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AN ESSAY ON THE HISTORY OF GLAUCOMA

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Even though the word "Glaucoma" appears in the Hippocratic writings, the concept of the illness associated with the increase of intraocular pressure appears much later. In the Hippocratic Aphorisms, the term "Glaykoseis": greenish or bluish, has been used to describe the blindness which comes on in old age, associated with the greenish-blue hue of the pupil. When the pupil becomes "sea coloured", "sight is destroyed and blindness of the other eye frequently follows". This term has been used without being based on a specific pathology and did not represent a nosological entity, but probably comprised several syndromes, including absolute glaucoma. Chronic glaucoma as we know it today, was completely unknown and classified as amblyopia, amaurosis or *gutta serena*. Originally, this lesion could not be distinguished from cataract. It was at a much later date, that Galen and other authors of the first centuries of the Christian era, situated this illness behind the pupil and considered that it can be the cause of blindness. It was divided into two groups: "suffusions or hypochyma" or cataracts fit for surgical treatment, and "glaucomata" which were not. Charles Saint Yves (1722) already knew that in an advanced stage, the patient sees objects ("du coin de l'oeil") from "the corner of the eye". As late as the beginning of the XVIIth century, the famous French oculist Antoine Maître

Jean, considered that this type of blindness was associated with the crystalline. Michael Brisseau who did not believe that this illness was located in the crystalline opposed the concept, and placed it in the vitreous (Fig. 1).

Ignorance of this disease was so great that even A. Gerard van Onsenoort of Utrecht in his little book "Geschichte der Augenheilkunde", published in 1838, which we have on many occasions read with great pleasure, does not mention it.

Although it is supposed that the Arabs considered glaucoma (naturally, this name was not used) to be related to raised ocular pressure, it was the English oculist Richard Banister in the XVIIth century who distinguished between "gutta obscura" – cataract and "gutta serena" – where the eye became hardened (Fig. 2). Hardening of the eye was also observed by Platner and Beger in the XVIIIth century. Arrachart of Paris and Beer of Vienna described glaucomatous symptomatology well, but they did not take into consideration the elevation of intraocular pressure, or rather, the "hardening" of the eye. Demours, the famous French oculist of the beginning of the XIXth century, affirmed that the eye is hard to the touch and the patient sees the colours of a rainbow around lights.

In London in 1823, Guthrie recognized hardness of the eye as typical of the disease which he called acute glaucoma. William Mackenzie (1835) distinguished congestive, chronic and acute glaucoma.

In 1826 Weller insisted upon the hardening of the eye and in 1831 Fabiani writes: "Bulbi normali elasticitas in duritiam fere lapideam mutatur".

The next epoch in the history of glaucoma follows the introduction of the ophthalmoscope.

Observations of glaucomatous cupping were made at the beginning of the second half of the XIXth century by Jacobson, Jaeger, von Graefe and Weber. These findings were confirmed by Müller's pathological studies. While Jaeger and von Graefe described it at first as edema, Weber corrected this mistake and later von Graefe himself did so. In the 1890's Schnabel described the nerve fiber breakdown with formation of cavities in the optic nerve.

Von Graefe divided glaucoma into three types: acute, chronic and secondary, but everyone at that time considered the disease as congestive or inflammatory (Fig. 3). It was only in 1862 that Donders recognized another characteristic, i.e. that increased intraocular pressure leads to blindness and evolves without inflammatory symptoms and he called it "simple glaucoma", which name would persist.

Then a great interest in the etiology of the disease was awakened. As always happens, infinite hypotheses, suppositions and speculations appeared, until finally the more serious works come into play. Naturally, all investigations can not be presented in a short review. Beer (1792) thought it was gouty iritis (from gout);

TRAITÉ
DE
LA CATARACTE
ET
DU GLAUCOMA.

Par M. BRISSEAU *le fils Medecin Major des Hôpitaux du Roy, & Penſionnaire de la Ville de Tournay.*

A PARIS,

Chez LAURENT D'HOURY, rue ſaint Severin, vis-à-vis la rue Zacharie, au Saint Eſprit.

