**Abstract**

Objectives: To highlight the contributions of Emil Theodor Kocher, Róbert Bárány, and Georg von Békésy to the field of Otolaryngology.

Study Design: Historical review

Methods: Literature search using the PubMed database supplemented by material obtained from various external sources.

Results: As Professor of Surgery at the University of Bern, Kocher's research focused on the thyroid gland. He became the first to excise the thyroid for goiter in 1867. In 1909, Kocher received the Nobel Prize for his advancements in thyroid pathology, physiology and surgery. In addition, his implementation of antiseptic wound treatment significantly decreased operative mortality.

Bárány was an Austro-Hungarian otorhinolaryngologist who explored the functions of the vestibular apparatus. He is credited with multiple discoveries, most notably, the caloric reaction. Further work addressed vestibular posturing during equilibrium and the physiology of nystagmus. In 1914, he was awarded the Nobel Prize while a prisoner of war in Russia. Békésy, a Hungarian biophysicist, is credited with laying the foundation for cochlear mechanics.

Conclusions: The developments of Kocher, Bárány, and Békésy have greatly influenced our field. As not only discoveries in otology, but also those in general surgery and biophysics have had implications on Otolaryngology, we are reminded of the truly, intellectually vast nature of this specialty.

**Introduction**

The Nobel Prize in Physiology or Medicine, dictated by Alfred Nobel in his will, was to be given “to the person who shall have made the most important discovery within the domain of physiology or medicine.” Since 1901, there have been 204 recipients of the Nobel Prize in this category. The work of three, in particular, has advanced the field of Otolaryngology: Emil Theodor Kocher (1868–1940), Robert Barany (1870–1953), and Georg von Békésy (1909–1972).

Emil Theodor Kocher, a surgeon in the late nineteenth century, was awarded the prize “for his work on the physiology, pathology and surgery of the thyroid gland.” Robert Barany, an otologist of the early twentieth century, was honored “for his work on the physiology and pathology of the vestibular apparatus.” Georg von Békésy, a physicist of the early to mid-twentieth century, was rewarded “for his discoveries of the physical mechanism of stimulation within the cochlea.”

We present the lives of these three Nobel Laureates and their seminal discoveries as they pertain to our field.

**Results**

---

**Emil Theodor Kocher**

Kocher was born on August 25, 1841 in Bern, Switzerland. During his training in medical school from 1860 to 1865, he spent time studying under Theodor Billroth at the University of Zurich who was one of Kocher’s greatest influences. After receiving his medical degree, he pursued deeper education from in Zurich, Berlin, Vienna, and London where he learned to use new antiseptic surgical techniques from Joseph Lister. When Kocher returned to Bern, he promted the Listerian concept of using weak chloride solutions for sterilization.

In 1872, Kocher was appointed Chief of Surgery of the City Clinic of Surgery at the age of 31, a position he held until his death in 1917.

The population of Switzerland at that time suffered from severe iodine deficiency which resulted in endemic goiter and cretinism. In 1872, when Kocher performed his first thyroidectomy, his procedure was reported to be as high as 75%. Patients often died due to blood loss or infection. Damage to the recurrent laryngeal nerve and post-operative tetany as a result of parathyroid gland removal were the most frequent complications. Many surgeons believed that thyroidea, in particular, was one of the most dangerous procedures. Samuel Gross, a prominent American trauma surgeon, was quoted describing thyroidea as an operation in which “an honest or sensitive surgeon should not be involved.”

Kocher’s mentor, Billroth had several patients who developed post-operative tetany (due to removal of the parathyroid glands) and decided to give up thyroidea in parallel with the sentiment of the surgical community. Kocher continued to perform thyroidea into the 1880s, using a surgical technique that allowed him to preserve the recurrent laryngeal nerve and parathyroid gland. His next series of 60 thyroidea, presented in 1898, had only one death.

Kocher began to realize that removal of the gland resulted in patients developing goiter. He hypothesized that damage to the parathyroid gland was the cause of this condition. In 1902, Kocher reported that the glandular tissue remained after surgery, and that it was responsible for the occurrence of goiter.

Kocher was also a pioneer in the development of his traveling wave theory of the hearing mechanism. His discovery of the caloric reaction and proposed use as a clinical test allowed the selective stimulation of horizontal semicircular canals.

---

**Robert Bárány**

Bárány was born on April 22, 1876 in Vienna. He graduated from the University of Vienna Medical School in 1900 and initially pursued training in thyroid pathology, physiology and surgery. In addition, his implementation of antiseptic wound treatment significantly decreased operative mortality.

Bárány’s discovery of the caloric reaction and proposed use as a clinical test allowed the selective stimulation of horizontal semicircular canals. This enabled him to observe movements of the inner ear, including the saccule and utricle.

---

**Georg von Békésy**

Békésy was born on June 3, 1899 in Budapest, Hungary. He received his doctorate in physics in 1923 from the University of Budapest. He was always interested in the beauty of nature and wrote, “I found the inner ear so beautiful under a stereoscopic microscope that I decided I would just stay with that problem.” It was the beauty and the pleasure of beauty that made me stick to the ear.

The only place Békésy was able to find research equipment was in the Hungarian Post Office Telephone laboratory where he was first employed.

His seminal work in the development of his traveling wave theory of the basilar membrane (BM) began in 1924. At that time, there were various theories about how the cochlea converted mechanical energy into neural activity, all of which developed without direct observation of the inner ear. Previous work attempted to expose the basilar membrane (BM) from the human cochlea, though he was never able to expose an intact BM. Békésy developed new methods of extraction and preservation of the membrane. His technique involved grinding the cochlea shell in thin layers under a constantly moving fluid bath in order to expose a functional BM.

Békésy was able to observe the traveling wave.

He described the cochlear traveling wave in 1925 in a seminal publication. The maximal amplitude of the traveling wave corresponded to the frequency of sound, with higher frequencies closer to the oval window at the base of the cochlea and lower frequencies at the apex.

Though the traveling wave model is correct in how the BM functions, Békésy’s conclusions were only the first part of the cochlear puzzle. Since his experiments were performed on post-mortem tissue, his findings were correlated with a passive model of the cochlea. Even before his later development of a large, mechanical model of the cochlea in 1950’s, he recognized that his observations of the BM were not corresponding with the specific frequency interpretation of the human ear. Békésy confirmed the neural shaper function in which perception of the sound was made frequency specific by the brain.

We now know that outer hair cells act as a cochlear amplifier which increases the sensitivity and specificity of the frequency response of the hearing organ. Therefore, today’s active models of the cochlea are more representative of true human perception.

---

**Conclusion**

**Kocher**

- His advances in thyroidectomy technique and the conclusions on the physiology of the thyroid gland paved the way for a new style of surgery focusing on the careful dissection of tissues, meticulous hemostasis, and adherence to antiseptic methods.

**Bárány**

- His discovery of the caloric reaction and proposed use as clinical test was considered pivotal in clinical otology during his time.

**Békésy**

- His experiments were the first to show how the inner ear processes sounds via traveling waves. Though his work was limited to the study of the passive components of basilar membrane function, his methods laid the foundation for future research in experimental cochlear mechanics.

---

**References**

1. All Nobel Laureates in Physiology or Medicine. http://nobelprize.org/nobel_prizes/medicine/laureates/
   Accessed 1/7/2013.