

2014

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1 HERBERT HERBERT: HIS CORNEAL PITS AND SCLERAL SLITS

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6 Material under consideration for presentation at the

7 Cogan Ophthalmic Historical Society

8 March 28-30, 2014

9 Financial Support: None

10 No conflicting relationship exists for this author

11 Running Head: Herbert Herbert

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15

16 Herbert Herbert (Fig. 1) was born in the English county of Cheshire on February 25,
17 1865. (1,2,3) Obviously, when I began to study his life, the first question which arose was his
18 unusual name. Herbert Herbert's birth certificate documents that he was originally named
19 Herbert Sherwood, and his mother was recorded as Alice Sherwood. His father was identified
20 as Richard Sherwood. Sherwood was native of the Isle of Man, the large island in the Irish
21 Channel between England and Ireland. Sherwood was a lawyer and a judge in the Island.
22 However, genealogic records from the Isle of Man show that Richard Sherwood had previously
23 married another woman in 1851. They had three children, were never legally divorced, and
24 when Richard Sherwood died, his obituary did not mention either his legal wife or his three
25 known legitimate children.(4) In fact, Herbert's mother was probably named Alice Herbert (not
26 Sherwood), was not married to Richard Sherwood, and thus Herbert was illegitimate. (5) In

27 1876, Herbert Sherwood's surname was changed from Sherwood to Herbert. Since he was
28 only 12 years old at that time, I presume he could not do that himself. It is likely when his
29 mother Alice had a falling out with Richard Sherwood, probably because he refused to marry
30 her, she changed her son's surname, but was not allowed to change his Christian name, thus
31 accounting for the name of Herbert Herbert. There are other mysteries surrounding the life of
32 Richard Sherwood. He sent his legitimate son to Australia, presumably to shield him from a
33 family scandal. It is possible that Sherwood had not one but two illegitimate families, and
34 Sherwood died under mysterious circumstances, either a suicide or possibly a murder victim. (6)
35 Herbert Herbert was not born on the Isle of Man where his Father lived, but in a small village on
36 the coast of the county of Cheshire, presumably where his Mother lived, which is across the
37 Irish Channel from the Isle of Man.

38 In spite of this somewhat inauspicious start to his life in strict Victorian England, Herbert
39 was educated at Leeds Medical School and graduated with his medical degree in 1886. He was
40 awarded the membership of the Royal College of Surgeons and the licentiate of the Royal
41 College of Physicians in the same year. In 1887, he entered the Indian Medical Service as a
42 surgeon, and was originally posted to the Middle East where he served and saw active military
43 service in Aden and East Africa. He 1891, he obtained the advanced qualification of Fellow of
44 the Royal College of Surgeons.

45 At that time, Herbert decided to specialize in ophthalmology, although I could find no
46 information on where he obtained his postgraduate training in ophthalmology. He then moved to
47 Bombay (now Mumbai) India where he became professor of ophthalmic surgery at Grant
48 Medical College, one of the premier medical institutions in India and one of the oldest schools
49 for the teaching of Western medicine in Asia. He also became ophthalmologist at the Sir
50 Jamshedjee Jeejeebhoy Group of Hospitals. He made good use of the large amount of clinical
51 material at those institutions. While in India he described his findings in trachoma, studied

52 superficial keratitis, and began his studies on glaucoma surgery. He was very interested in
53 histology and did all the pathological work on his patients in his spare time. He worked in
54 Mumbai from 1895 to 1907.

55 As was customary for officers of the Indian Medical Service, after twenty years of service
56 in India, he retired at age 42 with the rank of lieutenant-colonel and returned to England where
57 he was appointed surgeon to the Midland Eye Infirmary at Nottingham in 1907. At this time, his
58 work concentrated on developing newer techniques in glaucoma surgery and he published
59 extensively in this field. At the outbreak of World War I in 1914, he rejoined the Indian Medical
60 Service, serving on hospital ships, and ashore in both India and England. While in India, he had
61 the opportunity to perform many more glaucoma operations. After the war, he settled in
62 Sussex, England where he served as both a consulting ophthalmic surgeon and a pathologist.
63 He was active in the Ophthalmological Society of the United Kingdom (now the Royal College of
64 Ophthalmology) and served a term as a vice-president (Fig 2). He served on the editorial board
65 of the journal *The Ophthalmoscope* for 14 years. He died on March 19, 1942, age 77.

66 Herbert was one of the four famous British ophthalmologists who served with great
67 distinction in India at the end of the 19th century and beginning of the 20th century, during the
68 years of British control. The other three were Henry "Jullundur" Smith (1859-1948) who
69 championed the intracapsular extraction of cataracts rather than the more common
70 extracapsular method, Robert Henry Elliot (1864-1936) who developed the trephination
71 procedure for glaucoma filtering surgery and was a strong opponent of Herbert's proposal of iris
72 inclusion for glaucoma surgery, and Robert E. Wright (1884-1977) who developed a new
73 technique in local anesthesia for ocular surgery and did extensive bacteriological research.