M. D. C C I X.

Avec Approbation & Privilege du Roy.

bildung des Titelblattes von *Brisseaus*: «Traité de la cataracte

1. The Book of Brisseau (1709)

TREATISE OF ONE HVNDRED AND THIRTEENE DISEASES OF THE EYES, AND EYE-LIDDES.

The ſecond time publiſhed, with ſome profitable additions of certaine Principles and experiments, by RICHARD BANISTER, Mr. in Chyrurgery, Oculiſt, and Practitioner in Phyſicke.

God hath created medicines of the earth, and he that is wiſe, will not contemne them.

Imprinted at London by *Felix Kyngſten* for *Thomas Man*, dwelling in Paternoſter-row, at the ſigne of the Talbot. 1622.

ildung des Titelblattes von *R. Banister* «A Treatise of on

3. Albrecht von Graefe (1828–1870)

4. Otto Barkan (1857–1958)

Mackenzie, serous choroiditis; Donders, irritation of the secretory nerves of the eye; others, thickening of the sclera, disease of the vitreous, etc. In 1858 Heinrich Müller supposed that frequently there is an obstruction of the angle of the anterior chamber, which is later confirmed in the pathological studies of Knies and Weber, independently of each other. Smith was also inclined to consider that glaucoma was due principally to blockage of the angle rather than to the hyperproduction of the aqueous humour, as had been thought by Mackenzie.

For centuries, the causes of glaucoma constituted one of the most greatly discussed problems in ophthalmology. With the exception of the causes of secondary glaucoma which are obvious, all the rest is under consideration, which is still many times speculative. In the primary type much importance was given to the small eye ball large crystalline combination which led into a narrow anterior chamber and blockage of its angle.

For some decades it was thought that drainage of the aqueous was made difficult by anterior peripheral synechiae, and these, Knies and Weber thought, produced glaucoma. Seidel, Curran and Raeder introduced the idea of pupillary blockage.

During the first decades of this century Salzmann, Troncoso, Thorburn, and particularly Werner, when gonioscopes first came into use, observed that in certain glaucomatous eyes the angle of the anterior chamber is open and in others closed. Finally Barkan (1938), gonioscopy having been perfected, classified glaucoma in that with a deep anterior chamber and open angle and the other with a flat anterior chamber and a narrow angle, which closes and produces pressure increase, and also suggested that in this second type of glaucoma, the closing of the angle is due to the obstruction of the flow and aqueous humour through the pupil (Fig. 4); that is, from the posterior to the anterior chamber, and recommended a peripheric iridectomy, which concept had already been insisted upon by Curran in 1920.

The history of the classifications is much too long and complicated. For many years glaucoma was classified in: congenital, secondary and primary, the latter divided into chronic simple and congestive; lastly the final stage of glaucoma was absolute glaucoma. Barkan classified glaucoma in simple and closed-angle. Investigations progressed not only because of the possibility of electron microscopy studies, but also through the study of the dynamics of the aqueous humour.

It is impossible to describe all of the progesses made in anatomic and physiologic studies of the chamber angle. Schlemm in 1831 described the canal. To remind us of old and new studies we mention Ashton's excellent models and Ascher's description of the aqueous veins (1942).

It is also impossible to name even superficially the investigations on the biochemistry and biophysics of the aqueous humour, but the investigations of Schwalbe, Leber, Davson, Barány, Kinsey, Becker and others stand out. Among those who dedicated themselves to the calculation of the aqueous humour flow we must mention Davson, Kinsey, Goldmann and Friedenwald (Fig. 5).

The history of tonometry is another of the absorbing histories of human invention. According to Draeger in his "Geschichte der Tonometrie", Wahlfors in 1888 could by means of a tonometer measure intraocular pressure in a living subject, in the human eye, for the first time and considered a pressure of 26 mm Hg als "normal". When Helmholtz in 1855 described his ophthalmometer he believed that making a calculation based on the variation of the curvature of the cornea, eye pressure could also be calculated; of course this was one of the few errors he incurred. Coccius in 1867 also believed he had invented an optical tonometer.

