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1911 - An ophthalmologist won the Nobel Price: Allvar Gullstrand, surgeon, mathematician and creative inventor

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No financial interests

Allvar Gullstrand[31]

Introduction

Allvar Gullstrand (June, 5th 1862, Landskrona – July, 28th 1930, Stockholm, both Sweden) was neither a specialist in geometrical optics, nor he was mathematician. He provided valuable contribution to theoretical optics as well as carried out fundamental research on the mathematical and physical properties of the human eye. Furthermore he invented several important devices used in ophthalmology[2,3,4,7,13]. Most of his research he achieved while he was Professor at Uppsala University (Sweden)[2,13,14,33,35].

Gullstrand is noted for his research on astigmatism for improving the ophthalmoscope[2,3,4,7]. As well he developed corrective lenses for use after cataract surgery. Gullstrand developed also the first schematic model of the eye which is still in use today[2,6,7,13,14,17].

Gullstrand applied the methods of physical mathematics to optical images and to the refraction of light in the eye. For his work, he received the Nobel Prize in Physiology or Medicine in 1911 as well as numerous other awards[5,7,8,12].

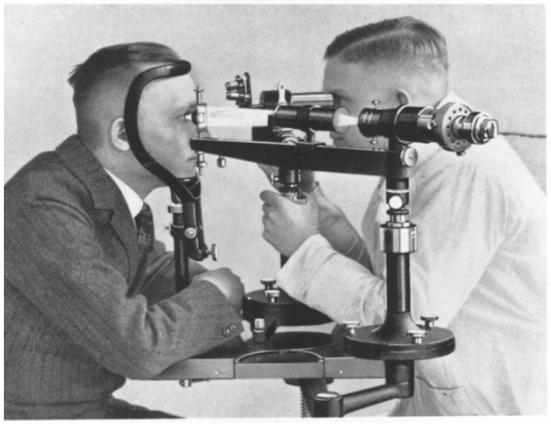
This poster is to honour Gullstand´s life and contribution to ophthalmology and science due to the 100th anniversary of him receiving the Nobel Prize in 2011.

Allvar Gullstrand´s achievements in ophthalmology

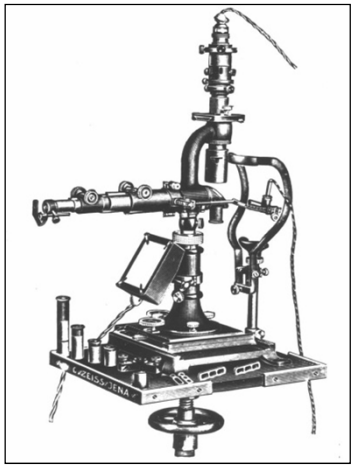
As Gullstrand contributed numerous achievements to ophthalmology only a selection is shown to demonstrate his important influence on science, valid even today.

Gullstrand´s Slit Lamp

His methods of focal illumination, particularly by means of the slit lamp (1911), have acquired greatest importance to the practical work of all ophthalmologists. Diagnosis of alterations of the cornea, the anterior chamber or even parts of the vitreous was greatly improved by this tool. For the first time it was possible to have highly improved sight into the eye by this new technique of illumination of the eye[2,3,4,7,15,35].



Examination of the eye using Gullstrand´s Slit Lamp[30]



Gullstrand´s Ophthalmoscope[30]

Gullstrand´s Ophthalmoscope

Another milestone for diagnostic in ophthalmology was the invention of his reflex-free ophthalmoscope (1910) which is also a valuable instrument to the ophthalmological diagnostician. It offered the possibility of monocular as well as binocular view on and into the eye[2,3,4,7,15,35].

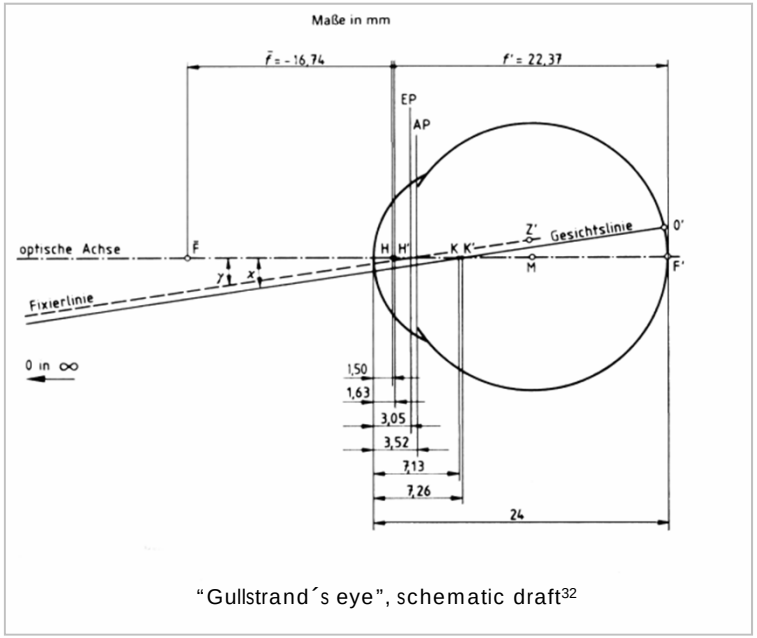
Allvar Gullstrand´s achievements in ophthalmology

$$Dges = D1 + D2 - \frac{d}{n} * D1 * D2$$

Gullstrand formula[31]