74 On a personal note, he was married and had four children. One of his sons became a
75 general surgeon in England, one of his daughters became a doctor who worked, like her Father,
76 in India, and a grandson was a general physician in England.

77 External disease

78 Some of Herbert' earliest ophthalmologic publications were on cases of epidemic
79 superficial punctate keratitis. (10) In retrospect, many of these cases were probably adenoviral
80 in origin. He wrote two brief reports in which he reported the microscopic appearance of
81 encapsulated bacilli in corneal epithelial scrapings. Discussion of these cases by other
82 ophthalmologists tended to raise doubt as to whether these bacilli were the cause of this
83 condition. In total he wrote four brief reports on this subject. Here I note early in his career a
84 characteristic of his medical papers in that he would write a short paper and then invariably
85 follow it with a "further note" which unfortunately offered little more than in the original report.

86 Thirty years after his initial reports in 1901, a much more complete analysis of this
87 condition was reported from India in which careful bacterial studies failed to confirm the
88 presence of the bacilli as noted by Herbert, and that filtration transmission studies indicated that
89 the cause was probably viral. Herbert responded immediately with a rather petulant article
90 decrying the fact that no other investigator had looked for or confirmed the presence of the
91 bacilli which he had previously noted. He concluded that he "personally had no doubt whatever
92 that the bacillus is the living infective agent of this disease." He appealed for further
93 investigation when the most recent report had clearly excluded any bacterial cause. As was his
94 habit, Herbert often seemed unable to let any discussion conclude, but wanted to have the last
95 word in the literature. (11)

96 Herbert was on much firmer ground when he became the first, or one of the first,
97 investigators to identify the presence of eosinophils in the conjunctival discharge of eyes with

98 spring or vernal catarrh. His second report on this subject was an analysis of 39 cases seen in
99 Bombay over a period of two years. He properly concluded that the presence of many
100 eosinophils was very helpful in confirming the diagnosis of this condition, thus excluding other
101 types of chronic keratoconjunctivitis, especially trachoma. He also noted the presence of tiny,
102 white points on the limbal nodules of vernal catarrh; these are now referred to as Horner-
103 Trantas's spots. (12)

104 These studies confirm that Herbert was indefatigable in doing his own cytology and
105 histology on his clinical material, and when he later returned to England, he worked as a
106 pathologist as well as an ophthalmic surgeon. He published several papers on the pathology of
107 chronic inflammation of the eyelids and conjunctiva.

108 Trachoma

109 Herbert's name is now mainly remembered for his description of the limbal corneal pits
110 found in trachoma. He described this in 1903. (13) At that time the slit lamp had not been
111 invented; Alvar Gullstrand (1862-1930) invented the slit lamp in 1911 and it entered general use
112 in the 1920s. Anterior segment examinations were conducted with hand-held loupes of up to 10
113 times magnification and focal illumination. Herbert clearly described the pannus of trachoma
114 and the associated lymphoid follicles of the limbus. The presence of limbal follicles surrounded
115 by a fine capillary network is sometimes referred to as Herbert's rosettes. When the follicles
116 resolve, he documented focal opacities which were depressed below the corneal surface and
117 appeared as pits. (Fig. 3) He noted that in the dark-skinned natives of India, there was often a
118 marked degree of pigmentation in the pits, while in white-skinned patients the pigmentation was
119 not found. He observed that the pits corresponded to the sites where the follicles occurred.
120 When less well developed, the pits produced a scalloped or festooned limbal border.

121 This original observation was soon confirmed by many other experts in this field, and
122 welcomed as a sign that could reliably diagnose trachoma from other conjunctival and corneal
123 diseases. (Figs. 4 and 5) The name of Herbert's pits was bestowed by the famous
124 trachomatologist Arthur F. MacCallan (1873-1955) who extensively studied this disease in
125 Egypt. (14) The pathology of these pits was described in 1935 by Archimede Busacca (1893-
126 1971), a pioneer in the field of slit lamp biomicroscopy. He demonstrated that when the limbal
127 follicles and corneal pannus start to heal, the fibrosis and scarring of the follicles leave a space
128 where the resolved follicle formerly existed; this pit is then filled with corneal epithelium and
129 appears optically clear, so that the stroma appears focally depressed. (15)

130 Herbert's pits or the scalloped limbal border are pathognomonic of trachoma and such a
131 finding has never been noted in any other ocular disease. Once developed, they persist
132 throughout life. The diagnostic importance of this finding cannot be overemphasized.