In 1862 the universal Albrecht von Graefe worked on the identation tonometer. Independently from von Graefe in 1863, Snellen, together with Donders, described his own device. Many other tonometers were tried until 1905.

Hjalmar Schiötz of Oslo described his tonometer, which has been modified on many occasions and still remains an excellent instrument of medical mensurations (Fig. 6, Fig. 7). It must be remembered that Schiötz worked for about 15 months in the famous Javal optical laboratory at the Sorbonne. Javal was fond of him and said about those times: "the best days of my life".

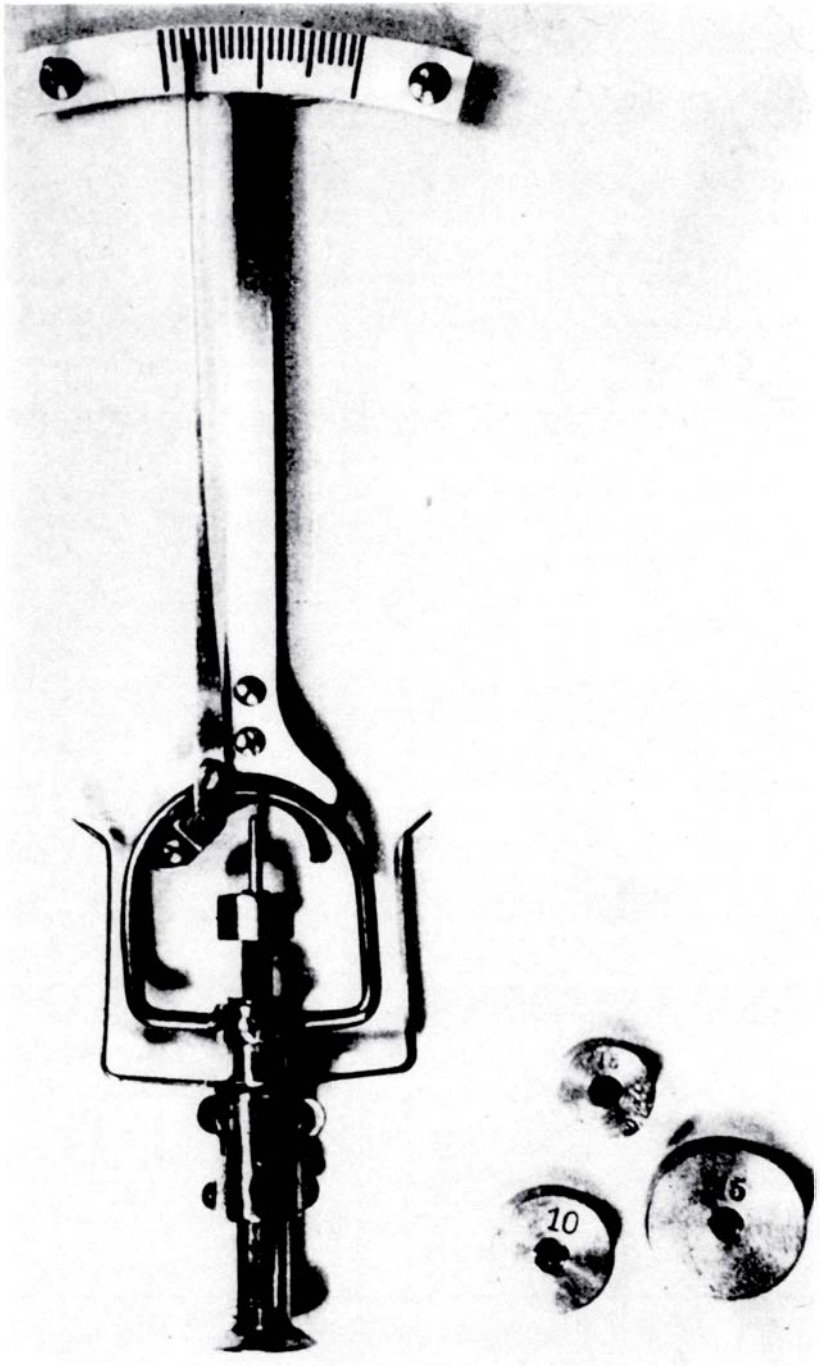
As about 1950 the house of Müller, Chicago, manufactured an electronic tonometer, and tonography progressed.

