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ACOUSTIC RESEARCH AND ENGINEERING ACTIVITIES IN HUNGARY IN THE LAST HUNDRED YEARS

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ABSTRACT

Hungarian acoustics dates back to 1893 when the „Telephone newscaster" was started. The first radio emission was transmitted from the Postal Experimental Station in 1924. Before WW2 the priority subject of acoustics was centered also around the radio: a number of dedicated studios were designed and built. This in turn drew the attention to the field of room acoustics. The most significant scientist of the second half of the 20th century was T. Tarnóczy, who was active in many areas. He founded a research group at ELTE University, which became an essential research entity of the Hungarian Academy of Science. A similarly important technical center was created at the Technical University under the leadership of Z. Barát.
Electroacoustics was clearly the core activity of the Hungarian acoustic industry. A number of ministries have also founded R&D institutes. After 1990 most of these industrial and ministerial institutions have significantly shrinked or disappeared. Their leading staff members have often founded small businesses, offering engineering services. Research activities were concentrated to certain universities, initially supported by EU-funded projects. Nowadays they represent centers of gravity for various modern acoustic areas.

Keywords: *speech science, electroacoustics, room acoustics, noise control.*

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1. INTRODUCTION

As probably in other countries too, acoustics in Hungary has always been hallmarked by some standout topics of the field, and these accents have changed from time to time. In this paper we make an attempt to present the most important events, processes and the most prominent actors, should they be scientists or engineers. The task is not easy because quite some acoustic institutions have already been vanished due to the political, societal and/or economic changes. On the other hand, as to the knowledge or this author, there is no summative work written on the history of acoustics in Hungary. Consequently, this paper is a first – and surely very incomplete – attempt to summarize the development, tendencies and cornerstones of the topics. Nevertheless, it can perhaps serve as a starting point to work out a more comprehensive and detailed description of our beloved profession.

2. THE OUTSET: TELEPHONE, TELEPHONE NEWSCASTER AND RADIO

The commencement of acoustics in this country dates undoubtedly back to 1893 when Tivadar Puskás has launched his „Telephone newscaster". Puskás has worked with Edison for one year and he was his representative in Europe, building the telephone network and the first telephone exchange in Paris. After having returned to Hungary, he has built the telephone network and set up the first telephone exchange in Budapest in 1891. Soon after that, he started the "Telephone newscaster", the predecessor of the radio in 1993, with which he transmitted political and economic news, reports from the Parliament and Stock exchange as well as theatre and concert broadcasting.
The first Hungarian radio emission was transmitted from the Postal Experiment Station in 1924. The first "studio"

was a furniture-remover coach on the courtyard, the first radio transmitter was a 250 watt unit installed at Csepel island, south from Budapest. The postal institution played an important role in the development of acoustic communication, inasmuch as G. Békésy, the later Nobel laureate worked there as a postal engineer between 1924-1948.

Figure 1. The first "radio studio" – a furniture-remover coach – on the courtyard of the Postal Experimental Station in 1924

Figure 2. Listening the Telephone Newscaster

Before WW2, the acoustic activities were centred around the radio: a number of studios were designed and built for various programmes. This in turn drew the attention to the field of room acoustics. A good example of the linking of the two is shown in Figure 3, which depicts the subjective test of the than new radio studio #6, around 1933. At that time only the raw structure was finished, the Radio orchestra has played various pieces and Békésy and Dohnányi (music director of the radio) were listening and evaluating various acoustic coatings along the walls.

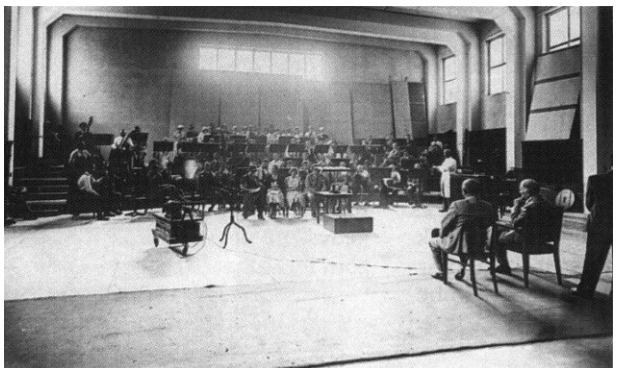

Figure 3. Subjective test to work out optimal acoustic coating of the large orchestra studio of the Hungarian Radio (approx. 1933)

Though rebuilt a couple of times and currently already out of service, the studio still does exist, probably one of the very few – if not the only one – of its sort of other European radios.