133 Herbert, in a clear and concise one page report, described the "sinuous lid border, a sign
134 of trachoma." His observation was that the nasal portion of the upper lid arched upward
135 normally but that the temporal half of the lid presented a curve with the convexity downward.
136 He pointed out that this was, in his experience, only seen in rather severe cases of trachoma.
137 He observed that it was not due to cicatricial scarring, as it was noted before any lid scarring
138 occurred. He hypothesized that the deformation was due to stretching and molding of the
139 diseased and infiltrated tarsus from the blinking action of the lid. Unfortunately, he had no
140 drawing or illustration of this finding in his report. This is now called Herbert's sign. Herbert did
141 not comment on the presence of a concomitant ptosis, but other observers noted a ptosis as
142 well, due to both the infiltration of Muller's muscle and the levator aponeurosis with inflammatory
143 cells, and the weight of the swollen tissues.(16) (Fig 6).

144 Herbert was clearly a careful observer of the clinical pathology in his practice, and able
145 to make several useful observations which have stood the test of time.

146 Cataract Surgery

147 Herbert wrote two books about cataract surgery, based on his personal experience of
148 about 5,000 extractions performed in India. He commented that “this is comparatively small
149 experience for an ophthalmic surgeon of standing in India.” His first book was published in 1903
150 and was a brief exposition of only 105 pages. (17) It was favorably reviewed, sold out in 6
151 months, and a second edition was printed. Encouraged by this reception, he expanded this
152 material into a second book, published in 1908. (18) This text was similar in organization to the
153 first, but much more thorough and the material expanded to 385 pages. He stated that all his
154 conclusions are formed by his experience in India and noted the differences between surgical
155 practice in India and in the Western countries: for example, most of his Indian patients had
156 chronic conjunctivitis, mainly trachoma, and thus extra attention in preparing the eye for surgery
157 was required for Indian patients.

158 This major text is remarkable for its precise and careful organization and attention to all
159 the details of the procedure. The writing is not as prolix or repetitive as in his later glaucoma
160 text. Every step of his procedure is related in careful detail: he devotes 14 pages to the
161 performance of the anterior capsulotomy and 29 pages to the cleansing and sterilization of the
162 conjunctiva. The latter subject was of great interest to him: he stated that “the problem of the
163 exclusion of exogenous infection still constitutes one of the most vital questions in cataract
164 work” and that postoperative “infective processes constitute by far the most important departure
165 from the normal course of events after operation”. He performed bacteriologic studies of the
166 conjunctiva before and after his preferred method of cleansing of the field by irrigation with
167 1:3000 sublimate perchloride solution to demonstrate its effectiveness.

168 This text has much better drawings and photographs of his surgical technique than
169 found in his later volume on glaucoma surgery. In contrast to his glaucoma writings where
170 references to other surgeons is rare, this text contains over 200 references to the English,
171 French, German, and American literature. This allowed him to not only describe his preferred
172 surgical technique but also to present in great detail other techniques championed by his
173 contemporaries, devoting 100 pages of his book to techniques recommended by other
174 surgeons. For example, on the subject of suturing of the wound, he acknowledged the
175 experience of other surgeons, but his opinion is that it is “altogether too difficult and complicated
176 a measure, placing too great a strain upon the patient for general use.” This was the general
177 standard of care at that time. No detail of the operation is too minor for him to consider: for
178 example, he recommended that the beginning surgeon perform finger exercises with forceps
179 having a strong spring to improve his manual dexterity, or that the handle of a Graefe knife
180 “should be of ivory or aluminum, as steel is too heavy and too slippery when wet.”

181 He discussed at length the history and development of removal of the lens in the capsule
182 and acknowledged the success achieved by his Indian colleague Henry Smith from the city of
183 Jullundur in the Punjab, India. However, Herbert felt that the incidence of vitreous loss during
184 intracapsular surgery, over 30% by other surgeons imitating Smith’s procedure, was
185 unacceptable, compared to the usual rate of about 5% or less by surgeons performing the
186 usual extracapsular procedure. He acknowledged the obvious advantage that intracapsular
187 surgery avoided the vast majority of development of after-cataract and the subsequent
188 necessity of a second procedure to clear the visual axis. Nevertheless, he stated that the
189 simple needling of secondary cataract is so safe that performing extraction of the lens in the
190 capsule, with the attendant high risk of vitreous loss was unacceptable. He admitted that he has
191 very little experience in the intracapsular technique under discussion. Another example is his
192 discussion of various types of capsulotomy. Herbert strongly favored a simple incision of the

193 anterior capsule with a toothed cystitome, as opposed to the removal of a flap of the central
194 anterior capsule with forceps. He acknowledged that the formation of secondary cataract is
195 much greater with his technique, but based on a few cases of his own in which his use of
196 capsule forceps caused vitreous loss or lens dislocation, he condemned the advantage of
197 removal of the anterior capsular flaps, and accepted as safer the problem of dealing with the
198 secondary procedures for after cataract. In these examples, as in others, he often formed
199 conclusions based on a very few results in his own experience without allowing for the
200 successful results of other surgeons

