared in recognition of Professor Rakowski's accomplishments and his life-long devotion to science, teaching, and professional service. His ideas and experimental findings have built bridges between acoustics, psychology, and music, and have provided profound insight into the underlying mechanisms of music and auditory perception.

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