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A TRIBUTE TO A SCIENTIST EXTRAORDINAIRE – ERNEST H. STARLING (1866-1927)

PRILOG O IZVANREDNOM ZNANSTVENIKU – ERNEST H. STARLING (1866.–1927.)

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Summary

One of the defining moments in the history of medicine came in the year 1902 with the discovery of Secretin, the first hormone to be isolated in the human body. The men credited with this milestone discovery, which went on to revolutionize medicine, are Ernest H. Starling and William M. Bayliss.

Their contributions aided the transition of medical practice from empiricism towards rationalism. E.H. Starling introduced the word 'hormone', laying the foundation for the development of Endocrinology as a medical specialty. His extensive research in circulatory physiology including the study of the electric activity of the heart and capillary fluid shift has made his name a mainstay in its study. His interests were varied, where he contributed his scientific bend of mind to the study of different fields of Physiology and his non-conformist ideals to the study of the then prevalent educational system in Great Britain.

In lieu with celebrating the 150th birth anniversary of E. H. Starling, a brilliant scientist and an educational reformist, a chronological construe of his academic pursuits and milestone achievements has been presented. One hopes that such recollections serve to inspire and

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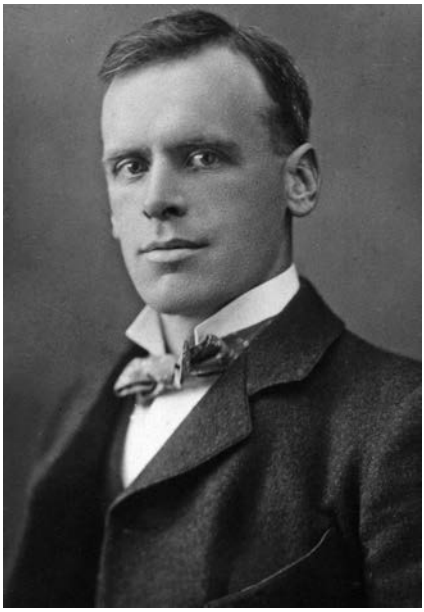
invigorate the scientist inside everyone and also serve as guiding beacons to students and researchers.

Key words: *History of medicine; 20th century Physiology; Ernest Starling; William Bayliss; Secretin; Starling's Forces*



Ernest Henry Starling, 1866-1927.
(U.S National Library of Medicine, History of Medicine Division.)

"In Physiology, as in all other sciences, no discovery is useless, no curiosity misplaced or too ambitious, and we may be certain that every advance achieved in the quest of pure knowledge will sooner or later play its part in the service of man" - a profound quote by Ernest Henry Starling, one of the most influential names in the field of Circulatory Physiology, well known for his works on heart, capillary fluid shift and for his contribution to Endocrinology [1].

Ernest Henry Starling (1866-1927) was born on 17th April, 1866 in Islington, London, the eldest son in the family of seven children to Matthew Henry Starling and Ellen Mathilda Watkins [2]. Starling received his early education in Islington (1872-1879) and King's College School (1880-1882). He pursued his higher education at Guy's Hospital Medical School, London (1882-1889), where he received a record number of scholarships and obtained

his qualifying degree of M.B.,Lond. One of the strongest influences in his developing period was his days at Willy Kühne's laboratory in Heidelberg. His experiences there shaped his future as a physiologist looking to move away from the practice of empiricism and to look towards treatment backed by the sciences [3].

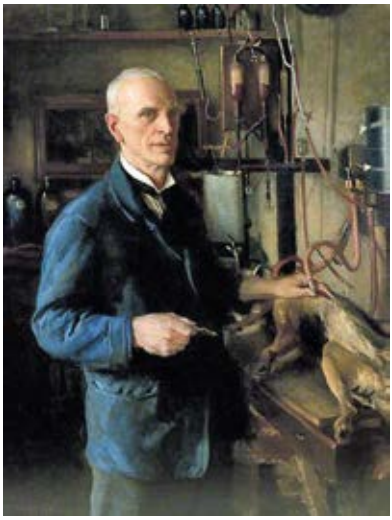
In 1889, he became a demonstrator in Physiology at Guy's and in 1890 began part-time work in Edward Albert Schäfer's (1850-1935) laboratory at University College, where he began a lifelong association with William Maddock Bayliss (1860-1924).It proved to be a complementary union and they published their first paper in 1891. In 1892, Starling again went abroad to work with Rudolf Heidenhain (1834-1897) in Breslau and with Metchnikoff at the Institut Pasteur [3]. On his return, Starling collaborated with Bayliss to improve the capillary electrometer and demonstrated the triphasic variation preceding each beat of the heart (later known as the P, QRS and T waves). They also demonstrated a delay of about 0.13 seconds between atrial stimulation and ventricular depolarization (later called PR interval) [4].

The duo further researched lymph formation and dynamics, capillary function and oncotic pressure of plasma proteins. Starling came up with the concept of "Starling's equilibrium", referring to the balance between the forces exerted due to the intravascular hydrostatic pressure and the osmotic pressure at the capillary level (referred to as Starling's forces) on the basis of their findings [5,6].