201 Much of his technique appears to the modern surgeon as rather rough and hurried. The
202 major cause for this is the absence of any oculomotor akinesia during surgery. Although
203 retrobulbar injection of cocaine had been introduced by Hermann Knapp (1832-1911) in 1884,
204 very soon after the discovery of cocaine for topical anesthesia by Carl Koller (1857-1944) in the
205 same year, it clearly was not used for ocular akinesia during surgery at this time. Herbert, in
206 common with his contemporaries, also avoided general anesthesia with either chloroform or
207 ether, due to postoperative vomiting and the consequent expulsion of intraocular tissues
208 through the unsutured wound. He thus depended on the patient's self control of fixation: this
209 was tested preoperatively and if the patient showed lack of control, the surgical assistant spent
210 time teaching the patient how to hold his eye steady during surgery and led the patient through
211 exercises to increase the time the patient could accomplish this. At all stages of surgery,
212 Herbert gives advice on what to do to avoid complications if the globe moves during the
213 procedure. The use of a lid speculum to control the orbicularis was fraught with problems of
214 excessive squeezing causing vitreous loss, and often the speculum was removed or released
215 after making the incision, exposure being maintained by the assistant's fingers on the lid. Since
216 the time that most patients could control their ocular fixation was limited, Herbert practiced

217 speedy surgery; this was also necessary because of the large volume of patients requiring
218 surgery in India.

219 This text was also carefully and thoroughly reviewed in the major journals of the time,
220 including both British and American journals. The *British Medical Journal* described it as “a
221 standard work on cataract for many years to come, and we heartily congratulate Colonel
222 Herbert on having produced such an extremely interesting and useful book.” (19) The review in
223 the journal *The Ophthalmoscope* ran for 4 pages and concluded that his book was of “great
224 importance” to ophthalmologists and emphasized the huge amount of practical details
225 offered.(20) As was his habit, Herbert was unable to completely accept this favorable review,
226 and immediately sent a letter to the editor decrying some minor points which he disagreed with
227 in the review.

228 This author’s impression Herbert’s two texts on cataract extraction is mixed: the most
229 positive points are his very careful and thorough presentation of all details in the operative and
230 perioperative period, certainly useful for the beginning surgeon. However, he offers no new
231 concepts and narrowly seems to press his own preferences in surgical techniques. Only in his
232 interest and insistence on careful preoperative conjunctival preparation to avoid infection does
233 he appear to present a new idea.

234 Glaucoma

235 Herbert’s main professional interest and importance were in the field of glaucoma,
236 especially in the development of glaucoma filtering surgery. He published over 25 papers in this
237 area as well as a small text on this subject (out of the approximately 65 papers I could identify in
238 his bibliography). His interest in the development of glaucoma surgery spanned 30 years from
239 his first publication in 1903 till his last in 1934. In order to understand the importance of his

240 contributions, a brief review of the history of the development of early glaucoma surgery is
241 needed.

242 The first surgery for glaucoma, indeed the first successful therapy at all for glaucoma,
243 was the operation of a large, basal iridectomy introduced by Albrecht von Graefe (1828-1870) in
244 1857. This operation held the field practically undisputed for the next 50 years, but while it was
245 acknowledged to be very useful in acute and subacute forms of glaucoma, most surgeons noted
246 disappointing results in chronic glaucoma. It was Louis de Wecker (1832-1906) in 1867 who
247 first suggested that the value of the operation was not in the excision of the iris, but in the
248 incision of the sclera and the formation of a filtering scar or cystoid cicatrix. De Wecker's
249 hypothesis was partially accepted but his operation of sclerotomy in the region of the angle was
250 disappointing due to its failure to produce a permanent result. There was some delay in
251 progress in this area, but with the introduction of topical anesthesia in 1884, Maklakoff
252 tonometry in 1885, and Schiotz tonometry in 1905, the stage was set for the development of
253 various filtering procedures .(21)

254 The basic principles of modern filtering surgery were introduced in the period from 1900
255 to 1920, and fell into three types. The first, introduced in 1905 by the Frenchman Pierre-Felix
256 Lagrange (1857-1928), consisted of excising (rather than simply incising) the anterior sclera in
257 the region of the filtration angle. He called this operation sclerectoiridectomy and it involved
258 resection of part of the anterior lip of a beveled scleral incision combined with a large iridectomy.
259 Herbert argued that this operation had several faults, i.e. too long an incision which often gaped,
260 excision of too large a portion of the iris, and lack of a means of regulating the size and depth of
261 the portion of excised sclera. Herbert felt that these problems could be relieved by performing
262 small incision sclerotomy without excision of scleral tissue. Another alternative to regulate the
263 size of the scleral fistula was introduced by the Norwegian Soren Holth (1863-1937) who

264 developed a punch to excise the anterior portion of the incision rather than the scissors
265 employed by Lagrange. (22, 23)