On the other hand applanation tonometers were used and developed. By 1868 Weber discussed the problem of tonometry by identation and applanation. In 1885 Maklakoff introduced his tonometer, and in 1888 the Ficks, father and son, presented a tonometer that for many years was very popular in some east European countries (Fig. 8). Many models have appeared up to Goldmann's, the most perfect. The air tonometer is another modern invention.

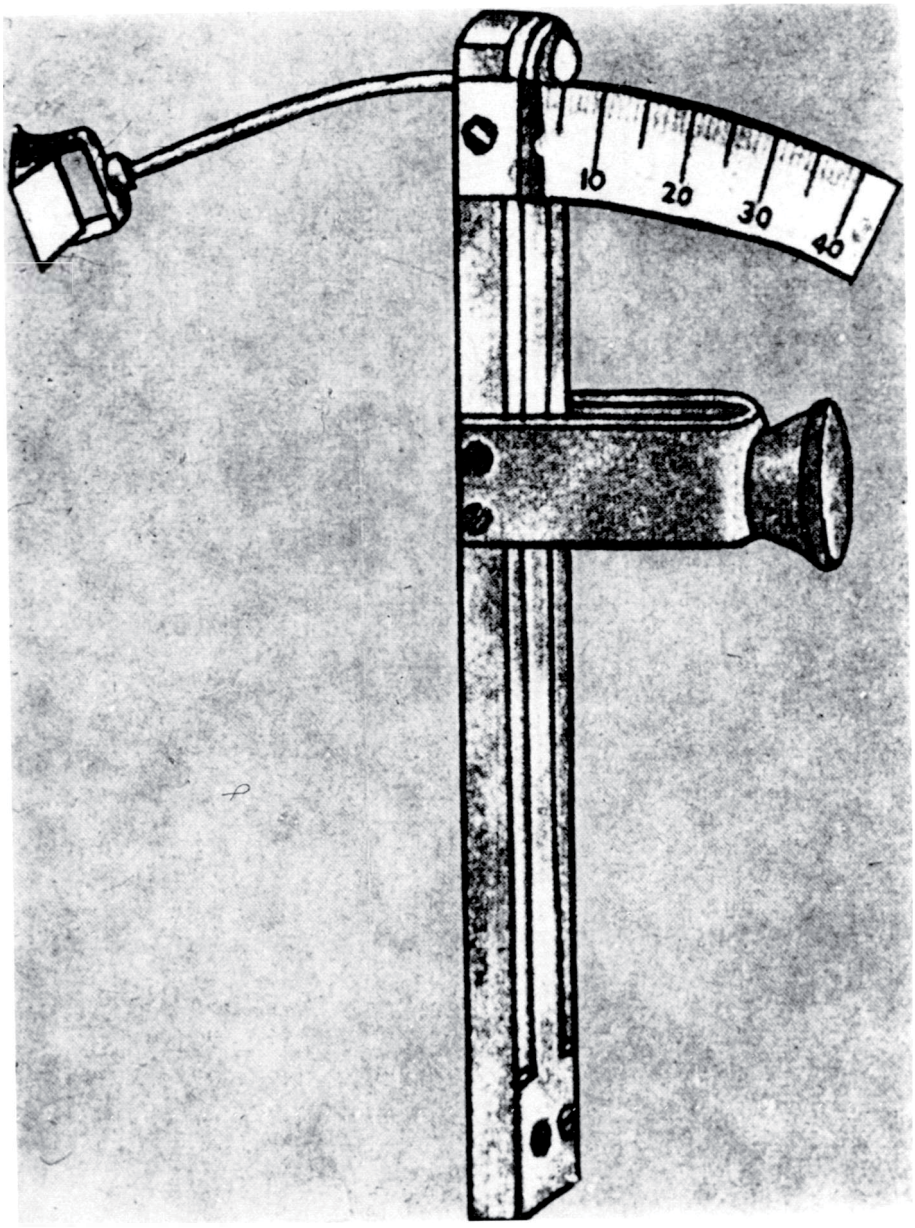
We have not even the possibility to name such problems as sex, heredity, refraction, and other subjects related to glaucoma, but we must mention something about histopathological studies. For many years these studies were limited only to enucleated eyes in state of absolute glaucoma. Beginning with Knies (1876) and Weber (1877) many authors concentrated on investigations of the occlusion of the chamber angle. In 1860 Speakman observed lesions in the trabeculum and the electron microscope studies of many authors starting with Bárány and Rohen in 1963 seemed to confirm his observations. Ashton insisted on lesions of outflow canals originating from the trabeculum.