3. ACADEMIC INSTITUTIONS AND SCIENTIFIC RESEARCH AFTER WW2

3.1 The Acoustic Research Laboratory and its founder, Prof. T. Tarnóczy

The most significant acoustic scientist of the second half of the 20th century was undoubtedly Prof. T. Tarnóczy, a true acoustic polyhistor. While his favorite research field was speech acoustics, he educated as a many-sided expert in most fields of acoustics from speech and language science to room acoustics, and from bioacoustics to ultrasonics.

He studied the acoustics of speech sounds for his PhD thesis under *Prof. G. Békésy* in the late 1930s. at the Pázmány Péter University Budapest, Department of Experimental Physics. After the war he started the

modern acoustics in Hungary. His aim was to raise the Hungarian acoustics to European level. While teaching at two universities at the same time, he headed first an academic research group, which became later the Acoustic Research Laboratory of the Hungarian Academy of Science. He wrote 11 books, several papers, organized the international contacts for the young professionals in scientific, engineering, and language science, and also in medical and environmental areas of acoustics.

He was one among the early leaders of European acoustics in organising regular international cooperation of acousticians, in order to to reach a united Europe instead of a divided one. He participated in the foundation of East-European, later on of the European Federation of Acoustic Societies (FASE), which became the forefather organisation of EAA. The peak performance of his endeavour was the organization of the 7th ICA Congress in Budapest under his presidency in 1971. That event was an epoch-making occasion, bringing together scientists from both side of the late iron curtain for the first time.

Figure 4. Prof. T. Tarnóczy in his laboratory

3.2 Further history of the Laboratory

After the death of Prof. Tarnóczy the leadership of the Laboratory went to Prof. A. Illényi (see Fig. 5.) The research focus of the lab was then speech processing and recognition (see Fig. 6.). Due to the steadily shrinking academic funding the resources were transmitted more and more for the development of measuring instruments and to provide measurement services and expertise. As from 2012 the remnants of the laboratory were split and the parts were attached to two departments of the Budapest University of Technology and Economics, and this is how they operate still today.

Figure 5. Prof. A. Illényi in his office at the University

Figure 6. Prototype of the speech recognizer with limited vocabulary (1985)

3.3 Acoustic engineering at the Budapest University of Technology and Economics in the 60s to 80s

While Prof. Tarnóczy was active in various fields of the acoustical science, a number of departments at the Budapest University of Technology performed acoustic research and education in some specialized engineering fields. Prof. Szentmártony, who wrote the first Hungarian book on noise control, was an outstanding expert of aeroacoustics at the Faculty of Mechanical Engineering, Prof. P. Nagy has introduced acoustic design into the curriculum of architects and built a testing laboratory for building acoustics. Prof. L. Timár Peregrin acted as valued expert and educator in the field of noise and vibration of electric motors.

Unlike these educational entities which were on the cutting edge but rather small in terms of staff and number of courses, an important and powerful R&D group and educational center was created at the Department of Telecommunication under the leadership of Prof. Z. Barát, He was a true engineer and excellent educator rather than a theoretician, who trained generations of engineers and infected them with acoustics. His major achievement was the development and widespread use of concentrated parameter modelling methods for a wide range of acoustic problems and constructions. His group also gave courses in the field of acoustic engineering, acoustic measurements, sound recording and even noise and vibration control.

4. INDUSTRIAL COMPANIES AND R&D INSTITUTIONS IN VARIOUS FIELDS OF ACOUSTICS

4.1 Electroacoustic industry

After WW1 the Hungarian industry had largely lost its raw material base and fell apart. New industrial sectors had to be brought into being and new product groups generated, attaching special importance to high-level technical development. Radio technology and electrical engineering were leading sectors in this process. Orion Electrical PLC, which was founded in 1924, has produced radio sets and its share from the world market – including the licenced factories – has reached 25 to 30 % by 1942. The fabrication of radio sets was later handed over to Videoton, and Orion came out with electronic instrumentation.

A characteristic example of how politics has influenced the economic activity of industrial companies of that time was the rise of ML (Mechanical Laboratory). The company was founded in 1949 and originally produced military transceivers. With the easing of cold war tension, the political leadership ordered the company to shift some of the available staff and technology to fabricate sound recorders and other equipment for radio and tv studios. Their products were rather successful and served as the backbone of all Hungarian radios and tvs for decades. (see picture STM210). Nevertheless, when the Hungarian market was open for foreign companies and international competition, ML was privatized and currently operates on a much smaller scale.