266 Herbert developed three types of sclerotomy and he was a pioneer in trying to develop
267 a diffuse, smooth, and even filtering bleb without a grossly fistulous scleral scar. In 1907, he
268 described the first of these as the “jagged incision” in which he aimed to secure delayed healing
269 of the sclerotomy and thus consequent filtration by making the incision jagged or uneven by
270 means of sawing movements with a narrow and dull Graefe knife under the conjunctiva in the
271 region of the angle. He reported on his experience of 60 cases with this procedure, concluded
272 that his results were “somewhat uncertain,” and abandoned it. (24)

273 Herbert then proposed the “wedge isolation” procedure and published this in 1908.(25)
274 This also required an ab interno incision with the Graefe knife and subconjunctival incisions so
275 as to isolate a wedge of corneal-scleral tissue in the angle under the conjunctiva. This wedge or
276 prism of sclera was still attached to the conjunctiva at its base; the flow of aqueous would lift this
277 bit of tissue from its bed, and since it was isolated from its blood supply, the tissue would shrink
278 and allow formation of a filtering incision without actually excising any tissue. (Fig. 7) This
279 procedure was often combined with a small basal iridectomy to prevent iris prolapse. The
280 maneuvers of this procedure were complex and not easily understandable from Herbert’s
281 description or drawing to explain his surgical procedures. Responding to these concerns, a
282 year later Herbert published a further explanation of this procedure with better illustrations. He
283 also suggested that “the technique can be easily learnt by operating on a few pig’s eyes.”
284 However, in a later paper he admitted that the “wedge operation can never become popular,
285 owing to the minute care required in its execution.” Robert H. Elliot, another pioneer in
286 development of glaucoma surgery, who had the advantage of learning the procedure from
287 Herbert himself, said it is a “tricky and difficult operation.” However, the partial success from
288 these two procedures convinced Herbert that it was unnecessary to excise pieces of limbal or

289 sclera tissue to produce a permanent filtering procedure, and that a small scleral incision
290 allowed formation of a diffuse filtering area rather than a large, gross fistulous bleb.

291 Between 1907 and 1909, he then developed a new type of sclerotomy which he labeled
292 “small flap” incision. This procedure was performed by an ab externo incision, thus avoiding
293 passage of the Graefe knife across the entire anterior chamber. He inserted a Graefe knife
294 horizontally through the conjunctiva, limbal sclera, and into the chamber, and then by turning the
295 knife vertically with the sharp edge anteriorly, made two vertical incisions on either side of this
296 initial incision, thus producing a small rectangular flap or tongue of scleral tissue based at the
297 limbus under the conjunctiva .(Fig 8) By making the initial incision either shorter or longer in
298 length, he hoped to titrate the amount of filtration for eyes with higher or lower elevation in
299 pressure. For eyes with moderate glaucoma, he used a flap 1-2 mm wide, but for eyes with
300 severe glaucoma he made the incision 4 mm. Here he clearly enunciated his major point about
301 glaucoma filtration surgery, and the one that he should be remembered for: that using large
302 incisions for glaucoma surgery, with all the attendant problems of large or gaping incisions and
303 unplanned prolapse of iris, were dangerous and that the success of filtration could be achieved
304 by the use of small incision surgery. His objection to any type of excisional sclerectomy was that
305 it removed too much tissue and either produced hypotony or excessively large filtering bleb
306 subject to complications such as infection or rupture. He felt that his sclerotomy without
307 excision of tissue disturbed the eye as little as possible, produced a uniform and diffuse filtration
308 area rather than the large fistulous bleb, and if it failed, more extensive surgery could be
309 performed. (26)

310 His “small flap” or “trap door” sclerotomy without iris inclusion became much more
311 popular than his prior procedures and was tried and employed successfully by his colleagues.
312 Herbert followed up his original 1910 report with two more papers in 1911, and two final reports
313 in 1920 and 1922. The two 1911 papers also included a series done by other surgeons in

314 England. Herbert reported only 3 failures out of 54 cases with at least a 5 month follow up. He
315 and other surgeons had introduced various modifications, such as making the scleral incision
316 with a keratome rather than with a Graefe knife and reflecting the conjunctival flap over the
317 cornea to allow more deliberate incision of the scleral flap with scissors rather than the straight
318 Graefe knife. His final impressions (as published in 1920 and 1922) were that this operation
319 was useful in cases of mild to moderate glaucoma, but not as successful in advanced or severe
320 cases. He also felt that a period of miotic treatment should be undertaken prior to the use of
321 this procedure. He also was concerned about the permanency of reduction in pressure in these
322 cases where there was no iris included in the incision. Here we see Herbert turning away from
323 sclerotomy alone and moving to his iris-inclusion operation. Herbert admitted that “there has
324 always been something elusive in small flap sclerotomy.” Another surgeon had reported
325 increasing success with post-operative massage of the globe to continue to keep the filtering
326 wound from scarring, and Herbert agreed with this recommendation.