5. Jonas S. Friedenwald (1897–1955)

6. Hjalmar Schiötz (1850–1927)



7. Schiötz's Tonometer



8. Fick's Tonometer

With respect to acute glaucoma, Birnbacher in 1890 and Elschnig in 1896 observed an obliteration of the angle of the anterior chamber. Christensen and Irvine in 1966 drew attention to the forward displacement of the crystalline lens and the iridian diaphragm.

The abundance of theories on glaucomatous excavation is well known. Starting with Schnabel at the beginning of the century and with Elschnig, they continued to be formulated by many authors and among them by François and Neetens. Zimmerman studied the optical nerve in acute phases of glaucoma and found that there is neither edema nor atrophy but a hydropic degeneration.

Concerning the investigation of the visual field we must name: Bjerrum (1850), Rönne (1909), Seidel (1914), Traquair (1927) and Peter.

There are so many historical data and progresses in the study of glaucoma that we cannot try to name them all; we can only stop for a minute on the medical and surgical treatment of glaucoma.

Rational medical treatment of glaucoma begins when Weber in 1876 advocated the use of the extract of jaborandi (pilocarpine) and Laquer (1876–77) the use of physostigmine, eserine. In 1874, at the age of 35 years, Laquer, after a long operation observed coloured haloes. He tried eserine but without a good lasting effect. In 1880 in Zürich, Horner operated on him and performed antiglaucomatous iridectomy at the right eye without anaesthesia, then a week later at the left eye. His sight was saved and he preserved a very good visual acuity, but his personality was gravely affected for the rest of his life. He feared that his patients colleagues and students would notice the operation, and always wore dark glasses and tried not to look at his interlocutor directly in the face.

Darier in 1900 used sympathomimetic drugs (ergot compounds). Even though it seems to be something very modern, osmotic therapy was already spoken of by Cantonnet in 1904, and the intravenous administration of saline injections by Hertel (1914) was followed later by the use of intravenous urea and glycerine by mouth. Finally, in 1954 Becker introduced carbonic anhydrase inhibitors such as acetazolamide.

Surgical therapy has an even longer and more complicated history than medical therapy.

According to Duke-Elder, surgical treatment of glaucoma began upon the suggestion of Mackenzie in 1830 of lowering intraocular pressure by paracentesis or sclerotomy. It is worth while remembering that Mackenzie, who proposed to make a paracentesis in congestive glaucoma, did not believe in the use of von Graefe's antiglaucomatous iridectomy. In 1857 von Graefe praised antiglaucomatous iridectomy. Von Graefe maintained that an immediate iridectomy is necessary in the

acute stage. And more than 100 years later, we still believe what he said. But he doubted the effectiveness of his operation in chronic glaucoma. He observed that once cupping appears, it never disappears and the operation becomes useless. It must be remembered that during the same year Critchett proposed iridolesis; that is, he suggested inclusion of the iris in the paracentesis' scar. In 1870 Louis de Wecker proposed anterior sclerotomy and Herbert in 1903 practiced a small sclerotomy.

Holth introduced iridencleisis and Elliot of Madras invented trephination (in a different manner proposed in 1876 by Douglas Argyll Robertson). Holth was not satisfied with either sclerectomy or trephination. About his operation: iridencleisis, he stated, that 50 % of the patients have definitely normal pressures, 35 % must use miotics at night for six months, and 15 % must use miotics constantly, but all will have a normal pressure.