Starling accepted the Jodrell professorship at University College in 1899, which enabled him to work full time with Bayliss. In 1899, they demonstrated the nervous control of peristalsis and the muscle action responsible for the movement of food through the intestine. Also, Starling's law of the intestine stated that food causes a band of constriction proximally and relaxation distally, resulting in a peristaltic wave [3].

Starling and Bayliss' greatest joint accomplishment was the discovery of secretin in 1902. They showed that when acid arrives from the stomach, it liberates a chemical messenger from the jejunal mucosa. This messenger travels through the blood to excite the pancreas to secrete pancreatic juice [7]. Starling and Bayliss delivered the famous Croonian lecture on "the Chemical Correlation of the Functions of the Body" in the summer of the year 1905.

Starling introduced the term "hormone" (1905), adapted from the Greek verb to excite or arouse (*ormao*) [8]. The discovery of hormones or chemical



Ernest Henry Starling, as depicted by Walter Westley Russell (1926).

(UCL Art Museum Collections; Image supplied by The Public Catalogue Foundation.)

messengers and the further understanding that they were carried by the blood from the organ in which they were produced to the organ they affected, revolutionized Physiology and provided the basis for Endocrinology to develop as a medical specialty.

Starling's focus then shifted to the physiology of cardiovascular regulation, the field in which his works remain unparalleled. He came up with the fundamental law on the mechanical effect of mammalian heart which states that the energy liberated by the heart when it contracts is a function of the length of its muscle fibers at the end of diastole [9]. He also published the Starling curve, which shows a graphical relationship between cardiac output, stroke volume and mean atrial or ventricular end-diastolic pressure [10]. In the year 1913, he was awarded the Royal Medal for his contributions to the advancement of Physiology [11].

The First World War (1914-1918) crippled research to a great extent. Starling was commissioned to the Royal Army Medical Corps. His war time services left little opportunity to exploit his scientific brilliance. He was awarded the Companion of the Order Of St. Michael and St. George, for his services at Salonika [12]. It was in 1915, that Starling gave his famous Linacre Lecture on the Law of the Heart in which he attempted to extend his research on the isolated heart to the intact organism in stress and at rest. In the year 1923, he delivered the Harveian oration, which is considered to be the most significant lecture of his career through which he sought to rectify the inadequacies of his earlier lecture [13]. In 1922, he accepted the Royal Society's Foulerton research professorship. He found that water, chlorides, bicarbonates and glucose, lost in the glomerular filtrate are reabsorbed at the lower end of the kidney tubules. Starling was elected fellow of the Royal Society in 1899 and was a prominent member of the Physiological Society. He was an honorary member of many foreign scientific organizations and bodies and delivered the Harvey lecture for 1908 in New York. Despite deteriorating

health, he continued his research work with fellows and students from all over the world. He died on 2 May 1927, aboard a ship, while on a Caribbean cruise, and was buried at Kingston, Jamaica. His nonconformist approach coupled with his sharp criticism might have resulted in the overlooking of his exemplary work during his times, made evident with no Nobel Prize or Knighthood decorating his illustrious career. The lack of support from his fellow English physiologists and a controversy with the chairman of the Medical Nobel Committee may have been the most prominent reasons behind him not winning the Prize, though he was nominated for the same four times. Starling was a revolutionist not only in science, but also extended his iconoclastic approach to the then prevailing education system in Britain and called for educational reforms for the betterment of his nation [14]. This paper was an attempt to recollect the academic pursuits and milestone achievements of E. H. Starling, a brilliant scientist and an educational reformist. One hopes that such recollections would inspire, invigorate and guide the scientist inside student and researcher.

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Sažetak

Jedan od ključnih trenutaka u povijesti medicine dogodio se 1902. godine s otkrićem sekretina, prvog hormona koji je izoliran iz ljudskog tijela. Ljudi zaslužni za ovo otkriće prekretnicu, koji je doprinio revoluciji medicine, su Ernest H. Starling i William M. Bayliss. Njihov doprinos pomogao je prijelazu medicinske prakse iz empirizma prema racionalizmu. E. H. Starling uveo je riječ „hormon", polažući temelj za razvoj endokrinologije kao medicinske specijalizacije. Njegova opsežna istraživanja fiziologije cirkulacije, uključujući proučavanje električne aktivnosti srca i smjene kapilarne tekućine, je učinio njegovo ime uporištem u sličnim studijama. Njegovi interesi su varirali, pri čemu je doprinio znanstvenoj promjeni klime u polju fiziologije i nekonformističkim idealima u istraživanju postojećeg obrazovnog sustava u Velikoj Britaniji. Povodom obilježavanja 148. obljetnice rođenja E. H. Starlinga, briljantnog znanstvenika i obrazovnog reformista, predstavljeno je kronološko tumačenje njegovih akademskih nastojanja i prekretnička postignuća. Ostaje za nadati se da će takva prisjećanja poslužiti kao poticaj i osnaženje znanstvenika unutar svakoga te također kao svjetlo-vodilja za studente i istraživače.

Ključne riječi: *povijest medicine; fiziologija XX. stoljeća; Ernest Starling; William Bayliss; sekretin; Starlingova ravnoteža sila.*