327 The drawback to all these small incision sclerotomies was that they were apt to fail
328 owing to healing of the small incision. On the other hand, there was some truth to Herbert’s
329 contention that operations such as Lagrange large incision sclerectomy or Elliott corneo-scleral
330 trephination which removed a defined piece of the sclera were apt to do too much and form an
331 excessively large filtering bleb which was likely to leak, rupture or become infected. Herbert
332 made a careful study of the appearance of the bleb and differentiated the desired filtration effect
333 with diffuse conjunctival edema formed from his operations of small incision sclerotomy or iris
334 inclusion, in contrast to the large and grossly fistulous blebs resulting from more extensive
335 removal of scleral tissue. He was very interested in the appearance and functionality of the
336 filtering cicatrix and performed histologic studies on postmortem eyes which had previously
337 undergone filtering surgery. (Fig 9)

338 In an effort to keep the sclerotomies from healing, he was one of the first
339 ophthalmologists to insert various setons in the sclerotomy to try to keep them open. He first
340 made a long conjunctival flap over the small sclerotomy and then pushed the conjunctival flap
341 into the anterior chamber; in some eyes, he used a temporary suture to secure the flap in the
342 incision to prevent its extrusion. However, this proved unsatisfactory after 23 cases and was
343 abandoned. He also inserted small bits of bent capillary glass tubing, knotted threads, or a bit
344 of wire through sclera-corneal punctures under the conjunctiva. All these attempts failed due to
345 inflammation and eventually Herbert abandoned them. This was an idea in advance of its time
346 and such setons are now commonly utilized.

347 Although Herbert thought his small flap sclerotomy was useful in cases of mild glaucoma,
348 he noted that permanent reduction of the pressure often failed due to closure of the sclerotomy
349 so he looked for another technique. In 1903, he reported 130 cases of deliberately prolapsing
350 the iris into a scleral incision under a conjunctival flap. This procedure grew out of observations
351 made by himself and many other surgeons in which, following iridectomy, the best and most
352 permanent reduction of pressure occurred when pieces of the iris by chance were entrapped
353 and healed in the incision. Herbert and others had noted that such iris prolapses commonly
354 occurred inadvertently following cataract extraction and this was well tolerated as long as the
355 prolapsed iris was completely covered by the conjunctival flap. Other surgeons had tentatively
356 proposed, and even performed a few operations with deliberate incarceration of the iris into
357 either the corneal or scleral incision, but Herbert was the first surgeon to deliberately perform a
358 large series of such operations. An iridectomy was also performed at the time of prolapse. He
359 reported good success and followed 51 eyes for at least 6 months. He denied any cases of late
360 infection, but had two cases of severe postoperative inflammation and in one of these cases,
361 sympathetic ophthalmia occurred. However, he concluded that the relief of the tension was
362 both certain and permanent. The only other complication was delayed reformation of the

363 anterior chamber in a few eyes. He called this operation subconjunctival prolapse of the iris.
364 (Fig 10) His report was important in establishing the basis for iris inclusion operations, but
365 clearly Herbert, at that time, did not see this as a promising lead to the ideal operation and
366 turned to sclerotomy without iris incarceration in his different techniques as described
367 previously. (27)

368 Herbert did not again write about iris incarceration surgery till 1919. It was thus left to
369 Soren Holth to fully develop this procedure and name it "iridencleisis antiglaucomatosa." Holth
370 first published this in 1906 and continued with various modifications. Opposition to this
371 procedure was common, and many condemned the idea of deliberate iris incarceration.
372 Objections raised included the risk of sympathetic ophthalmia, induced astigmatism, and the
373 cosmetic appearance of the updrawn pupil. Because of these concerns, and a 14% failure
374 rate, Holth returned to the sclerectoiridectomy procedure of Lagrange, and invented his punch
375 to help remove a standard bite of sclera rather than the use of scissors of Lagrange's
376 sclerectomy. Holth, like Herbert, vacillated between iris inclusion and iris free filtering
377 procedures. Although the name of Holth is usually associated with the development of
378 deliberate iris inclusion, it was really Herbert who first performed this procedure, published a
379 large series of eyes, and became its major proponent. (28)

380 Thus, incarceration of the iris into the sclerotomy became the second basic type of
381 filtration surgery. The third variation was corneoscleral trephination in which a small circular
382 trephine was applied at the anterior limbus to create a scleral fistula under a conjunctival flap.
383 First described in 1909, the originators of this procedure, Freeland Fergus (1858-1932) of
384 Scotland and Robert H. Elliot (1866-1936) of England, claimed this as simpler to perform than a
385 Lagrange sclerectomy and avoided deliberate iris inclusion as advocated by Holth and Herbert.
386 This procedure soon became widely accepted and was the commonest filtration procedure
387 performed during the first half of the 20th century. (29)