Figure 7. STM 210, a successful studio sound recorder of Mechanical Laboratory

The fabrication of electroacoustic products started in the Audio Sound- and Kinotechnical Factory as from 1948. Their product range, at the outset sound amplifiers and loudspeakers, was later extended by PA amplifiers, mixing amplifiers and microphones. All these developments have enabled Audio to step out to the international market, supplying complete PA systems to the stadiums of Moscow and Djakarta. In the 60s multichannel mixing consoles were developed, supplied to many Hungarian and foreign radio houses, opera houses and concert halls.

As from 1960 Audio was renamed to EAG (Electroacoustical Factory), and later to BEAG (Budapest Electroacoustical Factory). The product line was extended by large sound and interpreter systems.

In 1964 BEAG has established its Acoustic Research Laboratory, at the beginning lead by D. Huszty and later by G. Balogh Sr. Their task was to provide applied research for the steadily broadening product lines and to support product development. New products, such as loudspeakers, speaker boxes, horn and cardioid speakers, dynamic microphones and headphones were developed and produced. The number of employees topped 3000, out of which more than 300 engineers, in 1973-74.

Figure 8. FRF measurement of the studio monitor speaker HEC45, fabricated by EAG, in anechoic chamber

The most outstanding successes of BEAG in these years were the following: supply PA and radio transmitting systems of the Moscow Olympic Games as the official supplier of the games; participation in the reconstruction of the Budapest Opera House by its new electroacoustic system; digital PA and speaker system of the Hungarian Parliament and the Comecon Palast in Moscow etc. BEAG has established fruitful cooperation with various departments of the Budapest University of Technology and Institute of Linguistics of the Hungarian Academy of Sciences.

Figure 9. Digital room acoustics modification system, fabricated and installed by BEAG in the Kölcsey Cultural Centre in Debrecen

At the end of the 80s and in early 90s the market situation has essentially changed, the demand for BEAG products has largely reduced. Most of the employees have lost their jobs, and soon BEAG was discontinued.
However, based on their experience and knowledge, G. Balogh Sr. with his co-workers has established a new company, Interton Ltd. At the time of the foundation they designed and installed PA systems, while their portfolio was continuously broadened later on. Currently they design, install and maintain audio-visual, control engineering and IT systems, commercialise products from the world market and develop and fabricate their own products in five distinct divisions under the name of Interton Group.

Figure 10. Far-field measurement of the IVS sound source (line array of cardioid directivity pattern down to 100 Hz)

4.2 R&D institutions

Apart from the aforementioned academic laboratories, acoustic research and development was mainly deployed to research institutes, belonging to various ministries. The task of Vehicle Development institute, founded in 1950, was to support the newly established automotive factories (Rába, Ikarus, Csepel). Under different names and with often changing organization they set up an environmental protection department later on, dealing

with noise control design, testing and standardisation. The Ministry of Transport established the Research Institute for Road Transport, which built the largest and most developed acoustic laboratory of the 70s, consisting of two reverberation chambers, a good quality anechoic chamber and the first computer aided noise measuring and analysis system of the country. The Ministry of Building Industry ran two institutes: Construction Quality Inspection Institute for standard testing, and Institute of Construction Science for research and development, both having well equipped and staffed. Eventually, the Ministry of Environmental Protection established the Institute for Environmental Protection (see in detail below).

4.3 Activities against noise pollution: standardisation, system of decrees and network of environmental inspectorates

In 1977 the National Environment and Nature Protection Office was created, which was upgraded to ministerial level in 1988. Its supporting institute operated as from 1980. The *spiritus rector* of the field was L. Czabalay, who started his career in the Public Health Institute and joined later the Ministry of Environment and Water Affairs until his death in 1989. It was him who initialized the systematic law-making of noise control, motivated the standardisation in the field and built a nationwide, two-level network of environmental inspectorates. He worked actively in the adoption of international standards to Hungarian conditions and inserting them into a consistent set of prescriptions for standard noise measurement, noise evaluation and noise labelling methods The system of maximum allowed noise and vibration levels were laid down, controlled and enforced by the inspectorates. Noisy factories were enforced to work out noise control measures, which promoted the field of noise control engineering. R&D institutes, university labs and newly emerging private engineering companies provided services both for design and control.