Elliot, who not only invented antiglaucomatous trephination, but also wrote a "Treatise on Glaucoma", is at the same time author of the first book entitled "Tropical Ophthalmology". Actually, he is considered the father of tropical ophthalmology. In 1934, two years preceding his death, he published a very famous book: "Myth of the Mystic East".

In 1906 Lagrange introduced sclerectomy (Fig. 9). With relation to Lagrange's operation, the great Javal at a Meeting of the French Academy of Medicine, said that he would only have wished it had been invented earlier to save him from blindness. Javal was blind because of chronic glaucoma; he went through von Graefe's antiglaucomatous iridectomy with a fatal result. Already blind, Javal wrote a monumental dissertation "Entre Aveugles" wherein he indicates how to adapt to blindness (Fig. 10).

In 1924 Preziosi described the cauterization of the sclera, later made popular by Scheie in 1958.

Heine in 1905 conceived cyclodialysis and in 1893 de Vincentiis trabeculotomy, which later became a routine operation, perfected in 1968 by Cairns and later by Harms and Dannheim. In 1936 Barkan introduced goniotomy which became the operation of choice in congenital glaucoma.

In 1964 Krasnov published sinusotomy. Among the nonbloody operations, we must mention Weve's (1932) and Bietti's (1965) cyclodiathermy.

Naturally, we do not pretend to enumerate all types of operations as well as their modifications, which are countless.

Obviously we can not speak about the history of glaucoma without remembering Duke-Elder, François, Hollwich, Kronfeld, Leydhecker, Scheie and Sugar.

9. Felix Lagrange (1857–1928)

From what we have presented here, it can be deduced that while for many centuries glaucoma has been a mysterious disease, and even though the more advanced investigations and modern medical and surgical treatments made it less disastrous and in part more treatable, its malign mystery still persists. Even now, notwithstanding all efforts, glaucoma is one of the principal, not to say the primary cause of blindness; however, we look towards the future with great optimism.

Summary

The author surveys briefly the history of glaucoma. Even though the word "glaucoma" appeared in the Hippocratic writings, the concept of the illness associated with increase of intraocular pressure appeared much later. Although it is assumed that the Arabs consider glaucoma (naturally, this name was not used) to be related to raised ocular pressure, it was mentioned for the first time in a book of Richard Banister in the XVIIth century. For centuries, the causes of glaucoma have constituted one of the most discussed problems in ophthalmology. With the exception of the causes of secondary glaucoma which are obvious, all the other considerations were often speculative. During the first decades of this century, when gonioscopes came into use, Salzmann, Troncoso, Thorburn and particularly Werner observed that in certain glaucomatous eyes the angle of the anterior chamber is open and in others closed. The history of tonometry is another chapter of human invention. In 1862 the universal A. von Graefe worked on the indentation tonometer, while H. Schiötz (Oslo) designed his tonometer, which has been modified on many occasions and still remains an excellent instrument for medical measurement. In 1885 Maklakoff introduced his applanation tonometer, and in 1888 Fick father and son presented a tonometer that was very popular for many years in some East European countries. The rational medical treatment of glaucoma began, when Weber in 1876 advocated the use of extract of jaborandi (Pilocarpine) and Laqueur at the same time the use of physostigmine (Eserine). In 1954 Becker introduced carbonic anhydrase inhibitors such as acetazolamide. According to Duke-Elder, the surgical treatment of glaucoma began with the suggestion of Mackenzie in 1830 of lowering intraocular pressure by paracentesis or sclerotomy. In 1857 von Graefe suggested the antiglaucomatous iridectomy. In 1906 Lagrange introduced sclerectomy. In 1893 de Vincentiis conceived the trabeculotomy, which later became a routine operation, perfected in 1968 by Cairns and later by Harms and Dannheim. In 1936 Barkan introduced the goniotomy which became the operation of choice in congenital glaucoma. Even now, and notwithstanding all efforts, glaucoma is still one of the principal causes of blindness.