388 Herbert's next contribution to this subject came in 1919; the delay in publication was
389 undoubtedly due to his four years of service during World War I.(30) This paper describes both
390 iris-free as well as iris-inclusion sclerotomy. He does not give any statistical data with regard to
391 the results but seems to favor iris-inclusion as he described this technique in great detail.
392 However, as was typical for him, he vacillates between various techniques. He mentions the
393 use of the Schiotz tonometer in one case, but still appears to depend mostly on the use of finger
394 tension to measure the results of his surgery. As was his habit, a year later he published a
395 follow-up article describing his "improved iris prolapse operation" for those who could not
396 understand his admittedly "cursory" description of surgery in the prior article. (31) Again,
397 Herbert has no drawing or illustration for his surgical technique; his continual failure to better
398 illustrate his surgical technique does not make it easy for the reader to exactly understand the
399 steps of his operation. He acknowledged several problems with his surgical procedure:
400 induced astigmatism and often a temporary rise in pressure in the immediate postoperative
401 period, often causing a greater bulge in the prolapsed iris. Again, no statistical results are given
402 for the operation, but he claims a permanent, though short term result in the vast majority of
403 cases. He now tended to utilize his small flap sclerotomy as his primary operation in moderately
404 severe cases, and to use iris-incarceration only in more severe cases or where his first
405 procedure had failed. With regard to the common concern of sympathetic ophthalmia following
406 such cases, Herbert claims that in his opinion this only occurred rarely and in such eyes where
407 the iris was not entirely covered by the conjunctiva and there was a strong presumption that the
408 disease was introduced by problems or infection during the operation. By now he is
409 condemning the growing popularity of the trephination operations, and is clearly now fighting a
410 losing battle for his iris –inclusion filtration rather than the iris-free surgery performed with Elliot's
411 trephination.

412 In 1923 Herbert published his text *The Operative Treatment of Glaucoma*. (32) This
413 short text of 160 pages is disappointing in many ways, both to his contemporaries and later
414 readers. He made no attempt to review or summarize the vast literature on glaucoma surgery.
415 He stated that by not claiming originality in his ideas, he thus does not have to reference prior
416 surgeons's contributions. The text does not discuss iridectomy or other glaucoma operations
417 such as cyclodialysis (introduced in 1905) and thus does not really cover the subject of its title.
418 The text is prolix, long on description of his operations and short on illustration of how to perform
419 them. Although he was clearly familiar with the Schiotz tonometer, he apparently did not use it
420 regularly and still refers to the use of finger tension tonometry. He described this text as a
421 resume of papers already published but the book would have appeared more useful if the
422 compilation would have been more complete and careful; the text is not well organized and the
423 reader has to move back and forth to fully understand the reasons for emphasizing iris-inclusion
424 operations rather than iris-free operations such as Elliot's trephination. The main reason that he
425 rejected Elliot's trephination was that he felt the excision of the piece of sclera as too extensive
426 surgery, with the chance of producing an excessively large and fragile bleb, subject to
427 infections, rupture, and over-filtration; however, he admits that he has no experience with the
428 surgery. The disagreement between Elliot and Herbert is clearly delineated in the text, and the
429 reader forms the impression that Herbert is using his book to attack the obvious success of
430 trephination surgery.

431 The book was reviewed without critical analysis in the *American Archives of*
432 *Ophthalmology*. (33) The *British Journal of Ophthalmology* was much more critical of its
433 organization and contribution to the subject, and felt it was a disappointment. (34) The most
434 interesting reviews were in the *American Journal of Ophthalmology* in which two reviews are
435 presented. (35) The first, by the journal's editor, Edward Jackson, gives a one page discussion
436 which is mildly favorable. The guest review is by Elliot who very carefully throws doubt on

437 Herbert's contention that only iris-inclusion filtration gives permanent relief of glaucoma and
438 points out the inconsistencies in many of this text's conclusions.

439 In this author's analysis, if the text been better organized and the operations advocated
440 better illustrated, it would have been a much more useful text. This author wonders that Herbert
441 originally hurried this text into publication because Elliot was publishing his own text in 1922,
442 and Herbert wished to have his opinions in print simultaneously. This author hypothesizes that,
443 based on Herbert's brief text on cataract surgery, followed later by his much more complete
444 book later, Herbert might have planned a much more complete glaucoma surgical book at a
445 later date. This was typical of his publication pattern: an article, followed by a supplemental
446 paper later. When Herbert's text is compared to Elliot's classic book, A Treatise On Glaucoma,
447 published in 1922 ,(36), Herbert's book is clearly an inferior volume.