In spite of the fact that this system has worked more and more efficiently and contributed to the awareness of the risks of excessive noise and vibration as well as to their control as a relevant element of environmental pollution, later developments of the system were by far not so favourable. The Institute for Environmental Protection was merged with the Institute of Water affairs, inspectorates were subordinated to governmental offices and largely lost their professional staff. As a consequence of the growing disinterest of the successive governments and mainly of the current political leadership, Hungary is one of the very few countries in Europe which has no dedicated ministry for environmental protection. The system of decrees, as set up in the eighties and early nineties is still in force, but both the methods and limit values are obsolete and would need a major revision and updating.

5. ACOUSTIC R&D IN TRANSITION FROM COMMUNISM TO THE MARKET ECONOMY

As shown above, after 1989 it became clear very soon that the Hungarian industry is not sufficiently competitive. With the collapse of the Soviet Union and other, formerly socialist countries, many Hungarian companies have lost their market. Due to the budget balance problems many industrial and ministerial institutions have lost their central funding, and if they were not able to adapt themselves to market conditions, they have significantly shrunk or disappeared earlier or later, or just squirm today. Some of them have atomized and their leading staff members have founded their small private acoustic businesses separately, nowadays offering various engineering services. No doubt at the same time that, fortunately, a few of them were able to gain strength in certain areas and offer wide-range services even on international level (e.g. Vibrocomp International in environmental engineering, Arató Akusztika in room acoustics etc.).

Research activities were driven back to certain university departments, provided that the necessary staff and knowledge was available. This was the case e.g. at the Department of Telecommunication (Budapest University of Technology and Economics, Faculty of Electrical Engineering and Informatics). As from the 2000s a new acoustic laboratory has emerged under the leadership of F. Augusztinovicz, who initiated new activities in the field of noise and vibration control, computer aided acoustic design and numerical simulation. The lab participated in more than 10 EU-funded R&D projects, new equipment and software tools were purchased. Measuring and calculation methods, originally developed for automotive NVH problems were adapted and used for large infrastructural and cultural projects such as the construction of new and renewal of existing metro lines, construction of the vibration isolated Palace of Arts (see Fig. 9 and 10.), renewal of the Liszt Ferenc Music Academy and others. Department of Fluid Mechanics of Faculty of Mechanical Engineering

developed multichannel source identification methods for successful noise control of fans.

Figure 11. Test rig, developed for measurement and optimisation of shock absorber noise. The project was financed by Monroe Belgium and the Flemish government.

Figure 12. Soil vibration measurements at the place of the would-be Palace of Arts by a group of experts (I. Dombi, A. B. Nagy and F. Augusztinovicz)

Figure 13. Elastic support elements between steel brackets (suppled by CDM, Belgium) under the Festival Theatre of the Palace of Arts. Designer P. Forián Szabó (2003-2005)

Another, very positive sequel of the emerge of these new techniques and tools was that 10 to 30 young engineers earn their engineering diploma every year who are familiar with modern acoustics. Their skill has met the endeavour of famous industrial companies to set up development centres in Hungary, dealing with acoustic engineering too. This is the case e.g. of Robert Bosch Hungary who has built a large development Campus recently, Thyssenkrupp Nothelfer in Budapest and Audi in Győr, in close cooperation with the Szécheny István University. These industrial R&D entities perform on-the-cutting-edge work in acoustics and NVH, and their labour demand and formulation of relevant industrial problem for students and young engineers result in ever closer cooperation between industrial practice and academia.

6. SCIENTIFIC SOCIETIES AND OTHER ORGANIZATIONS

In Hungary, acousticiens can join various professional organisations. The largest and most traditional society is Scientific Society for Optical, Acoustical, Film and Theatre Technology (OPAKFI), comprising two sections: Acoustical Section and Noise and Vibration Control Section. Both sections organize regular yearly conferences: Acoustic Day and Noise Control Seminar. OPAKFI, as their umbrella organisation has organized a couple of large and renowned scientific events in the past, such as 7th ICA, InterNoise and Active 1997 and Forum Acusticum in 2005.
Scientific issues are treated by the Acoustic Standing Committee of the Hungarian Academy of Sciences.

Engineers and other professionals have formed the Acoustic Section in the framework of the Hungarian Chamber of Engineers. This Section is entitled to grant proofs of expert authority – provided that the applicant has appropriate education and sufficient expertise – , which is a must for participating in design teams and expert activities.. Audio engineers have the possibility to join the Hungarian Section of the Audio Engineering Society.

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