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GROM E. – Un essai d'histoire du glaucome

Resumé

L'auteur passe en revue l'histoire du glaucome. Bien que le mot "glaucome" apparaisse dans les écrits d'Hippocrate, la conception de la maladie associée à une augmentation de la tension oculaire n'apparaît que beaucoup plus tard. Alors que les Arabes considéraient que le glaucome (ce nom n'était évidemment pas utilisé) était en rapport avec une tension oculaire augmentée, le terme a été mentionné pour la première fois au XVIIe siècle dans un livre de Richard Banister. Pendant des siècles les causes du glaucome ont constitué un des problèmes les plus discutés en ophtalmologie. A l'exception des causes du glaucome secondaire, qui sont évidentes, toutes les autres considérations étaient souvent spéculatives. Au cours des premières décades de ce siècle, lorsque le gonioscope a vu le jour,

Salzmann, Troncoso, Thorburn et surtout Werner ont observé que dans certains yeux glaucomateux l'angle irido-cornéen est ouvert et dans d'autres fermé. L'histoire de la tonométrie est un autre chapitre de l'invention humaine. En 1862 l'universel A. von Graefe fabriqua un tonomètre à indentation, alors que H. Schiötz (Oslo) conçut son tonomètre, qui a été modifié très souvent, mais qui reste un excellent instrument pour la mesure de la tension oculaire. En 1885 Maklakoff introduisit le tonomètre par aplanation et en 1888 Fick père et fil présentèrent un tonomètre qui est resté très longtemps populaire dans les pays Européens de l'Est. Le traitement rationnel du glaucome débuta, lorsque Weber conseilla en 1876 l'emploi d'extrait de jaborandi (pilocarpine) et Laqueur, a la même époque, l'emploi de physostigmine (éserine). En 1954 Becker introduisit les inhibiteurs de l'anhydrase carbonique, comme l'acétazolamide. D'après Duke-Elder le traitement chirurgical du glaucome débuta lorsque Mackenzie suggéra en 1830 de diminuer la tension oculaire par une paracentèse ou une sclérotomie. En 1857 von Graefe préconisa l'iridectomie antiglaucomateuse. En 1906 Lagrange introduisit la sclérectomie. En 1893 de Vincentiis conçut la trabéculotomie, qui plus tard devint une opération de routine, perfectionnée en 1968 par Cairns et plus tard par Harms et Dannheim. En 1936 Barkan introduisit la goniotomie, qui devint l'opération de choix pour le glaucome congénital. Encore maintenant et malgré tous les efforts, le glaucome reste une des causes principales de cécité.

GROM E. – Eine Abhandlung zur Geschichte des Glaukoms

Zusammenfassung

Der Autor gibt einen Abriß der Geschichte des Glaukoms. Obgleich der Begriff „Glaukom" bereits in den Schriften des Hippokrates erscheint, taucht der Gedanke dieser Krankheit, die mit einem Anstieg des Augendrucks in Verbindung gebracht wird, erst viel später auf. Während die Araber annahmen, daß das Glaukom (der Name wurde augenscheinlich nicht gebraucht) in Zusammenhang mit einem erhöhten Augendruck stehe, wurde der Ausdruck das erste Mal im 17. Jahrhundert in einem Buch von Richard Banister erwähnt. Während Jahrhunderten stellten die Ursachen des Glaukoms eines der meistdiskutierten Probleme in der Ophthalmologie dar. Mit Ausnahme der Ursachen des Sekundärglaukoms, die offensichtlich sind, waren alle anderen Überlegungen oft spekulativ. Im Laufe der ersten Jahrzehnte dieses Jahrhunderts, als die Gonioskopie aufkam, haben Salzmann, Troncoso, Thorburn und vor allem Werner beobachtet, daß in einigen glaukomatösen Augen der Kammerwinkel offen und in anderen geschlossen ist. Die Geschichte der Tonometrie ist ein anderes Kapitel der menschlichen Forschungen. Im Jahre 1862 verfertigte das Universalgenie A. von Graefe ein Impressionstonometer, während H. Schiötz (Oslo) ein eigenes Tonometer konzipierte, das sehr oft modifiziert