Gullstrand´s formula

The Gullstrand formula is still the Gold Standard when calculating the overall refractive power of optical systems[2,7,13,14,24,28,30,31].



"Gullstrand´s eye", schematic draft[32]

Gullstrand glasses

These glasses, which still carry the name of this great ophthalmologist are point by point projecting glasses ("Katral Glasses"), which were used for aphacic eyes after cataract surgery. These glasses reduced a set of aberrations[2,6,7,13,14,30].

Gullstrand eye

With his data on anatomy and physical properties of the human eye Gullstrand set a scientific schematic model of the human eye for the first time. The information provided by the "Gullstrand eye" is still regarded as Gold Standard today[2,7,13,14,17,23,25,32].

A life for Ophthalmology

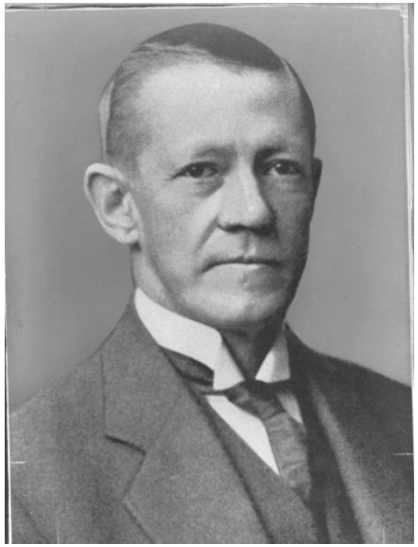
Allvar Gullstrand was entirely self-taught in the fields covering his most important work (geometric and physiological optics) [13,14,35].

The basis of the science he developed was laid in 1890 in his thesis *Bidrag till astigmatismens teori* (Contribution to the theory of astigmatism[2,6,11,13,14,35]). The complete proof of this theory is found in the following three works:

•*Allgemeine Theorie der monochromatischen Aberrationen und ihre nächsten Ergebnisse für die Ophthalmologie* (General theory of monochromatic aberrations and their immediate significance for ophthalmology), 1900, which received awards from the Swedish Royal Academy of Sciences and the Swedish Medical Association

•*Die reelle optische Abbildung* (The true optical image), 1906

•*Die optische Abbildung in heterogenen Medien und die Dioptrik der Kristallinse des Menschen* (The optical image in heterogeneous media and the dioptrics of the human crystalline lens), 1908, which was awarded the Centenary Gold Medal of the Swedish Medical Association[1,9,11,13,19,21,22,23].



Prof Allvar Gullstrand[30]

The results are combined in these works:

•*Tatsachen und Fiktionen in der Lehre von der optischen Abbildung* (Facts and fictions in the theory of the optical image), 1907

•*Handbuch der physiologischen Optik* (Handbook of physiological optics), by H. von Helmholtz, 3rd edition, Vol. I, 1909

•*Einführung in die Methoden der Dioptrik der Augen des Menschen* (Introduction to the methods of the dioptrics of the human eyes), 1911[7,8,13,14,26,36].

Gullstrand was an honorary Doctor of Philosophy of the Universities of Uppsala, Jena and Dublin, and a member of a number of Swedish and foreign scientific societies. He was member of the Nobel Physics Committee of the Swedish Academy of Sciences (1911-1929), and its Chairman (1922-1929). In 1927 he was awarded the Graefe Medal of the "Deutsche Ophthalmologische Gesellschaft". His probably most important award was receiving the Nobel Price in 1911 for his work[1,2,5,6,7,8,9,10,11,12,13,14,16,18,20,26,27,29,34,35].

Gullstrand´s diagnostic chair at the Museum for History of Medicine, University of Uppsala (S)[33]

Conclusions

Allvar Gullstrand´s empiric research on refraction of the light in the human eye laid the basis for the theory of imaging in the eye. This gave the scientific basis to ophthalmology and optometry.

His achievements not only led to improved glasses, they also led to completely new diagnostic devices in ophthalmology beginning 20th century. Therefore Gullstrand can be regarded as one of the founding fathers of modern ophthalmology.

Allvar Gullstrand will be remembered with deep appreciation for his extraordinary talents and great contributions to ophthalmology and science.

Allvar Gullstrand
(5 June 1862 – 28 July 1930)[7]

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