448 From 1923 till his last paper in 1934, Herbert published 6 more long articles on iris-
449 inclusion filtration. The major points that he repeats are that iris free filtration tends to fail over
450 time while iris-inclusion surgery tends to be a permanent cure, and he is clearly pushing for iris-
451 inclusion surgery as more efficacious and safe compared to trephination. He is adamant that
452 the risk of sympathetic ophthalmia is overly emphasized and that measures can be undertaken
453 to reduce this risk. Acting on the assumption that sympathetic uveitis arises from exogenous
454 infection at the time of surgery, he went to great lengths to prepare the eye with extensive
455 irrigation with perchloride solution and careful aseptic technique during surgery. He claimed
456 that the only case of sympathetic arising in his 35 years of glaucoma surgical experience
457 developed in a patient early in his career when the thorough cleansing of the conjunctiva was
458 not performed. He also stated that sympathetic ophthalmia only occurred in cases of iris
459 prolapse not completely covered by the conjunctival flap.He mentioned that iris-inclusion
460 surgery is especially suited in patients in which the contralateral eye is blind or nearly so, so as
461 to obviate any concern over sympathetic uveitis. The use of a small incision of about 3.5 mm

462 reduces the chance of delayed reformation of the chamber which was commonly observed
463 following sclerectomy or trephination with formation of a much larger fistula. He recommended
464 performing a deliberate irido-dialysis prior to prolapsing the iris in the sclerotomy. He
465 emphasized that iris –inclusion surgery is not suitable for eyes with active or past irido-cyclitis.
466 In eyes with acute glaucoma, instead of performing a simple iridectomy as was the common
467 procedure, he combined his iridectomy with deliberate incarceration of the iris into the incision.
468 (37)

469 To summarize, the period from about 1900 to 1920 saw the development of true
470 glaucoma filtration surgery. The introduction of the Schiotz tonometer in 1905 certainly allowed
471 a better understanding of chronic glaucoma and allowed its surgical treatment to be better
472 understood. Multiple varieties of filtration surgery were developed, but all were variations of
473 three basic types: Lagrange sclerectomy, iris-inclusion as proposed by Herbert and Holth, and
474 corneoscleral trephination as championed by Elliot. The only exception to external filtration
475 surgery was cyclodialysis, a non filtration procedure. Each of these procedures had its
476 champions. Trephination was the most popular, followed by iridencleisis, and finally by the
477 anterior lip sclerectomy of Lagrange and Holth. In 1924, Count Sir Luigi Preziosi (1888-1965)
478 from Malta introduced another variation: he produced the corneoscleral fistula with a thermal
479 cautery needle. This procedure did not enter common use till about 1950, and was made much
480 more practical and useful by its development in 1957 by Harold G Scheie (1909-1990). Scheie
481 called his operation peripheral iridectomy with scleral cautery and this replaced, to a large
482 extent, all prior procedures for glaucoma filtration until the introduction and popularization of
483 trabeculectomy in the 1960s.(21)

484 I have reviewed the life and work of one of these pioneers, whose contribution in the
485 diagnosis of trachoma has perpetuated his name, and justly so, as his diagnostic acumen here
486 was both very important and has stood the test of time. His efforts, however, in glaucoma

487 surgery have been forgotten. The major reason is that the operation which he proposed and
488 championed, iris-inclusion filtration or iridencleisis, was never fully accepted at that time, and its
489 basic principle is now discredited. The impact of his publications was hampered by poor
490 organization, a somewhat contentious and dogmatic approach, and lack of clarity and and
491 illustrations on how to perform his operations. However, his efforts to advance glaucoma
492 filtration surgery were significant. He and Lagrange were the first to insist that the filtering bleb
493 was the mechanism by which filtration surgery functioned, an idea not well understood when
494 they began their studies. By analyzing the various morphologies of the filtering bleb, and
495 tailoring his surgery to obtain the ideal bleb, Herbert's observations were important. His major
496 point that small incision sclerotomy, either with or without iris incarceration, was a major
497 advance over large incision sclerectomy is still valid. His attempt to titrate the degree of surgery
498 to the degree of glaucoma severity was also notable, as many surgeons simply performed the
499 same operation on all eyes. Herbert thus holds a premier position as one of the pioneers in the
500 history of glaucoma surgery.

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564

565

Legends

566 Fig. 1. Herbert Herbert. 1865-1944. (Photograph reproduced with permission of Lady
567 Fiona Montagu, granddaughter of Herbert)

568 Fig. 2 Herbert Herbert at the Oxford Ophthalmological Congress, 1911. The arrow
569 identifies him. The man sitting directly behind Herbert is Sir William Osler. Although not
570 an ophthalmologist, he helped organize the early ophthalmological congresses.
571 (Photograph reproduced with permission of Richard Keeler FRCOphth (Hon))

- 572 Fig. 3 Herbert's drawings of peripheral corneal pits in trachoma.
- 573 Fig. 4 Modern clinical photograph of Herbert's pits.
- 574 Fig. 5 Drawing of Herbert's pit.
- 575 Fig. 6 Trachomatous Ptosis and lid malformation.
- 576 Fig. 7. Herbert's schematic illustration of his "corneal wedge" operation.
- 577 Fig 8. Herbert's schematic drawing of his "small flap sclerotomy" operation.
- 578 Fig 9. Histologic slide of the "small flap operation."
- 579 Fig 10. Herbert's schematic drawing of healed "iris inclusion operation."