wurde, das aber ein ausgezeichnetes Instrument blieb, um den Augendruck zu messen. Im Jahre 1888 stellten Fick und Sohn ein Tonometer vor, das sehr lange in den europäischen Ländern des Westens populär geblieben ist. Die zweckmäßige Behandlung des Glaukoms nahm ihren Anfang, als Weber im Jahre 1876 zur Anwendung des Auszugs aus dem Pilocarpus jaborandi (Pilocarpin) riet und Laqueur zur gleichen Zeit zur Anwendung von Physostigmin (Eserin) riet. Im Jahre 1954 führte Becker die Hemmer der Carboanhydrase ein, wie das Azetazolamid. Nach Duke-Elder nahm die chirurgische Behandlung des Glaukoms ihren Anfang, als Mackenzie im Jahre 1830 anregte, den Augendruck durch Punktion oder Sklerasektion zu mindern. Im Jahre 1857 befürwortete von Graefe die Antiglaukomiridektomie. Im Jahre 1906 führte Lagrange die Sklerotomie ein. 1893 konzipierte de Vincentiis die Zerschneidung der Trabekel von der Vorderkammer aus, die später eine Routineoperation wurde und 1968 von Cairns und später von Harms und Dannheim verbessert wurde. 1936 führte Barkan die Goniotomie ein, die zur Operation für angeborenes Glaukom wurde. Noch heute und trotz aller Anstrengungen bleibt das Glaukom eine der Hauptursachen der Erblindung.

GROM E. – Un ensayo de la historia del glaucoma

Resumen

El autor relata la historia del glaucoma. Aún cuando la palabra "glaucoma" aparece en los escritos de Hipócrates, la concepción de la enfermedad asociada a una manifestación de la tensión ocular aparece mucho más tarde. Cuando los árabes consideraban que el glaucoma (este nombre evidentemente no era utilizado) estaba relacionado con una tensión ocular aumentada, el término a sido mencionado por primera vez en el siglo XVII en un libro de Richard Banister. Durante siglos las causas del glaucoma han constituído uno de los problemas más discutidos en oftalmología. A excepción de las causas del glaucoma secundario, que son evidentes, todas las otras consideraciones eran a menudo especulativas. En el curso de las primeras décadas de este siglo, cuando el gonioscopio hizo su aparición, Salzmann, Troncoso, Thorburn y sobretodo Werner han observado que en ciertos ojos glaucomatosos el ángulo iridocorneal está abierto y en otros cerrado. La historia de la tonometría es un otro capítulo de la invención humana. En 1862 el universal A. von Graefe fabrica un tonómetro por indentación, mientras que H. Schiötz (Oslo) realiza el suyo, que ha sido modificado varias veces, pero que sigue siendo un excelente instrumento para medir la tensión ocular. En 1885 Maklakoff introducía el tonómetro de aplanación y en 1888 Fick padre e hijo presentarían un tonómetro que ha quedado popular durante mucho tiempo en los paises europeos del Este. El tratamiento racional del glaucoma, comienza, cuando en 1876 Weber aconseja el empleo de extracto de jaborandi (pilocarpina), y en la misma época Laqueur el empleo de fisostigmina (eserina). En 1954 Becker intro-

dujo los inhibidores de la anhidrasa carbónica, como la acetazolamida. Según Duke-Elder el tratamiento quirúrgico del glaucoma debuta cuando Mackenzie en 1830 sugiere de disminuir la tensión ocular por medio de una parasintésis o una esclerotomia. En 1857 von Graefe preconisa la iridectomía anti-glaucomatosa. En 1906 Lagrange introducía la esclerectomía. En 1893 de Vincentiis ideó la trabeculotomía, que luego se vuelve una operación de rutina, perfeccionada en 1968 por Cairns y luego por Harms y Dannheim. En 1936 Barkan introducía la goniotomía, que llega ha ser la operación elegida para el glaucoma congénito. Aún hoy y a pesar de todos los esfuerzos, el glaucoma es una de las principales causes de ceguera.

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